

PROJECT MANUAL FOR THE CONSTRUCTION OF:

PROJECT:

BIRMINGHAM PUBLIC SCHOOLS
2015 BOND PROGRAM

BID PACKAGE NO. 5

WEST MAPLE ELEMENTARY
FRENCH SCHOOL REMODELING

OWNER:

BIRMINGHAM PUBLIC SCHOOLS
31301 Evergreen Road
Beverly Hills, MI 48025

TMP PROJECT NO.: 15104A

DATE: December 4, 2017

ISSUED FOR BIDS

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END OF SECTION

LIST OF DRAWINGS

1.1 LIST OF DRAWINGS

- A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the TITLE SHEET (TS.1) page of the separately bound drawing set titled WEST MAPLE ELEMENTARY FRENCH SCHOOL REMODELING – BID PACKAGE NO. 5, dated December 4, 2017, as modified by subsequent Addenda and Contract modifications.

END OF DOCUMENT

AVAILABILITY OF ELECTRONIC FILES

PART 1 – GENERAL

1.1 POLICY

- A. As a service to contractors, subcontractor, vendors, material suppliers and others needing electronic copies of drawing files, the Architect will provide CAD files electronically in accordance with the following policy:
1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
 2. It is further understood and agreed that the undersigned will hold TMP Architecture harmless and indemnify TMP Architecture from all claims, liabilities, losses, etc., including attorney's fees arising out of the use or misuse of the transferred items.
 3. It is understood and agreed that the items transmitted are prepared from CAD files current at the time of preparation. All files are AutoCAD version 2009 dwg files.
 4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
 5. As a record of information to be transmitted, TMP Architecture will prepare a duplicate electronic back-up for its record.
 6. Compensation for providing this material will be as follows:
 - a. Base Fee of \$250 for 1 to 3 drawings.
 - b. Base Fee of \$500 for 4 to 10 drawings.
 - c. For each additional drawing after 10 the fee is \$40.00 per drawing (i.e., 11 drawings = \$540).
 7. Payment must be provided along with a signed copy of the Release Letter before files will be released.

1.2 REQUEST PROCEDURE

- A. To receive files the attached Release Letter must be completed in full and submitted to the Construction Manager to be forwarded to the Project Manager at TMP Architecture.
1. A signed copy of the Release Letter must be submitted; faxed or emailed copies will be accepted.
 2. Upon remittance of the signed Release Letter and Fee, allow five working days for processing.
 3. Transmission of documents will be provided electronically after the receipt of payment.

Date: _____

Firm Requesting Files:

Name: _____

Company: _____

Address: _____

City, State, Zip: _____

Re: Letter of Authorization for CAD File Transfers

Project Name: _____

TMP Project No. : _____ Bid Pack No. : _____

Dear Sir:

Per your request, TMP Architecture will transmit the requested CAD files in the form of CD-ROM upon receipt of an original signed copy of this letter with conditions of agreement as stated.

1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
2. It is further understood and agreed that the undersigned will hold TMP Architecture harmless and indemnify TMP Architecture from all claims, liabilities, losses, etc., including attorney's fees arising out of the use or misuse of the transferred items.
3. It is understood and agreed that the items transmitted are prepared from CAD files current at the time of preparation. All files are AutoCAD 2009.
4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
5. As a record of information to be transmitted, we will prepare a duplicate back-up for our files, which may be electronic or hard-copy.
6. Compensation for providing this material will be as follows: Base Fee of \$250 for 1 to 3 drawings and a Base Fee of \$500 for 4 to 10 drawings; for each additional drawing after 10 the fee is \$40.00 per drawing (i.e., 11 drawings = \$540). Payment must be provided along with a signed copy of this form before files will be released. Please remit to TMP Architecture and allow five working days for processing.

Fee: \$ _____ Drawings: _____

Signed: _____ Printed Name/Title: _____

Firm Requesting: _____

Phone: _____ Fax: _____

To Be Completed By TMP Architecture, Inc.

Released (signed by): _____ TMP Architecture, Inc.

Printed Name/Title: _____ Date: _____

****END OF SECTION****

ALTERNATES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF REQUIREMENTS:

- A. Definition: An alternate is an amount proposed by Bidders and stated on the Bid Form that will be added to or deducted from Base Bid amount if the Owner decides to accept a corresponding change in either scope of work or in products, materials, equipment, systems or installation methods described in Contract Documents.
- B. Coordination: Coordinate related work and modify or adjust adjacent work as required to ensure that work affected by each accepted alternate is complete and fully integrated into the project.
- C. Notification: Immediately following award of Contract, prepare and distribute to each party involved, notification of the status of each alternate. Indicate whether alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to alternates, if any.
- D. Schedule: A "Schedule of Alternates" is included at the end of this section. Specification sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the work described under each alternate.
1. Include as part of each alternate, miscellaneous devices, appurtenances and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. A-1: For Rooms D105, D106, D107, D108 and D109 quote change in price to not provide concrete work; doors and frames; door hardware; louvers and vents; gypsum wallboard assemblies; floor finishes; acoustical ceilings; painting; interior signage; toilet and bath accessories; roller shades; and prefabricated cabinets and countertops; and to provide plumbing rough-in work and alternate heating, ventilating and air conditioning work, electrical work, as indicated on Drawings and in Specifications.
- B. Alternate No. A-2: Quote change in price to provide wardrobe lockers in Corridors D104, D110, D112 and D124, as indicated on Drawings and in Specifications.
- C. Alternate No. A-3: Quote change in price to provide cubbie unit casework in Classrooms D105 and D108, as indicated on Drawings and in Specifications.

END OF SECTION

ELECTRONIC SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for preparation, submittal, and distribution of Shop Drawings, Samples, Product Data, and similar information required to be furnished by the Contractors by electronic means.
- B. Related Work: The following items of work are specified under other Sections of these Specifications:
 - 1. Division 01 Section "Project Record Documents" for project record documents.

1.2 DEFINITIONS

- A. Samples: See General Conditions.
 - 1. Preliminary Samples: Handmade or simulated examples or proposed materials submitted to demonstrate anticipated finished appearance.
 - 2. Product Samples: Representative examples of materials proposed for use.
 - 3. Range Samples: Samples showing extremes of variations in appearance, texture or color and the limits within which the Contractor agrees to hold the materials used in the work.
 - 4. Sample Installation: Trial run or initial example provided for review and acceptance by the Architect before continuing with the work.
 - 5. Test Samples: Samples provided for purposed of physical or chemical test analysis. If samples are submitted directly to the Testing Laboratory, submit copy of letter of transmittal.
- B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- C. Portable Document Format (PDF): Adobe Acrobat (www.adobe.com), Bluebeam PDF Revue (www.bluebeam.com) or other similar PDF review software for applying electronic stamps and comments for representing documents in a device-independent and display resolution-independent fixed-layout document format.
- D. Shop Drawings: See General Conditions
 - 1. Electronic File: Drawings and other data submitted electronically in PDF format only.
 - 2. Preliminary Shop Drawings: Drawings and other data submitted electronically prior to acceptance of systems and only required to show information necessary for evaluation and coordination with other work.
 - 3. Project Shop Drawings: Drawings and other data illustrating materials and assemblies proposed for the Project.
 - 4. Coordination Drawings: Original electronic drawings prepared by the Trades to investigate conflicts and coordinate locations of each with the work of the other.

- E. Identification: All shop drawings, samples and product data shall be identified by the project title, the Architect's name and the Architect's project number or numbers.

1.3 SUBMITTALS IN ELECTRONIC FORM:

- A. Contractors shall submit shop drawings and product data in electronic form. Submittals are to be made to the Construction Manager in the following form.
 - 1. Shop drawings: Combined together into one pdf file for each assembly or product.
 - 2. Product data: Provide product data in individual pdf file.
- B. File naming shall be in the following format. (Specification Section Number-consecutive number of submittal for that section) Description of file being submitted.
 - 1. Example: (079200-01) Joint Sealants.pdf
- C. Contractor shall fill out Submittal Transmittal found at the end of this Section and include at the beginning of the file. PDF version of Submittal Transmittal form is available upon request from the Architect.
- D. Physical Samples must be submitted through the Construction Manager and must be accompanied by an electronic (PDF) copy of the completed TMP Shop Drawing and Transmittal Form.
- E. Construction Manager shall provide a reasonable means of transmitting files. Either through a data management provider (i.e. Submittal Exchange) or an established data management system specifically for the Project by Construction Manager or an approved method agreed to by the Architect and Owner.

1.4 SCHEDULES

- A. Prepare Sample and Shop Drawing Submittal Schedule as required.
- B. Recognize and allow for lead-time required for manufacture, fabrication, delivery to the site, and for review.
- C. Arrange schedule in orderly sequence in compliance with Project Schedule.
- D. Request for approval of materials, systems, substitutions, or for deviations from the Contract Documents shall be submitted according to Section 016000 – “Product Requirements” and shall be Preliminary submittal with allowances for time for review prior to submittal of Product Samples or Project Shop Drawings.

1.5 SAMPLES - GENERAL

- A. Samples in general, are required for all materials that form an exposed part of the finished Project. Samples of concealed components are not required unless specifically called for.
- B. Typical Samples shall be taken from production run material and shall be representative examples of proposed quality and finish.

- C. Preliminary Samples shall, as far as possible, anticipate the quality and finish of production run material.
- D. Samples will be retained at the job site for comparison purposes. Samples of manufactured items will be returned to the Contractor for installation in the Work after approval of materials. Use in locations where directed.
- E. All materials in the completed installation shall be equal in every respect to the approved product samples and within the limits defined by the approved range samples.

1.6 SAMPLES SUBMITTALS

- A. Size and quantity, unless otherwise specified: Four (4) each; 8 inches by 12 inches, or 12 inches long, as applicable; not over one inch thick for masonry or cementitious materials.
- B. Preliminary or Range Samples shall be resubmitted as directed until an acceptable Sample or Range is established, at which time Project Samples shall be submitted.
- C. Furnish Samples to other trades where required to match color or finish.
- D. Required Samples are scheduled or are listed in the Trade Sections. Optional Samples will be accepted and reviewed by the Architect.
- E. Review will be for shape and appearance only. Physical and chemical properties shall be established by adequate documentation that shall accompany samples.
- F. In all cases where preliminary approval samples have been submitted, final production run, or in-place installation samples will be required for verification.
- G. Notify Architect in advance and obtain directions for place and time to ship large, heavy or bulky samples. Ship such samples "Prepaid." If return is requested, they will be returned "Collect."

1.7 SHOP DRAWINGS AND PRODUCT DATA - GENERAL

- A. Shop Drawings shall be prepared by a qualified detailer and shall be complete including erection diagrams and shall show the fabrication and construction of all items required for complete assembly.
- B. Provide pertinent information relating to installation and connection to work of other trades, and coordinate with work of other trades as required for proper placing, anchorage and support of the work. Indicate in detail, the precise location and spacing of all embedded anchor bolts, sleeves and other features required to be placed in the concrete, structural steel or masonry or otherwise required to be built into the structure.
- C. Identify details by reference to the Contract Drawings, other Shop Drawings or other information as required to properly identify and locate the portion of the Work covered.
- D. Indicate on the Drawings and explain by covering letter all proposed deviations from the requirements of the Contract Documents.
- E. Manufacturer's Standard Documents:

1. Drawings and similar documents submitted as PDF electronic document from original documents: Modify drawings to delete information which is not applicable to the Project. Provide additional information where required and submit electronically.
 - a. Brochures and other pre-printed data, clearly mark PDF information as follows: Identify pertinent material, product, and model.
 - b. Number or otherwise reference each item to applicable Contract Document or other Shop Drawing.
 - c. Show dimensions and clearances required.
 - d. Provide all other information required for Shop Drawings including, where applicable, wiring diagrams and controls.
 - e. Delete all options, or variations from the Contract Documents, except where such items are specifically noted as proposed deviations.
- F. Where proper installation of the work requires that other work be set to special detail, held to tolerance, or dimension be established, so indicate on the Shop Drawings.
- G. Where items must fit spaces previously constructed, take measurements at the site, not from drawings.
- H. Where applicable, indicate mechanical and electrical characteristics of, or required to be provided for, the material shown on the Shop Drawings.
- I. Each shop drawing or coordination drawing shall have a blank area (5 x 8 inches), located adjacent to the title block. The title block shall display the following:
 1. Number and title of drawing
 2. Date of drawing or revision
 3. Name or project building or facility
 4. Name of Contractor and (if appropriate) name of Subcontractor submitting drawings.
 5. Clear identity of contents and location of the work.
 6. Project title and contract number.
 7. Initials or party preparing drawings.
 8. Signature of party responsible and, where applicable, professional engineers seal.

1.8 SHOP DRAWING SUBMITTALS

- A. Submit all Shop Drawings, required to be reviewed, to the Construction Manager, in electronic file PDF except where otherwise specified. The Construction Manager shall review the Shop Drawings prior to submitting for review by the Architect and the Engineer(s). The Architect will review and will note his comments or corrections and return electronic file. Product Data, Brochures and other pre-printed material shall be submitted electronically.
- B. The Architect will return the electronic file to the Construction Manager for resubmission or final distribution, as indicated. The Contractor shall then distribute as needed whether electronically or hard copy.
- C. Submittals returned with the notation "Not Approved" - "Resubmit" or "Revise and Send Record Copy" shall be promptly revised and resubmitted.
- D. Contractor to furnish drawings to other contractors, electronically or hard copy, as required to prepare openings, supports, for verification of matching details, and obtain approval before submittal.

- E. Required Shop Drawings are scheduled and are listed in the Technical Sections.
- F. Schedule and lists of required Shop Drawings are provided for convenience of reference only and do not necessarily include all Shop Drawings necessary for completion of the Work. Procedures for additional for optional Shop Drawings will be the same as for required Shop Drawings.

1.9 SHOP DRAWINGS - TYPES

A. Preliminary Shop Drawings:

- 1. Preliminary Shop Drawings shall be provided for portions of the Work where interpretations or variations from the Contract Documents are proposed, or otherwise required.

B. Project Shop Drawings:

- 1. Project Shop Drawings shall show all changes to building details to coordinate with required modifications and indicate approval by other trades for required modifications to their work.
- 2. Where Shop Drawings are based on the use of a particular material, such material shall be submitted for review independently of the Shop Drawing.
- 3. When Shop Drawings are submitted in the form of brochures indicate all current variations from the information in effect at time documents were issued for bids.

C. Coordination Drawings:

- 1. Coordination Drawings unless otherwise agreed shall consist of notations in colored upon a PDF version of the Shop Drawings for the First Trade in the area of potential conflict.
- 2. Coordination Drawings shall be prepared for all conditions where the exercise of the installing Trade's option concerning selection or location of materials or equipment could conflict with other work.
- 3. First contractor: That contractor so designated by the Construction Manager. The other contractors shall review in order and sequence as directed by the Construction Manager.
- 4. Preparation:
 - a. First contractor will prepare complete Shop Drawings at adequate scale and provide white prints at earliest practicable date.
 - b. Subsequent contractors shall mark routing and layout on the print each in a different colored pencil than previously used.
 - c. When drawing is completed, all parties shall meet to examine the completed layout and determine areas of conflict.
 - d. The contractors shall negotiate re-routing and cooperation to resolve conflict. If they cannot agree, the Construction Manager will determine an equitable solution.

- e. Determinations shall be indicated in a Shop Drawing Submittal for review. Deviations from agreed layout shall be remedied at the expense of the Trade that did not follow agreed layout.
- 5. Conflicts that cannot be resolved by simple re-routing or relocation may involve a change in the work but no extra cost will be allowed for tearing out or re-building work which could have been avoided but use of Coordination Drawings.
- 6. Each Contractor shall be fully and individually responsible for coordination. In the event of conflict, the Trade Contractor responsible for the mislocation or ill-timed work, determined by the Architect and Construction Manager, will be required to assume all costs for relocation and adjustment unless he has called attention to the conflict at the time he reviewed the coordination documents.

1.10 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall obtain, review, stamp with his approval and submit for review all Shop Drawings and Samples required by the Contract Documents. The Construction Manager shall be required to utilize the "Shop Drawing Transmittal Form attached to this section. Only one (1) specification section trade shall be submitted per each transmittal form.
- B. By approving and submitting Shop Drawings and Samples, the Contractor thereby represents that he has determined and verified all field measurements and field construction criteria at the site, and all materials, catalog numbers and similar data, or will do so, and that he has checked and coordinated each Shop Drawing and Sample with the requirements of the work and of the Work and of the Contract Documents.
- C. The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Owner's, Construction Manager or the Architect's acceptance or Shop Drawings, Product Data or Samples, unless the Contractor has informed the Owner, Construction Manager and the Architect, in writing, of such deviation at the time of submission and the Architect has given written acceptance to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data or Samples by the acceptance thereof.
- D. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples to revisions other than those requested on previous submittals.
- E. No portion of the Work requiring submission of Shop Drawings, Product Data or Sample shall be commenced until the submittal has been accepted as provided herein. All such portions of the Work shall be in accordance with accepted submittals.

1.11 ARCHITECT'S REVIEW

- A. The Architect will complete review of Shop Drawings within fifteen (15) working days, and of Samples within twenty-one (21) working days of receipt thereof except that:
 - 1. Shorter time limits will be negotiated on a basis of need for each specific case for "fast track" or critical path items.
 - 2. With respect to those areas with special architectural finishes and coordination of various material sources the parties shall agree upon a mutually satisfactory time schedule.

3. Review time will be considered as starting when Drawings and Samples are substantially correct and so submitted.
 4. Incomplete or incorrect submittals will be returned without review, for proper submission.
- B. Shop Drawings, Samples and Product Data will be reviewed only for conformance with the design concept, compliance with the information given in the Contract Documents, arrangement and appearance. Deviations from the Contract Documents will be noted with comments and required corrections or changes will be noted on the returned submittal.
- C. Shop Drawings will be returned electronically.
- D. Architect will retain electronic file of Product Data and an electronic file of A-E "mark-ups" or corrections of mark-ups. The Architect will **not** accept physical copies (hard copies) of shop drawings or product data submittals. Physical submittals will be accepted for Samples only. Physical Samples must be submitted through the Construction Manager and must be accompanied by an electronic (PDF) copy of the completed TMP Shop Drawing and Sample Transmittal Form.
- E. One sample from each set will be returned to the Contractor, one filed at the office of the Architect, one at the office of the Construction Manager and one at the jobsite. If the Contractor intends that samples such as hardware or fixtures be installed on the project or returned at completion of the Project, he shall indicate at time of submittal, otherwise the Owner and the Architect assume no responsibility for protection or return of such samples.

1.12 EQUIPMENT ROOM LAYOUT DRAWINGS

- A. The Contractor shall prepare and submit equipment room layout drawings as required by the technical specifications and additionally for areas where equipment proposed for use could present interface or space difficulties. Such drawings shall be prepared in the same manner as coordination drawings.

1.13 MATERIALS, EQUIPMENT AND FIXTURE LISTS

- A. Where required by the Technical Provisions, lists of materials, equipment and fixtures shall be submitted by the Contractor. The lists shall be supported by sufficient descriptive material, such as catalogs, cuts, diagrams, and other data published by the manufacturer, as well as evidence of compliance with safety and performance standards, to demonstrate conformance to the specification requirements; catalog numbers alone will not be acceptable.
- B. The data shall include the name and address of the nearest service and maintenance organization that regularly stocks repair parts. No consideration will be given to partial lists submitted from time to time.
- C. Materials, equipment and fixtures will not be approved for use at capacity ratings in excess of manufacturer's published data.
- D. Approval of materials and equipment will be tentative subject to submission of complete shop drawings indicating compliance with the Contract Documents.

TMP SHOP DRAWING AND SAMPLE TRANSMITTAL FORM

CONTRACTOR/CONST. MANAGER: _____ _____ _____	PROJECT TITLE AND LOCATION: _____ _____ _____	DATE SUBMITTED: _____ NEW _____ SUB. NO. _____ CHECKER: _____ RESUB. _____ RESUB. NO. _____ TMP PROJECT NO. _____
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SPEC SECTION NO.	NO. PRINT	NO. SEPIA	NO. CAT.	NO. SAMPLES	SUBCONTRACTOR/MFR.	ITEM DESCRIPTION	*ACTION CODE	DATE CHECKED	DATE RETURNED	NO. COPIES

The undersigned certifies that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract documents except as otherwise noted. NOTE: Approval of items submitted does not relieve contractor from complying with all requirements of the contract documents.		* ACTION DEFINITION R = REVIEWED – NO EXCEPTIONS NOTED RN = REVIEWED WITH CORRECTIONS NOTED RR = REVISE AND SEND RECORD COPY X = NOT APPROVED – RESUBMIT NA = NO ACTION REQ'D
CONTRACTOR'S COMMENTS: ARCHITECT'S COMMENTS:	_____ CONTRACTOR'S NAME _____ SIGNATURE cc: Owner Consultant	

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: Requirements and procedures for the work and services of Independent Testing Laboratories and Consultants employed by the Owner to perform materials testing and special inspections during the course of the Work.

1.2 OWNER'S OPTION

- A. The Owner will employ the services of Independent Testing Laboratories or Consultants or both to perform specified tests and inspections for the Owner's benefit. This inspection and testing shall not obligate the Owner to provide inspection or testing services, or both, for the benefit of the Contractor or any person party or agency associated with the work.
- B. The Owner may, at its option, perform inspections and tests in addition to those specified herein in accordance with the General Conditions.
- C. The Contractor shall provide free, safe and convenient access to the Work at all locations of the Work including the Site, Fabrication Works and other applicable locations to allow thorough meaningful inspections and obtaining of physical samples for testing. Free access shall include turning, lifting, moving and positioning of the Work or components to allow reasonable access for inspection.
- D. In the event that the accuracy or adequacy of any Owner's inspection or tests is challenged by the Contractor for any reason and re-inspection or re-testing is performed, all costs for each specific instance or re-inspection or re-testing shall be paid by the Contractor or other party challenging the original report. Results of such inspections or tests will be accepted for consideration by the Owner only when performed by a Testing Laboratory or Consultant approved, in writing, by the Owner prior to the beginning of the subject re-tests or re-inspections.
- E. All tests and Laboratory Inspection specified to be performed for the project shall be performed by the selected Testing Laboratory and the cost for services shall be paid by the Owner except where otherwise specified.
- F. Testing Laboratory Qualifications:
 - 1. ASTM E548-94: Guide for General Criteria Used for Evaluating Laboratory Competence.
 - 2. ASTM E329: Specification agencies Engaged in the Testing and/or Inspection of Materials used in Construction.
 - 3. ASTM D3740: Practice for minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 RESPONSIBILITIES

- A. Testing Laboratories or Consultants will be properly equipped and qualified to perform the duties and tests for which they are hired.
- B. Specialized testing such as acoustics will be performed by the Laboratory designated by the Owner.

- C. The Contractor is not obligated to employ the Owner's Testing Laboratory for Contractor's tests or other services required as a part of the Work. The cost of Owner's review and evaluation of Contractor's tests by Owner's Testing Laboratory or Consultants will be paid by the Owner; all costs of other services performed by the Owner's Testing Laboratory or Consultants in the interest of the Contractor shall be paid by the Contractor.
- D. Testing performed by the Owner's Testing Laboratory shall not act to relieve the Contractor from his responsibility to provide all testing laboratory services called for in this Section or under individual Trade
- E. Measurements and surveys performed by the Testing Laboratory shall be under the supervision of a surveyor licensed to practice in the State of Michigan.

1.4 OTHER MATERIALS TO BE TESTED

- A. When so instructed by the Owner, or the Architect, the Contractor shall deliver samples and materials to Owner's Testing Laboratory so that independent tests can be made to determine compliance with the requirements of the Specifications.
- B. When instructed by the Owner or the Architect, the Contractor shall take samples form materials being installed at the job site and deliver these to locations as directed. Samples shall be selected at random by Testing Laboratory, or Consultant, from material being applied or installed.
- C. Samples of various materials or equipment delivered on the site or in place may be taken by the Owner for testing. Samples failing to meet Contract requirements will automatically void previous approvals of items tested. The Contractor shall replace such materials or equipment found not to have met Contract requirements, unless a proper adjustment of the Contract price is made and is accepted by the Owner.

1.5 MISCELLANEOUS TESTING SERVICES

- A. The following Laboratory Testing and Inspection Services will be performed during the course of the work. The Contractor shall provide support services and cooperation as specified.
- B. Earthwork:
 - 1. Fill and backfill will be tested for specified consolidation of materials.
 - 2. Coordinate Work and cooperate with Soils Inspector and Testing Laboratory to permit compacting tests as described in "Earthwork" Section of Division 2, as each layer of material is placed.
- C. Special Foundations: None required.
- D. Concrete Testing:
 - 1. Concrete testing shall be as specified herein and under other sections as referenced.
 - 2. The Contractor shall provide necessary site labor to assist in taking and preparing job samples; coordinated with the Testing Laboratory for scheduling, testing and inspection; submit samples of materials for concrete, admixtures, and cement to the Laboratory for testing.

3. Concrete testing will be required for all concrete work performed under individual Sections of Division 2, "Site Work," and Sections of Division 3, "Concrete" including all cast-in-place and pre-cast concrete used on the Project.
- E. Reinforcing Steel Testing:
1. Inspect before and after setting in forms, prior to concrete placement.
 2. Certify compliance with Contract Documents; do not check using shop drawings.
- F. Steel Testing:
1. Reinforcing Steel: Tests as specified under Concrete and Masonry Sections Division 2, 3 and 4.
 2. Structural Steel: As specified under Division 5.
 3. Steel Joints: As specified under Division 5.

1.6 SOIL CONSULTANT

- A. The Owner may, in its sole interest, employ and pay for the services of a Soils Consultants to observe the work and advise the Owner concerning activities in connection with the performance of excavation and foundation work.
- B. Obtain Consultant's approval for construction schedule and sequence of operations.
- C. Discontinue any practice immediately when notified, that in the Consultant's opinion, it is not in accordance with the intent of the Specification or will act to the detriment of the system. All work affected by the practice will be subject to complete replacement.
- D. See applicable Trade Sections for procedures.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SOILS TESTING AND INSPECTION

- A. Materials Testing:
 1. Test soil materials proposed for use in the work and promptly submit test result reports of:
 - a. Test reports on borrow material.
 - b. Field density test reports.
 - c. One optimum moisture-maximum density curve for each type of soil encountered.
 - d. Other tests and materials certificates as required.
 2. Provide one optimum moisture-maximum density curve for each type of soil encountered in subgrade and fills. Determine maximum densities in accordance with ASTM D 1557.
 3. Analyze material within 3 feet of finished grades of paved areas to determine content of chemicals deleterious to concrete.

4. The testing service will determine the suitability of materials to be used as fill.
 5. For borrow materials, perform a mechanical analysis (AASHTO T88), plasticity index (AASHTO T91), moisture-density curve AASHTO T180 or ASTM D 1557), and chemical analysis.
- B. Testing During Construction:
1. Testing service shall inspect and approve subgrades and fill layers before further construction work is performed thereon. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D2167 (rubber balloon method).
 2. Make at least one field density test of the subgrade for every 2000 sq. feet of paved area, but in no case less than 3 tests.
 3. In each compacted fill layer, make one field density test for every 2000 sq. feet of overlaying paved area, but in no case less than 3 tests.
 4. If, in the opinion of the Architect, based on reports of the testing service and inspection, the subgrade or fills which have been placed are below the specified density, additional compacting and testing will be required until satisfactory results are obtained.
 5. The results of density tests of soil-in-place will be considered satisfactory if the average of any 4 consecutive density tests which may be selected are in each instance equal to or greater than the specified density, and if not more than 1 density test out of 5 has a value more than 2% below the required density.
 6. Perform soil load bearing test, "Repetitive Static Load Tests of Soils and Flexible Pavement Components for use in Evaluation and Design of Airport and Highway Pavements", in accordance with ASTM D1195.

3.2 BITUMINOUS CONCRETE TESTING AND INSPECTION

- A. Secure samples of all bituminous concrete materials proposed by Contractor for evaluation and testing.
- B. Review paving designs proposed by the Contractor as specified in "Bituminous Paving" Section.
- C. During the course of the work, perform the following inspections and tests and furnish the Architect and the Owner with certified reports of each inspection or test:
- D. Test Method: Meet requirements of the State of Michigan Department of Transportation and the local jurisdictional authorities.

3.3 CONCRETE TESTING AND INSPECTION

- A. Secure samples of all concrete materials proposed by Contractor for evaluation and testing.
- B. Conduct tests of materials and mixes to substantiate that they perform as specified and submit certified reports of same to the Architect.
- C. During the course of the work, perform the following inspections and tests and furnish the Architect and the Owner with certified reports of each inspection or test:

1. Inspect operations, equipment and materials at concrete plant for conformance with the Contract Documents.
 2. Sample concrete for test cylinders in accordance with ASTM D 172.
 3. Mold test cylinders in accordance with ASTM C31 in the numbers specified herein.
 4. Perform slump tests in accordance with ASTM C143. Make one representative test for each batch of concrete and at least one test per hour during a continuous concrete pour.
 5. Make air-entrainment tests on air entrained concrete with sufficient frequency to accurately control the air content.
 6. Job-site cure test cylinders in accord with ASTM C31.
 7. Transport test cylinders to Testing Laboratory.
 8. Cure test cylinders in accordance with ASTM C39.
 9. Make compressive strength tests in accordance with ASTM C39.
- D. Test Cylinders: Mold, cure, and test cylinders as follows:
1. For cast-in-place concrete using Type I or II cement:
 - a. Each day's pour for each strength of concrete: Make 4 minimum.
- E. Materials Test:
1. Cement: Conform to physical requirements of ASTM C150 for each carload or part thereof. Mill test certificates will generally be satisfactory verification.
 2. Fine Aggregate: Field tests for organic matter (by color) silt (by decantation), sieve analysis, and laboratory tests of mortar tensile strength each day or change of source.
 3. Course Aggregate: Sieve analysis each day or change of material.
- F. Reports: Furnish two copies of all test and inspection reports to the Architect. Verify that concrete delivered to the job consists of material tested and that placement and testing of the delivered concrete conforms to these Specifications.
- G. The Owner and the Architect reserve the right to perform inspection and tests during the progress of the work. These additional inspections and tests will be in addition to, and will not replace or remove, the requirements for tests and inspections specified herein.
- 3.4 MORTAR AND GROUT TESTING
- A. General: Provide all inspection and tests specified in ASTM C 780 Annex through A7.
- B. Inspection and Tests:
1. Mortar and Grout at structural bearing and reinforced walls only: Make 3 cylinders for each week's work for each type of mortar, and grout. Make a minimum of 3 cylinders for each change of material, mortar, cement aggregate or mix.

2. Test cylinders at the following ages: For concrete made with Type II cement, one at 7 days, two at 28 days.
3. Provide complete evaluation in accordance with ASTM C78 Annex A8 for design mix and at each change of materials thereafter.

3.5 STRUCTURAL STEEL TESTING AND INSPECTION

- A. Where material identity is maintained and readily demonstrable, certified mill test certificates will be acceptable. Material not satisfactorily and clearly traceable to an acceptable mill test certificate shall not be used in the Work. The Testing Laboratory shall verify conformance of all structural steel materials.
- B. Conduct tests of materials and assemblies to substantiate that they perform as specified and submit certified reports of same to the Owner and the Architect.
- C. Tests for Welding and Bolting: The Testing Laboratory shall test all shop and field welding and inspect all high strength bolting. The Laboratory shall furnish Inspectors approved by the Owner and shall be registered in, and shall comply with, all regulations of the Department of Building and Safety of the Local Governing Authority and shall certify in writing, upon completion of the work, that the welding and high strength bolting have been performed in accordance with the Drawings and Specifications and all codes and ordinances.

3.6 MECHANICAL AND ELECTRICAL TRADES

- A. Tests performed by the Owner's Testing Laboratory for Mechanical and Electrical Trades shall include materials testing only.
- B. Balancing, testing, and other checking required to verify proper performance of systems shall be by the Contractor as specified.

****END OF SECTION****

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the General Conditions.
- B. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Architect," "requested by the Architect," and similar phrases.
- D. Approve: The term "approved," where used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in General and Supplementary Conditions.
- E. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
- G. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
- H. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
- I. Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term "experienced" when used with the term "Installer" means having a minimum of 5 previous Projects similar in size and scope to this Project, being familiar with the precautions required, and having complied with requirements of the authority having jurisdiction.
 - 2. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

3. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.
 - a. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.
- J. Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.
- K. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's MASTERFORMAT 2004 Edition (MF04) numbering system.
 1. Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the full context of the Contract Documents so indicates.
 2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
 - a. The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Architect for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.
 2. Although copies of standards needed for enforcement of requirements may be included as part of required submittals, the Architect reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.
- F. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations as referenced in Contract Documents are defined to mean the associated names. Names and addresses are subject to change and are believed to be but are not assured to be accurate and up to date as of date of Contract Documents.
- | | | |
|--------|---|---------------|
| AA | Aluminum Association
900 19th St., NW, Suite 300
Washington, DC 20006
www.aluminum.org | (202)862-5100 |
| AABC | Associated Air Balance Council
1518 K St., NW, Suite 503
Washington, DC 20005
www.aabchq.com | (202)737-0202 |
| AAMA | American Architectural Manufacturers Association
1827 Walden Office Sq., Suite 104
Schaumburg, IL 60173-4268
www.aamanet.org | (847)303-5664 |
| AAN | American Association of Nurserymen
(See ANLA) | |
| AASHTO | American Association of State Highway and Transportation
Officials
444 North Capitol St., NW, Suite 249
Washington, DC 20001
www.aashto.org | (202)624-5800 |

SECTION 014200
REFERENCES

AATCC	American Association of Textile Chemists and Colorists P.O. Box 12215 One Davis Dr. Research Triangle Park, NC 27709-2215 www.aatcc.org	(919)549-8141
ABMA	American Bearing Manufacturers Association (Formerly: Anti-Friction Bearing Manufacturers Association) 1200 19th St., NW, Suite 300 Washington, DC 20036-2401 www.abma-dc.org	(202)429-5155
ABMA	American Boiler Manufacturers Association 950 North Glebe Rd., Suite 160 Arlington, VA 22203-1824 www.abma.com	(703)522-7350
ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333-9094 www.aci-int.org	(248)848-3700
ACIL	ACIL: The Association of Independent Scientific, Engineering, and Testing Firms 1629 K St., NW, Suite 400 Washington, DC 20006 www.acil.org	(202)887-5872
ACPA	American Concrete Pipe Association 222 West Las Colinas Blvd., Suite 641 Irving, TX 75039-5423 www.concrete-pipe.org	972) 506-7216
ADC	Air Diffusion Council 104 South Michigan Ave., Suite 1500 Chicago, IL 60603	(312) 201-0101
AEIC	Association of Edison Illuminating Companies 600 N. 18th St. P.O. Box 2641 Birmingham, AL 35291-0992 www.aeic.org	(205) 250-2530
AFBMA	Anti-Friction Bearing Manufacturers Association (See ABMA)	
AFPA	American Forest and Paper Association (Formerly: National Forest Products Association) 1111 19th St., NW, Suite 800 Washington, DC 20036 www.afandpa.org	(800) 878-8878 (202) 463-2700

SECTION 014200
REFERENCES

AGA	American Gas Association 1515 Wilson Blvd. Arlington, VA 22209 www.aga.com	(703) 841-8400
AHA	American Hardboard Association 1210 W. Northwest Hwy Palatine, IL 60067-1897	(847) 934-8800
AHAM	Association of Home Appliance Manufacturers 20 N. Wacker Dr., Suite 1231 Chicago, IL 60606 www.aham.org	(312) 984-5800
AI	Asphalt Institute P.O. Box 14052 Lexington, KY 40512-4052 www.asphaltinstitute.org	(606) 288-4960
AIA	The American Institute of Architects 1735 New York Ave., NW Washington, DC 20006-5292 www.aia.org	(202) 626-7300
AIA	American Insurance Association 1130 Connecticut Ave., NW, Suite 1000 Washington, DC 20036	(202) 828-7100
AIHA	American Industrial Hygiene Association 2700 Prosperity Ave., Suite 250 Fairfax, VA 22031 www.aiha.org	(703) 849-8888
AISC	American Institute of Steel Construction One East Wacker Dr., Suite 3100 Chicago, IL 60601-2001 www.aisc.web.com	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute 1101 17th St., NW, Suite 1300 Washington, DC 20036-4700 www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction 7012 S. Revere Pkwy, Suite 140 Englewood, CO 80112 www.aitc-glulam.org	(303) 792-9559
ALA	American Laminators Association (See LMA)	

SECTION 014200
REFERENCES

ALCA	Associated Landscape Contractors of America 150 Elden St., Suite 270 Herndon, VA 20170-4831 www.alca.org	(800) 395-2522 (703) 736-9666
ALI	Associated Laboratories, Inc. P.O. Box 152837 Dallas, TX 75315 www.assoc-labs.com	(214) 565-0593
ALSC	American Lumber Standards Committee P.O. Box 210 Germantown, MD 20875	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. 30 W. University Dr. Arlington Heights, IL 60004-1893 www.amca.org	(847) 394-0150
ANLA	American Nursery and Landscape Association (Formerly: American Association of Nurserymen) 1250 Eye St., NW, Suite 500 Washington, DC 20005 www.anla.org	(202) 789-2900
ANSI	American National Standards Institute 11 West 42nd St., 13th Floor New York, NY 10036-8002 www.ansi.org	(888) 267-4783 (212) 642-4900
AOAC	AOAC International 481 N. Frederick Ave., Suite 500 Gaithersburg, MD 20877 www.aoac.org	(301) 924-7077
AOSA	Association of Official Seed Analysts P.O. Box 81152 Lincoln, NE 68501-1152 www.zianet.com/AOSA	(402) 476-3852
APA	APA-The Engineered Wood Association (Formerly: American Plywood Association) P.O. Box 11700 Tacoma, WA 98411-0700 www.apawood.org	(253) 565-6600
APA	Architectural Precast Association P.O. Box 08669 Fort Myers, FL 33908-0669 www.archprecast.org	(941) 454-6989

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REFERENCES

API	American Petroleum Institute 1220 L St., NW, Suite 900 Washington, DC 20005-8029 www.api.org	(202) 682-8000
ARI	Air-Conditioning and Refrigeration Institute 4301 Fairfax Dr., Suite 425 Arlington, VA 22203 www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association Center Park 4041 Powder Mill Rd., Suite 404 Calverton, MD 20705 www.asphaltroofing.org	(301) 348-2002
ASA	Acoustical Society of America 500 Sunnyside Blvd. Woodbury, NY 11797 //asa.aip.org	(516) 576-2360
ASC	Adhesive and Sealant Council 1627 K St., NW, Suite 1000 Washington, DC 20006-1707 www.ascouncil.org	(202) 452-1500
ASCA	Architectural Spray Coaters Association 895 Doncaster Dr. West Deptford, NJ 08066	(609) 848-6120
ASCE	American Society of Civil Engineers World Headquarters 1801 Alexander Graham Bell Dr. Reston, VA 20191-4400 www.asce.org	(800) 548-2723 (703) 295-6000
ASHES	American Society for Healthcare Environmental Services Division of the American Hospital Association One North Franklin, Suite 2700 Chicago, IL 60606	(312) 422-3860
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers 1791 Tullie Circle, NE Atlanta, GA 30329-2305 www.ashrae.org	(800) 527-4723 (404) 636-8400
ASLA	American Society of Landscape Architects 636 Eye St., NW Washington, DC 20001-3736 www.asla.org	(202) 898-2444

SECTION 014200
REFERENCES

ASME	American Society of Mechanical Engineers 345 East 47th St. New York, NY 10017-2392 www.asme.org	(800) 843-2763 (212) 705-7722
ASPA	American Sod Producers Association (See TPI)	
ASPE	American Society of Plumbing Engineers 3617 Thousand Oaks Blvd., Suite 210 Westlake Village, CA 91362-3649	(805) 495-7120
ASQ	American Society for Quality 611 East Wisconsin Ave. Milwaukee, WI 53201-3005 www.asq.org	(800) 248-1946 (414) 272-8575
ASSE	American Society of Sanitary Engineering 28901 Clemens Rd. Westlake, OH 44145 www.asse-plumbing.org	(440) 835-3040
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohocken, PA 19428-2959 www.astm.org	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions (Formerly: Exchange Carriers Standards Association) 1200 G St., NW, Suite 500 Washington, DC 20005 www.atis.org	(202) 628-6380
AWCI	Association of the Wall and Ceiling Industries--International 803 West Broad St., Suite 600 Falls Church, VA 22046 www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (See WCMA)	
AWI	Architectural Woodwork Institute 1952 Isaac Newton Sq. West Reston, VA 20190 www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association P.O. Box 5690 Granbury, TX 76049 www.awpa.com	(817) 326-6300

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REFERENCES

AWPB	American Wood Preservers' Bureau (This organization is now defunct.)	
AWS	American Welding Society 550 NW LeJeune Rd. Miami, FL 33126 www.amweld.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association 6666 W. Quincy Ave. Denver, CO 80235 www.awwa.org	(800) 926-7337 (303) 794-7711
BAC	Brick Association of the Carolinas (Formerly: Brick Association of North Carolina) P.O. Box 13290 Greensboro, NC 27415-3290 www.gobrick.com	(800) 622-7425 (336) 273-5566
BHMA	Builders Hardware Manufacturers Association 355 Lexington Ave., 17th Floor New York, NY 10017-6603	(212) 661-4261
BIA	Brick Industry Association 11490 Commerce Park Dr. Reston, VA 22091-1525 www.bia.org	(703) 620-0010
BIFMA	The Business and Institutional Furniture Manufacturer's Association International 2680 Horizon Dr., SE, Suite A1 Grand Rapids, MI 49546-7500 www.bifma.com	(616) 285-3963
CAGI	Compressed Air and Gas Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/cagi	(216) 241-7333
CAUS	Color Association of the United States 409 W. 44th St. New York, NY 10036-4402	(212) 582-6884
CBMA	Certified Ballast Manufacturers Association 355 Lexington Ave., 17th Floor New York, NY 10017 www.certbal.org	(212) 661-4261
CCC	Carpet Cushion Council P.O. Box 546 Riverside, CT 06878-0546	(203) 637-1312

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REFERENCES

CDA	Copper Development Association Inc. 260 Madison Ave., 16th Floor New York, NY 10016-2401 www.copper.org	(800) 232-3282 (212) 251-7200
CFFA	Chemical Fabrics & Film Association, Inc. c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/cffa	(216) 241-7333
CGA	Compressed Gas Association 1725 Jefferson Davis Hwy, Suite 1004 Arlington, VA 22202-4102 www.cganet.com	(703) 412-0900
CGSB	Canadian General Standards Board Place du Portage Phase III, 6B1 11 Laurier St. Hull, Quebec K1A 0S5 CANADA www.pwgsc.gc.ca/cgsb Mailing Address: Canadian General Standards Board Sales Centre Ottawa K1A 1G6 CANADA	(819) 956-3500 (819) 956-0425
CISCA	Ceilings and Interior Systems Construction Association 1500 Lincoln Hwy, Suite 202 St. Charles, IL 60174 www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute 5959 Shallowford Rd., Suite 419 Chattanooga, TN 37421 www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute 9891 Broken Land Pkwy, Suite 300 Columbia, MD 21046 www.baileadership.com	(301) 596-2584
CPA	Composite Panel Association (Formerly: National Particleboard Association) 18928 Premiere Ct. Gaithersburg, MD 20879-1569 www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association 3621 Secor Rd., Suite 320 Toledo, OH 436046 www.cppa-info.org	(800) 510-2772 (419) 241-2221

SECTION 014200
REFERENCES

CRI	Carpet and Rug Institute 310 S. Holiday Ave. Dalton, GA 30722-2048 www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute 933 N. Plum Grove Rd. Schaumburg, IL 60173-4758 www.crsi.org	(847) 517-1200
CSSB	Cedar Shake and Shingle Bureau 515 116th Ave., NE, Suite 275 Bellevue, WA 98004-5294 www.cedarbureau.org	(206) 453-1323
CTI	Ceramic Tile Institute of America 12061 West Jefferson Blvd. Culver City, CA 90230-6219	(310) 574-7800
CTI	Cooling Tower Institute P.O. Box 73383 Houston, TX 77273 www.cti.org	(281) 583-4087
DASMA	Door and Access Systems Manufacturers Association, International (Formerly: National Association of Garage Door Manufacturers) c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/dasma	(216) 241-7333
DHI	Door and Hardware Institute (Formerly: National Builders Hardware Association) 14170 Newbrook Dr. Chantilly, VA 20151-2223 www.dhi.org	(703) 222-2010
DIPRA	Ductile Iron Pipe Research Association 245 Riverchase Pkwy East, Suite O Birmingham, AL 35244 www.dipra.org	(205) 402-8702
DLPA	Decorative Laminate Products Association (Dissolved in 1995 - Now part of KCMA.)	
ECSA	Exchange Carriers Standards Association (See ATIS)	
EIA	Electronic Industries Association 2500 Wilson Blvd. Arlington, VA 22201 www.eia.org	(703) 907-7500

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REFERENCES

EIMA	EIFS Industry Members Association 3000 Corporate Center Dr., Suite 270 Morrow, GA 30260-4116 www.eifsfacts.com	(800) 294-3462 (770) 968-7945
EJMA	Expansion Joint Manufacturers Association 25 N. Broadway Tarrytown, NY 10591-3201 www.ejma.org	(914) 332-0040
ETL	ETL Testing Laboratories, Inc. (Now part of ITS)	
FCI	Fluid Controls Institute c/o Thomas Associates, Inc 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/fci	(216) 241-7333
FCICA	Floor Covering Installation Contractors Association P.O. Box 948 Dalton, GA 30722-0948	(706) 226-5488
FGMA	Flat Glass Marketing Association (See GANA)	
FM	Factory Mutual System 1151 Boston-Providence Tnpk. P.O. Box 9102 Norwood, MA 02062-9102 www.factorymutual.com	(781) 762-4300
GA	Gypsum Association 810 First St., NE, Suite 510 Washington, DC 20002 www.usg.com	(202) 289-5440
GANA	Glass Association of North America (Formerly: Flat Glass Marketing Association) 2945 Southwest Wanamaker Dr., Suite A Topeka, KS 66614 www.glasswebsite.com/gana	(913) 266-7013
GRI	Geosynthetic Research Institute 475 Kedron Ave. Folsom, PA 19033 www.drexel.edu/gri	(610) 522-8440
HEI	Heat Exchange Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/hei	(216) 241-7333

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REFERENCES

HI	Hydraulic Institute 9 Sylvan Way Parsippany, NJ 07054-3802	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute Division of Gas Appliance Manufacturers Association P.O. Box 218 35 Russo Pl. Berkeley Heights, NJ 07922 www.gamanet.org	(908) 464-8200
HMA	Hardwood Manufacturers Association (Formerly: Southern Hardwood Lumber Manufacturers Association) 400 Penn Center Blvd., Suite 530 Pittsburgh, PA 15235-5605 www.hardwood.org	(412) 829-0770
HPVA	Hardwood Plywood and Veneer Association 1825 Michael Farraday Dr. P.O. Box 2789 Reston, VA 22195-0789 www.hpva.org	(703) 435-2900
IAS	International Approval Services Division of Canadian Standards Association 8501 East Pleasant Valley Rd. Cleveland, OH 44131 www.iasapprovals.org	(216) 524-4990
IBD	Institute of Business Designers (Now part of IIDA)	
ICC	International Code Council 5203 Leesburg Pike #708 Falls Church, VA 22041 www.intlcode.org	(703) 931-4533
ICEA	Insulated Cable Engineers Association P.O. Box 440 South Yarmouth, MA 02664 www.icea.net	(508) 394-4424
IEC	International Electrotechnical Commission (Available from ANSI) 11 West 42nd St., 13th Floor New York, NY 10036-8002 www.ansi.org	(888) 267-4783 (212) 642-4900
IEEE	Institute of Electrical and Electronics Engineers 345 E. 47th St. New York, NY 10017-2394 www.ieee.org	(800) 678-4333 (212) 705-7900

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REFERENCES

IESNA	Illuminating Engineering Society of North America 120 Wall St., 17th Floor New York, NY 10005-4001 www.iesna.org	(212) 248-5000
IGCC	Insulating Glass Certification Council P.O. Box 9 Henderson Harbor, NY 13651	(315) 938-7444
IIDA	International Interior Design Association 341 Merchandise Mart Chicago, IL 60654-1104 www.iida.com	(800) 888-4432 (312) 467-1950
ILI	Indiana Limestone Institute of America Stone City Bank Building, Suite 400 Bedford, IN 47421 www.iliai.com	(812) 275-4426
IMSA	International Municipal Signal Association P.O. Box 539 165 E. Union St. Newark, NY 14513 www.imsasafety.org	(800) 723-4672 (315) 331-2182
INCE	Institute of Noise Control Engineering P.O. Box 3206, Arlington Branch Poughkeepsie, NY 12603 www.ince.org	(914) 462-4006
IRI	HSB Industrial Risk Insurers P.O. Box 5010 85 Woodland St. Hartford, CT 06102-5010 www.industrialrisk.com	(800) 520-7300 (860) 520-7300
ISA	ISA - International Society for Measurement and Control P.O. Box 12277 67 Alexander Dr. Research Triangle Park, NC 27709 www.isa.org	(919) 549-8411
ISEA	Industrial Safety Equipment Association 1901 N. Moore St., Suite 808 Arlington, VA 22209 www.safetycentral.org/isea	(703) 525-1695
ISS	Iron and Steel Society 410 Commonwealth Dr. Warrendale, PA 15086-7512 www.issource.org	(412) 776-1535

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REFERENCES

ITS	Intertek Testing Services (Formerly: Inchcape Testing Services) P.O. Box 2040 3933 US Route 11 Cortland, NY 13045-7902 www.itsglobal.com	(800) 345-3851 (607) 753-6711
KCMA	Kitchen Cabinet Manufacturers Association (Formerly: National Kitchen Cabinet Association) 1899 Preston White Dr. Reston, VA 22191 www.kema.org	(703) 264-1690
LGSI	Light Gage Structural Institute P.O. Box 560746 The Colony, TX 75056	(972) 625-4560
LIA	Lead Industries Association, Inc. 295 Madison Ave., Suite 808 New York, NY 10017 www.leadinfo.com	(800) 422-5323 (212) 578-4750
LMA	Laminating Materials Association (Formerly: American Laminators Association) 116 Lawrence St. Hillsdale, NJ 07642-2730 www.lma.org	(201) 664-2700
LPI	Lightning Protection Institute 3335 N. Arlington Heights Rd., Suite E Arlington Heights, IL 60004-7700 www.lightning.org	(800) 488-6864 (847) 577-7200
MBMA	Metal Building Manufacturers Association c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/mbma	(216) 241-7333
MCAA	Mechanical Contractors Association of America 1385 Piccard Dr. Rockville, MD 20850-4329 www.mcaa.org	(301) 869-5800
MFMA	Maple Flooring Manufacturers Association (Formerly: Wood and Synthetic Flooring Institute) 60 Revere Dr., Suite 500 Northbrook, IL 60062 www.maplefloor.com	(847) 480-9138
MFMA	Metal Framing Manufacturers Association 401 N. Michigan Ave. Chicago, IL 60611	(312) 644-6610

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REFERENCES

MHIA	Material Handling Industry Association 8720 Red Oak Blvd., Suite 201 Charlotte, NC 28217-3957 www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America 30 Eden Alley, Suite 301 Columbus, OH 43215 www.marble-institute.com	(614) 228-6194
MIA	Masonry Institute of America 2550 Beverly Blvd. Los Angeles, CA 90057 www.masonryinstitute.org	(213) 388-0472
ML/SFA	Metal Lath/Steel Framing Association 8 South Michigan Ave., Suite 1000 Chicago, IL 60603	(312) 456-5590
MRCA	Midwest Roofing Contractors Association 4840 W. 15th St., Suite 1000 Lawrence, KS 66049 www.mrca.org	(913) 843-4888
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry 127 Park St., NE Vienna, VA 22180-4602 www.mss-hq.com	(703) 281-6613
NAA	National Arborist Association P.O. Box 1094 Amherst, NH 03031-1094 www.natlarb.com	(800) 733-2622 (603) 673-3311
NAAMM	National Association of Architectural Metal Manufacturers 8 South Michigan Ave., Suite 1000 Chicago, IL 60603 www.gss.net/naamm	(312) 322-0405
NAAMM	North American Association of Mirror Manufacturers (See GANA) 2945 Southwest Wanamaker Dr., Suite A Topeka, KS 66614 www.glasswebsite.com/naamm	(913) 266-7013
NACE	NACE International (Formerly: National Association of Corrosion Engineers) P.O. Box 218340 Houston, TX 77218-8340	(281) 492-0535 (281) 492-8254
NAGDM	National Association of Garage Door Manufacturers (See DASMA)	

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REFERENCES

NAIMA	North American Insulation Manufacturers Association (Formerly: Thermal Insulation Manufacturers Association) 44 Canal Center Plaza, Suite 310 Alexandria, VA 22314 www.naima.org	(703) 684-0084
NAMI	National Accreditation & Management Institute, Inc. P.O. Box 366 207 S. Washington St. Berkeley Springs, WV 25411	(304) 258-5100
NAPA	National Asphalt Pavement Association NAPA Building 5100 Forbes Blvd. Lanham, MD 20706-4413 www.hotmix.org	(888) 468-6499 (301) 731-4748
NBHA	National Builders Hardware Association (See DHI)	
NBGQA	National Building Granite Quarries Association, Inc. 1220 L. St., NW, Suite 100-167 Washington, DC 20005	(800) 557-2848
NCAC	National Council of Acoustical Consultants 66 Morris Ave., Suite 1A Springfield, NJ 07081 www.ncac.com	(973) 564-5859
NCCA	National Coil Coaters Association 401 N. Michigan Ave. Chicago, IL 60611 www.coilcoaters.org	(312) 321-6894
NCMA	National Concrete Masonry Association 2302 Horse Pen Rd. Herndon, VA 20171-3499 www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute P.O. Box 759 253-80 Center St. Lake Geneva, WI 53147 www.ncpi.org	(414) 248-9094
NCRPM	National Council on Radiation Protection and Measurements 7910 Woodmont Ave., Suite 800 Bethesda, MD 20814-3095 www.ncrp.com	(800) 229-2652 (301) 657-2652

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REFERENCES

NCSPA	National Corrugated Steel Pipe Association 1255 23rd St., NW, Suite 850 Washington, DC 20037 www.ncspa.org	(202) 452-1700
NEBB	Natural Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877-4121 www.mcaa.org/nebb.htm www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814-3299 www.necanet.org	(301) 657-3110
NEI	National Elevator Industry 185 Bridge Plaza North, Suite 310 Fort Lee, NJ 07024	(201) 944-3211
NELMA	Northeastern Lumber Manufacturers Association 272 Tuttle Rd. P.O. Box 87A Cumberland Center, ME 04021 www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association 1300 N 17th St., Suite 1847 Rosslyn, VA 22209 www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association P.O. Box 687 106 Stone St. Morrison, CO 80465-1526 www.electricnet.com/neta	(303) 697-8441
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org	(800) 344-3555 (617) 770-3000
NFPA	National Forest Products Association (See AFPA)	
NFRC	National Fenestration Rating Council Incorporated 1300 Spring St., Suite 500 Silver Spring, MD 20910 www.nfrc.org	(301) 589-6372

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REFERENCES

NGA	National Glass Association 8200 Greensboro Drive, 3rd Floor McLean, VA 22102-3881	(703) 442-4890
NHLA	National Hardwood Lumber Association P.O. Box 34518 Memphis, TN 38184-0518 www.natlhardwood.org	(901) 377-1818
NIA	National Insulation Association (Formerly: National Insulation and Abatement Contractors Association) 99 Canal Center Plaza, Suite 222 Alexandria, VA 22314 www.insulation.org	(703) 683-6422
NIAC	National Insulation and Abatement Contractors Association (See NIA)	
NKCA	National Kitchen Cabinet Association (See KCMA)	
NLGA	National Lumber Grades Authority #406-First Capital Pl. 960 Quayside Dr. New Westminster, BC V3M 6G2 CANADA	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association P.O. Box 3009 Memphis, TN 38173-0009 www.nofma.org	(901) 526-5016
NPA	National Parking Association 1112 16th Street, NW, Suite 300 Washington, DC 20036	(202) 296-4336 (800) 647-7275
NPCA	National Paint and Coatings Association 1500 Rhode Island Ave., NW Washington, DC 20005-5597 www.paint.org	(202) 462-6272
NRCA	National Roofing Contractors Association O'Hare International Center 10255 W. Higgins Rd., Suite 600 Rosemont, IL 60018-5607 www.roofonline.org	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association 900 Spring St. Silver Spring, MD 20910 www.nrmca.org	(301) 587-1400

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NSA	National Stone Association 1415 Elliot Pl., NW Washington, DC 20007 www.aggregates.org	(800) 342-1415 (202) 342-1100
NSF	NSF International (Formerly: National Sanitation Foundation) 3475 Plymouth Rd. Ann Arbor, MI 48105 www.nsf.org	(734) 769-8010
NSSEA	National School Supply and Equipment Association 8300 Colesville Rd., Suite 250 Silver Spring, MD 20910 www.nssea.org	(800) 395-5550 (301) 495-0240
NTMA	National Terrazzo and Mosaic Association 110 E. Market St., Suite 200-A Leesburg, VA 20176-3122 www.ntma.com	(800) 323-9736 (703) 779-1022
NUSIG	National Uniform Seismic Installation Guidelines P.O. Box 0933 Alamo, CA 94507	(925) 555-6331
NWMA	National Woodwork Manufacturers Association (See NWWDA)	
NWWDA	National Wood Window and Door Association (Formerly: National Woodwork Manufacturers Association) 1400 E. Touhy Ave. Des Plaines, IL 60018 www.nwwda.org	(800) 223-2301 (847) 299-5200
PATMI	Powder Actuated Tool Manufacturers' Institute 1603 Boonslick Rd. St. Charles, MO 63301-2244	(314) 947-6610
PCA	Portland Cement Association 5420 Old Orchard Rd. Skokie, IL 60077-1083 www.portcement.org	(847) 966-6200
PCI	Precast/Prestressed Concrete Institute 175 W. Jackson Blvd. Chicago, IL 60604 www.pci.org	(312) 786-0300
PDCA	Painting and Decorating Contractors of America 3913 Old Lee Hwy, Suite 33-B Fairfax, VA 22030 www.pdca.com	(800) 332-7322 (703) 359-0826

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REFERENCES

PDI	Plumbing and Drainage Institute 45 Bristol Dr., Suite 101 South Easton, MA 02375 //pdi-online.org	(800) 589-8956 (508) 230-3516
PEI	Porcelain Enamel Institute 4004 Hillsboro Pike, Suite 224-B Nashville, TN 37215 www.porcelainenamel.com	(615) 385-5357
PGI	PVC Geomembrane Institute/Technology Program University of Illinois-Urbana Champaign 205 N. Mathews Ave. 2215 Newmark Civil Engineering Lab Urbana, IL 61801 //pgi-tp.ce.vivc.edu	(217) 333-3929
PIMA	Photographic and Imaging Manufacturers Association 550 Mamaroneck Ave., Suite 307 Harrison, NY 10528 www.pima.net	(914) 698-7603
PPFA	Plastic Pipe and Fittings Association 800 Roosevelt Rd., Building C, Suite 20 Glen Ellyn, IL 60137-5833	(888) 314-6774 (630) 858-6540
PPI	Plastics Pipe Institute (The Society of the Plastics Industry, Inc.) 1801 K St., NW, Suite 600K Washington, DC 20006 www.plasticpipe.org	(202) 974-5306
RCMA	Roof Coatings Manufacturers Association Center Park 4041 Powder Mill Rd., Suite 404 Calverton, MD 20705 www.roofcoatings.org	(301) 348-2003
RCSC	Research Council on Structural Connections Sargent & Lundy 55 E. Monroe St. Chicago, IL 60603	(312) 269-2424
RFCI	Resilient Floor Covering Institute 966 Hungerford Dr., Suite 12-B Rockville, MD 20850-1714	(301) 340-8580
RMA	Rubber Manufacturers Association 1400 K St., NW, Suite 900 Washington, DC 20005 www.rma.org	(800) 220-7620 (202) 682-4800

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REFERENCES

SAE	SAE International 400 Commonwealth Dr. Warrendale, PA 15096-0001 For publications: Call (724) 776-4970 www.sae.org	(724) 776-4841
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021 www.sdi.org	(847) 462-1930
SDI	Steel Door Institute 30200 Detroit Rd. Cleveland, OH 44145-1967 www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association 7 Wildbird Lane Hilton Head Island, SC 29926 www.sefalabfurn.com	(843) 689-6878
SEGD	Society for Environmental Graphic Design 401 F St., NW, Suite 333 Washington, DC 20001-2728	(202) 638-5555
SGCC	Safety Glazing Certification Council P.O. Box 9 Henderson Harbor, NY 13651	(315) 938-7444
SHLMA	Southern Hardwood Lumber Manufacturers Association (See HMA)	
SIGMA	Sealed Insulating Glass Manufacturers Association 401 N. Michigan Ave. Chicago, IL 60611-4267 www.sigmaonline.org/sigma	(312) 644-6610 x3279
SJI	Steel Joist Institute 3127 10th Ave., North Ext. Myrtle Beach, SC 29577-6760	(803) 626-1995
SMA	Screen Manufacturers Association 2850 S. Ocean Blvd., Suite 114 Palm Beach, FL 33480-5535	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Dr. P.O. Box 221230 Chantilly, VA 20151-1209 www.smacna.org	(703) 803-2980

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REFERENCES

SPI	The Society of the Plastics Industry, Inc. Spray Polyurethane Division 1801 K St., NW, Suite 600K Washington, DC 20006 www.socplas.org	(800) 951-2001 (202) 974-5200
SPIB	Southern Pine Inspection Bureau 4709 Scenic Hwy Pensacola, FL 32504-9094 www.spib.org	(850) 434-2611
SPRI	SPRI (Formerly: Single Ply Roofing Institute) 200 Reservoir St., Suite 309A Needham, MA 02494-3034 www.spri.org	(781) 444-0242
SSINA	Specialty Steel Industry of North America c/o Collier, Shannon Rill & Scott 3050 K St., NW, Suite 400 Washington, DC 20007 www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings 40 24th St., 6th Floor Pittsburgh, PA 15222-4656 www.sspc.org	(800) 837-8303 (412) 281-2331
SSPMA	Sump and Sewage Pump Manufacturers Association P.O. Box 647 Northbrook, IL 60065-0647	(847) 559-9233
STI	Steel Tank Institute 570 Oakwood Rd. Lake Zurich, IL 60047-1559 www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/swi	(216) 241-7333
SWPA	Submersible Wastewater Pump Association 1806 Johns Dr. Glenview, IL 60025-1657	(847) 729-7972
SWRI	Sealant, Waterproofing and Restoration Institute 2841 Main St. Kansas City, MO 64108 www.swrionline.org	(816) 472-7974

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REFERENCES

TCA	Tile Council of America P.O. Box 1787 Clemson, SC 29633 www.tileusa.com	(864) 646-8453
TIMA	Thermal Insulation Manufacturers Association (See NAIMA)	
TPI	Truss Plate Institute 583 D'Onofrio Dr., Suite 200 Madison, WI 53719	(608) 833-5900
TPI	Turfgrass Producers International (Formerly: American Sod Producers Association) 1855-A Hicks Rd. Rolling Meadows, IL 60008 www.turfgrassod.org	(800) 405-8873 (847) 705-9898
UFAC	Upholstered Furniture Action Council P.O. Box 2436 High Point, NC 27261	(910) 885-6085
UL	Underwriters Laboratories Inc. 333 Pfingsten Rd. Northbrook, IL 60062 www.ul.com	(800) 704-4050 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association 2655 Villa Creek Dr., Suite 155 Dallas, TX 75234 members.aol.com/unibell	(972) 243-3902
USITT	USITT: The American Association of Design and Production Professionals in the Performing Arts 6443 Ridings Rd. Syracuse, NY 13206-1111 www.culturenet.ca/usitt	(800) 938-7488 (315) 463-6463
USP	U.S. Pharmacopeia (Formerly: U.S. Pharmacopoeial Convention) 12601 Twinbrook Pkwy Rockville, MD 20852-1790 www.usp.org	(800) 227-8772 (301) 881-0666
WA	Wallcoverings Association 401 N. Michigan Ave. Chicago, IL 60611-4267	(312) 644-6610

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REFERENCES

WASTEC	Waste Equipment Technology Association 4301 Connecticut Ave. NW, Suite 300 Washington, DC 20008	(202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau P.O. Box 23145 Portland, OR 97281-3145	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (Formerly: American Window Covering Manufacturers Association) 355 Lexington Ave., 17th Floor New York, NY 10017-6603	(212) 661-4261
WEF	Water Environment Federation (Formerly: Water Pollution Control Federation) 601 Wythe St. Alexandria, VA 22314-1994 www.wef.org	(800) 666-0206 (703) 684-2400
WIC	Woodwork Institute of California P.O. Box 980247 West Sacramento, CA 95798-0247 www.wicnet.org	(916) 372-9943
WMMPA	Wood Moulding & Millwork Producers Association 507 First St. Woodland, CA 95695 www.wmmpa.com	(800) 550-7889 (530) 661-9591
WPCF	Water Pollution Control Federation (See WEF)	
WRI	Wire Reinforcement Institute 301 E. Sandusky St. Findlay, OH 45840 www.bright.net/~rreiter	(419) 425-9473
WSC	Water Systems Council Building C, Suite 20 800 Roosevelt Rd. Glen Ellyn, IL 60137	(630) 545-1762
WSFI	Wood and Synthetic Flooring Institute (See MFMA)	
WWPA	Western Wood Products Association Yeon Building 522 SW 5th Ave. Portland, OR 97204-2122 www.wwpa.org	(503) 224-3930

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REFERENCES

EPA	Environmental Protection Agency 401 M St., SW Washington, DC 20460 www.epa.gov	(202) 260-2090
FAA	Federal Aviation Administration (U.S. Department of Transportation) 800 Independence Ave., SW Washington, DC 20591 www.faa.gov	(202) 366-4000
FCC	Federal Communications Commission 1919 M St., NW Washington, DC 20554 www.fcc.gov	(202) 418-0126
FDA	Food and Drug Administration 5600 Fishers Lane Rockville, MD 20857 www.fda.gov	(301) 443-1544
FHA	Federal Housing Administration (U.S. Department of Housing and Urban Development) 451 Seventh St., SW Washington, DC 20410 www.hud.gov	(202) 401-0388
FS	Federal Specification Unit (Available from GSA) 470 East L'Enfant Plaza, SW, Suite 8100 Washington, DC 20407 www.gsa.gov	(202) 619-8925
GSA	General Services Administration F St. and 18th St., NW Washington, DC 20405 www.gsa.gov	(202) 708-5082
MIL	Military Standardization Documents (U.S. Department of Defense) Defense Automated Printing Service 700 Robbins Ave., Building 4D Philadelphia, PA 19111 www.dodssp.daps.mil	(215) 697-2179
NIST	National Institute of Standards and Technology (U.S. Department of Commerce) Building 101, #A1134, Rte. I-270 and Quince Orchard Rd. Gaithersburg, MD 20899 www.nist.gov	(301) 975-2000

OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) 200 Constitution Ave., NW Washington, DC 20210 www.osha.gov	(202) 219-8148
PS	Product Standard of NBS (U.S. Department of Commerce) Government Printing Office Washington, DC 20402 For product standards, contact: Ms. Brenda Umberger CS & PS Specialist c/o NIST Gaithersburg, MD 20899 www.nist.gov	(202) 512-1800 (301) 975-4036
RUS	Rural Utilities Service (Formerly: Rural Electrification Administration) (U.S. Department of Agriculture) 14th St. and Independence Ave., SW Washington, DC 20250	(202) 692-0187
TRB	Transportation Research Board, National Research Council 2101 Constitution Ave., NW Washington, DC 20418 www.nas.edu/trb	(202) 334-2934
USDA	U.S. Department of Agriculture 14th St. and Independence Ave., SW Washington, DC 20250 www.usda.gov	(202) 720-8732
USPS	U.S. Postal Service 475 L'Enfant Plaza, SW Washington, DC 20260-0010 www.usps.gov	(202) 268-2000

1.5 GOVERNING REGULATIONS/AUTHORITIES

- A. The Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents; that information may or may not be of significance to the Contractor. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.
- B. Copies of Regulations: Obtain copies of the following regulations and retain at the Project Site, available for reference by parties who have a reasonable need for such reference.

1.6 SUBMITTALS

- A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records

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established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

****END OF SECTION****

ABBREVIATIONS

PART 1 - GENERAL

1.1 The following is a list of abbreviations utilized throughout the Contract Documents.

A	B	C
ABV.	Above	CAB.
A.F.F.	Above Finish Floor	C.U.H.
ABR.	Abrasive	CAP.
ABS.	Absorbing	CPT.
ACC.	Access	CSMT.
A.C.C.	Air Cooled Condenser	CSWRK.
ACC.PNL.	Access Panel	CSG.
A.V.	Acid Vent	C.I.
A.W.	Acid Waste	C.I.F.
AC.	Acoustic/Acoustical	C.I.P.
AC.T.	Acoustic Tile	CSTG.
AC.INSUL.	Acoustical Insulation	CAT.NO.
A.D.A.	Americans with Disability Act.	C.B.
ADD.	Addendum	CLG.
ADDN.	Addition	C.D.
ADDNL.	Additional	CLG.HT.
ADH.	Adhesive	CEM.
ADJ.	Adjacent/ Adjustable	CEM.PLAS.
AGGR.	Aggregate	CTR.
A.C.B.	Air Circuit Breaker	C.L.
A/C	Air Conditioning	C/C
A.C.	Air Conditioner	CER.
A.C.C.	Air Conditioning Compressor	CER.T.
A.C.U.	Air Conditioning Unit	CBD.
A.H.U.	Air Handling Unit	CHAM.
ALT.	Alternate	CHG.
ALUM./AL.	Aluminum	C/CHAN.
AMT.	Amount	CHKD. PL.
AMP.	Amphere	CH.W.R.
AMPL.	Amplifier	CH.W.S.
ANCH.	Anchor/Anchorage	CHD.
A.B.	Anchor Bolt	CIRCUM.
&	And	CIR.
L/AN.	Angleg	CIRC.
ANOD.	Anodized	CIRC.
APT.	Apartment	C.BR.
APR.	Approved	C-
APPR.	Approximate	
ARCH.	Architect Architectural	CL.
A-	Architectural Drawing Number	CLRM.
A.T.	Ash Tray	C.O.
ASPH.	Asphalt	CLR.
ASSY.	Assembly	CLR. GL.
@	At	CLR. W.GL.
AUTO.	Automatic	COEF.
A.S.R.	Automatic Sprinkler Riser	C.W.
AUX.	Auxiliary	COL.
AVG.	Average	CO.
		COMPT.
		COMPO.
		C.A.
		COMPR.
		CONC.
		C.M.U.
		Unit
B/B	Back-to-Back	
B.F.P.	Back Flow Preventer	
B.D.D.	Back Draft Damper	
B.F.	Barrier Free	
B.B.R.	Base Board Radiation	
B.PL.	Base Plate	
BSMT.	Basement	
B.	Bath Room	
BM.	Beam	
BRG	Bearing	
BR.	Bedroom	
B.M.	Bench Mark	
BT.	Bent	
BETW.	Between	
BEV.	Bevel	
BIT.	Bituminous	
B.I.	Black-iron	
BLK.	Block	
BD.	Board	
BLR.	Boiler	
BLR.F.	Boiler Feed	
BLR.H.	Boiler House	
B.S.	Both Side	
B.W.	Both Ways	
BOT.	Bottom	
B.O.D.	Bottom of Duct	
B.O.P.	Bottom of Pipe	
BOT.EL.	Bottom Elevation	
BLVD.	Boulevard	
BDRY.	Boundry	
BRKT.	Bracket	
B.HP.	Brake Horsepower	
BR.	Brass	
BRKR.	Breaker	
BRK.	Brick	
B.T.U.	British Thermal Unit	
BRZ.	Bronze	
BLDG.	Building	
B.L.	Building Line	
B.M.S.	Building Management System	
B.U.R.	Built-up Roofing	
BN.	Bullnose	
BLKHD.	Bulkhead	
BULL.	Bulletin	
B.A.	Burglar Alarm	
BUZZ.	Buzzer	

SECTION 014213
ABBREVIATIONS

C.W.R. Condensing Water Return
C.W.S. Condensing Water Supply
COND. Condensate
COND. Conduit
CONF. Conference
CONN. Connect
C.A.V. Constant Air Volume
CONST. Construction
C.J. Control Joint
CONT. Continue/Continuous
CONTR. Contractor
C.P. Control Panel
CONV. Convector
CNVYR. Conveyor
COR. Corner
C.G. Corner Guard
CORR. Corridor/Corrugated
CPR. Copper
CNTR. Counter
CTSK. Countersink/Countersunk

CRS. Course
COV. Cover
COV.PL. Cover Plate
C.C.T. Cubical Curtain Track
CU.FT. Cubic Feet/Cubic Foot

C.F.M. Cubic Feet Per Minute
C.Y. Cubic Yard
CULV. Culvert
C.D. Cup Dispenser
CYL. Cylinder
CYC. Cycles

D

DMPR. Damper
DMPFG. Dampproofing
D.L. Dead Load
DB. Decibel
D. Deep
DEG. Degree
DMT. Demountable
PARTN. Partition
DEPT. Department
DEPR. Depressed
DES. Design
DET. Detail
D.E.CO. Detroit Edison Co.
DIAG. Diagonal
DGM. Diagram
DIA. Diameter
DIFF. Diffuser
DIM. Dimension
D.R. Dining Room
DIR. Directory
D.D.C. Direct Digital Control
DISC. Disconnect

DISCONT. Discontinuous
DW. Dishwasher
DISP. Dispenser
DIST. Distance
D.P. Distribution Panel
DO. Ditto
DIV. Divider/Division
DR. Door
D.O. Door Opening
DR.OP. Door Operator
DBL. Double
D.A. Double Acting
D.H. Double Hung
DWL. Dowel
DN. Down
D.S. Downspout
D.S.B. Downspout Boot
DRN. Drain
D.T. Drain Tile
D.T.C. Drain Tile Connector
DWR. Drawer
DWG. Drawing
D.F. Drinking Fountain
D.B. Dry Bulb
D.S.P. Dry Stand Pipe
DBWTR. Dumbwaiter
DUP. Duplicate
D.DR. Dutch Door

E

EA. Each
E.F. Each Face
E.W. Each Way
E. East
ELAST. Elastomeric
FLASH. Flashing
ELAST W.P. Elastomeric Waterproofing
E.S.R. Elastomeric Sheet Roofing
E.D.H. Electric Duct Heater
ELEC. Electric/Electrical
ELEC. CL. Electric Closet
ELEC.CAB. Electrical Cabinet
E.C. Electrical Contractor
E- Electrical Drawing Number
E.P. Electrical Panel
E.R.P. Electric Radiant Panel
E.U.H. Electric Unit Heater
EWC. Electric Water Cooler
E.W.H. Electric Water Heater
ELEC.OPER. Electrically Operated
EL. Elevation
ELEV. Elevator
EMERG. Emergency
ENCL. Enclosure
ENGR. Engineer
E/E End-to-End

E.A.T. Entering Air Temperature
ENTR. Entrance/Entry
EP. Epoxy
EQ. Equal
EQUIP. Equipment
EQUIV. Equivalent
ESC. Escalator
EST. Estimate
EXC. Excavated
EXH. Exhaust
E.D. Exhaust Duct
E.F. Exhaust Fan
E.G. Exhaust Grille
E.R. Exhaust Register
EXIST. Existing
EXP. Expansion
EXP.B. Expansion Bolt
E.J. Expansion Joint
EXPL.P. Explosion Proof
EXP'D. Exposed
EXT'N. Extension
EXT. Exterior
E.H. Extra Heavy
EXTR. Extruded
E.S.P. External Static Pressure

F

FAB. Fabricated/Fabric
F/F Face-to-face
F. FIN. Factory Finish
F.C.U. Fan Coil Unit
F.S. Far Side
FAS. Fastener
FDR. Feeder
FT. Feet/Foot
F.P.M. Feet Per Minute
FN. Fence
FBD. Fiberboard
FIG. Figure
FIN. Finish/Finished
FIN.FLR/ Finish Floor
F.F.
F.T.R. Finned Tube Radiation
F.A. Fire Alarm
F.A.C.P. Fire Alarm Control Panel
F. BRK. Fire Brick
F.D. Fire Damper
F.E. Fire Extinguisher
F.E.C. Fire Extinguisher Cabinet
F.H.C. Fire Hose Cabinet
F.H. Fire Hydrant
F.L. Fire Line
F.R. Fire Retardant/
Fire Rated
F.V.C. Fire Valve Cabinet
FP. Fireplace

SECTION 014213
ABBREVIATIONS

FPRFG. Fireproofing
 FIXT. Fixture
 FLG. Flange
 FLASH. Flashing
 F.H.M.S. Flat Head Machine
 Screw
 F.H.W.S. Flat Head Wood
 Screw
 F.C. Flexible Connection
 FLR. Floor
 F.CO. Floor Cleanout
 F.D. Floor Drain
 FLR.FIN. Floor Finish
 FLUOR. Fluorescent
 FLDG. Folding
 FTG. Footing
 FMBD. Formboard
 FDN. Foundation
 FR. Frame
 FRMG. Framing
 F.A.I. Fresh Air Intake
 FRZR. Freezer
 F.L.A. Full Load Amperes
 F.S. Full Size
 FURN. Furnish/ Furnished

G

GA. Gauge
 GAL. Gallon
 G.P.H. Gallons Per Hour
 G.P.M. Gallons Per Minute
 GALV. Galvanized
 GALV.I. Galvanized Iron
 G. Gas
 GKT. Gasket
 G.V. & B. Gate Valve And Box
 GA. Gauge
 GEN'L. General
 GL. Glass
 GLZ. Glazing
 G.H.T. Glazed Hollow Tile
 G.B. Grab Bar
 GR. Grade/Grille
 GB. Grade Beam
 GRAT. Grating
 G.L. Grid Line
 GRN. Granite
 G.S. Grease Separator
 G.T. Grease Trap
 GND. Ground
 G.F. Ground Fault
 GT. Grout
 GYP. Gypsum
 GYP.BD. Gypsum Board

H

HNDCP. Handicapped
 H.R. Handrail
 H.BD. Hardboard

HDWE. Hardware
 HDWD. Hardwood
 HD. Head
 HDR. Header
 H.O.A. Hands-Off-Auto
 HD. Head
 H.A.GL. Heat Absorbing
 Glass
 H.R.U. Heat Recovery Unit
 HTR. Heater
 HTG. Heating
 H/V. Heating And
 Ventilating
 H.V.A.C. Heating, Ventilating,
 and Air Conditioning
 H.H.W.R. Heating Hot Water
 Return
 H.H.W.S. Heating Hot Water
 Supply
 HGT. Height
 HEX. Hexagon
 H. High
 H.I.D. High Intensity
 Discharge
 H.P. High Point
 H.PR. High Pressure
 H.S. High Strength
 H.S.B. High Strength Bolt
 H.V. High Voltage
 HWY. Highway
 HSTWY. Hoistway
 H.C. Hollow Core
 H.M. Hollow Metal
 HK. Hook
 HORIZ. Horizontal/
 Horizontally
 HP. Horsepower
 H.B. Hose Bibb
 H.S.P. Hose Stand Pipe
 H.V.C. Hose Valve Cabinet
 HOSP. Hospital
 H.W. Hot Water
 H.W.R. Hot Water Return
 H.W.S. Hot Water Supply
 HR. Hour
 H.O. Hub Outlet
 HYD. Hydrant/Hydraulic
 H. Hydrogen

I

I.D. Identification
 INCAND. Incandescent
 IN. or " Inch/ Inches
 INCIN. Incinerator
 INCL. Include/ Including
 I.W. Indirect Waste
 INFO. Information
 I.D. Inside Diameter
 I.F. Inside Face
 INST'L. Install/ Installation
 INSUL. Insulate/ Insulation

I.H. Intake Hood
 INT. Interior
 INTER. Intermediate
 INV. Invert
 I.E. Invert Elevation

J

J.C. Janitor Closet
 JT. Joint
 JST. Joist
 J.B. Junction Box
 JR. Junior

K

K.P. Kick Plate
 KV. Kilovolt
 KV.A. Kilovolt Ampere
 KW. Kilowatt
 K. Kip (1000#)
 KIT. Kitchen
 K.D. Knock Down
 K.O.P. Knock-Out Panel

L

LBL. Label
 LAB. Laboratory
 LAD. Ladder
 L.B. Lag Bolt
 LAM. Laminate/ Laminated
 LDG. Landing
 L- Landscape Drawing
 Number
 LGE. Large
 LDRY. Laundry
 LAV. Lavatory
 L.A.T. Leaving Air
 Temperature
 L.H. Left Hand
 L.H.R.B. Left Hand Reverse
 Bevel
 LGTH. Length
 LEV. Level
 LIB. Library
 LT. Light
 LPRF. Lightproof
 LTG. Lighting
 L.P. Lighting Panel
 L.R.P. Lighting Receptacle
 Panel
 LTWT. Lightweight
 LTWT. Lightweight Concrete
 CONC.
 LMS. Limestone
 LTL. Lintel
 L.D. Linear Diffuser

SECTION 014213
ABBREVIATIONS

L.C.D.	Linear Ceiling Diffuser	M.I.	Miscellaneous Iron Model	OHD.DR.	Overhead Door
L.F.	Linear Feet/Foot	MOD.	Model	OXY.	Oxygen
LIQ.	Liquid	MON.	Monument		
L.L.	Live Load	M.S. & S.	Mop Strip And Shelf		P
L.R.	Living Room	M.O.	Motor Operated		
LOC.	Location	M.O.D.	Motor Operated Damper		
LKR.	Locker	MLDG.	Molding	PRD.	Painted
LG.	Long	MTD.	Mounted	PR.	Pair
L.L.H.	Long Leg Horizontal	MTG.	Meeting/Mounting	PNL.	Panel
L.L.V.	Long Leg Vertical	MTD.	Mounted	P.T.D.	Paper Towel Dispenser
LVR.	Louver	MOV.	Moveable	P.T.W.R.	Paper Towel Waste Receptacle
L.O.	Louver Opening	MOV.	Moveable Partition		
L.P.	Low Point	PARTN.		PARA.	Paragraph
L.PR.	Low Pressure	MULL.	Mullion	PRL.	Parallel
LBR.	Lumber	M	Thousand	PGK.	Parking
LBS.	Pounds	MBH	1000BTU/Hour	P.BD.	Particle Board
	M		N	PRTN.	Partition
				PASS.	Passage
MACH.	Machine	NAT.	Natural	PAT.	Patent
M.B.	Machine Bolt	N.S.	Near Side	PVMT.	Pavement
MACH.RM.	Machine Room	NK.	Neck	PVG.	Paving
M.U.A.	Make-Up Air	NEUT.	Neutral	PED.	Pedestal
M.A.U.	Make-up Air Unit	N.R.C.	Noise Reduction Coefficient	PERF.	Perforated
M.D.P.	Main Distribution Panel	NOM.	Nominal	PERIM.	Perimeter
M.S.B.	Main Switch Board	N.C.	Non-Corrosive	PERM.	Permanent
MAINT.	Maintenance	NOR.	Normal	PERP.	Perpendicular
MH.	Manhole	N.C.	Normally Closed	PHOTO.	Photograph
M.V.D.	Manual Volume Damper	N.O.	Normally Open	P.H.	Physically Handicapped
MFR.	Manufacturer	N	North	PC.	Piece
MAR.	Marble	NOS.	Nosing	PCS.	Pieces
MK.	Mark	N.I.C.	Not In Contract	PLAS.	Plaster
MAS.	Masonry	N.T.S.	Not To Scale	PL.LAM.	Plastic Laminate
M.O.	Masonry Opening	NO. or #	Number	PL.	Plate
MATL.	Material			PL.GL.	Plate Glass
MAX.	Maximum			PLAT.	Platform
MECH.	Mechanical			PLBG.	Plumbing
M-	Mechanical Drawing Number			PLYWD.	Plywood
				PT.	Point
M.C.	Medicine Cabinet	OBS.	Obscure	P.T.	Point of Tangency
MED.	Medium	OBS.GL.	Obscure Glass	P.C.	Point of Curvature
MEMB.	Membrane	OFF.	Office	POL.	Polish/ Polished
MET.	Metal/ Metallic	O.C.	On Center	PVC.	Polyvinylchloride
M.C.S.	Metal Carpet Strip	OPQ.	Opaque	PORC.	Porcelain
M.D.S.	Metal Divider Strip	OPG.	Opening	PORC.	Porcelain Enamel
M.E.S.	Metal Edge Strip	OPER.	Operator	ENAM.	
M.L.	Metal Lath	O.B.V.D.	Opposed Blade Volume Damper	POR.	Porous
M.L. & PLAS.	Metal Lath And Plaster	OPP.	Opposite	PORT.	Portable
MET.W.P.	Metallic Waterproofing	OPP.HD	Opposite Hand	POS.	Position
MEZZ.	Mezzanine	ORIG.	Original	P.I.V.	Post Indicator Valve
M.D.O.T.	Michigan Department of Transportation	ORN.	Ornamental	LBS. or #	Pounds
MWK.	Millwork	OZ.	Ounce	P.L.F.	Pounds Per Linear Foot
MIN.	Minimum	O/O	Out-to-Out	P.S.F.	Pounds Per Square Foot
MIR.	Mirror	O.A.	Outside Air	P.S.I.	Pounds Per Square Inch
M. & S.	Mirror And Shelf	O.D.	Outside Diameter	P.C.F.	Pounds Per Cubic Foot
MISC.	Miscellaneous	O.F.	Outside Face	P.P.	Power Panel
		O.H.S.	Oval Head Screw	P/C	Precast
		OA.	Overall		
		OHD.	Overhead		

SECTION 014213
ABBREVIATIONS

P.T.C. Precast Terrazzo Receptor
 PREFAB. Prefabricated
 PFN. Prefinished
 P.C.T./C.M. Pressure Control Terminal/Control Module
 P.G. Pressure Gauge
 P.R.G. Pressure Relief Grille
 P.R.V. Pressure Reducing Valve
 PRIM. Primary
 PROJ. Project/ Projection
 PROP. Property/ Proposed
 P.L. Property Line
 P.A. Public Address
 P.S. Purse Shelf
 P.B. Push Button

Q

QTY. Quantity
 Q.T. Quarry Tile
 QTR. Quarter
 QTR.RD. Quarter Round

R

RBT. Rabbet
 R.C.P. Radiant Ceiling Panel
 RAD. or R. Radius
 R.W.C. Rain Water Conductor
 R.R. Railroad
 RECV. Receive/ Receiving
 RECPT. Receptacle
 R.P. Receptacle Panel
 REC. Recess
 RECIRC. Recirculation
 RECT. Rectangle / Rectangular
 RED. Reducer
 RWD. Redwood
 REF. Refer/Reference
 REFL. Reflected/Reflective
 REFRIG. Refrigerant
 REFR. Refrigerator
 REG. Register
 RH.C. Reheat Coil
 REINF. Reinforce/Reinforcing Reinforcement
 R.H. Relief Hood
 REM. Remove/ Removable
 REP. Repair
 REQ'D. Required
 RESIL. Resilient
 RET. Return
 R.A. Return Air

R.A.D. Return Air Duct
 R.A.F. Return Air Fan
 REV. Revised/Revision
 R.P.M. Revolutions Per Minute
 R. Riser
 R.H. Right Hand
 R.H.R.B. Right Hand Reverse Bevel
 R.O.W. Right Of Way
 RVT. Rivet
 RD. Road
 R.S.C. Rolling Steel Curtain
 RF. Roof
 R.C. Roof Conductor
 R.D. Roof Drain
 RF.H. Roof Hatch
 R.T.U. Roof Top Unit
 R.S. Roof Sump
 R.V. Roof Ventilator
 RFG. Roofing
 R.W.C. Rain Water Conductor
 RM. Room
 R.O. Rough Opening
 RND. or O Round
 R.H.M.S. Round Head Machine Screw
 R.H.W.S. Round Head Wood Screw
 R.T. Rubber Tile

S

SAN. Sanitary
 S.N.D. Sanitary Napkin Dispenser
 S.N.R. Sanitary Napkin Receptacle
 SCHED. Schedule
 SCN. Screen
 STG. Seating
 SECT. Section
 SERV. Service
 S.S. Service Sink
 SHTHG. Sheathing
 SHT. Sheet
 SHT.MET. Sheet Metal
 SH. & P. Shelf And Pole
 SHWR. Shower
 S.C.R. Shower Curtain Rod
 S.DR. Shower Door
 SW. Sidewalk
 SIM. Similar
 SGL. Single
 SK. Sink
 S.D. Soap Dispenser
 S.C. Solid Core
 S.T.C. Sound Transmission Class
 S South
 SP. Space

SPR. Spare
 SPKR. Speaker
 SPEC. Specifications
 S.D. Splitter Damper
 SPRYD. Sprayed
 SPKLR. Sprinkler
 SQ. Square
 S.F. Square Feet/ Square Foot
 STAG. Staggered
 ST.STL Stainless Steel
 STD. Standard
 SP. Standpipe
 S.P. Static Pressure
 STA. Station
 STM. Steam
 STL. Steel
 STL.PL. Steel Plate
 STIFF. Stiffener
 STO.FR. Storefront
 STOR. Storage
 ST. Storm
 STR. Straight
 ST. Street
 STRUCT. Structural Drawing Number
 S.G.F.T. Structural Glazed Facing Tile
 S.STL. Structural Steel
 SS.D. Subsoil Drain
 SS.D.C. Subsoil Drain Connection
 SUB. Substation
 S.A.G. Supply Air Grille
 S.D. Supply Diffuser/ Duct
 SUBST. Substitute
 S.A.R. Supply Air Register
 S.F. Supply Fan
 S.A. Supply Air
 S.A.D. Supply Air Diffuser
 SUPP. Support
 SURF. Surface/Surfacing
 SUSP. Suspend/Suspension
 SW. Switch
 SWBD. Switchboard
 SWGR. Switchgear
 SYM. Symbol/Symmetrical
 SYS. System

T

T.BD. Tackboard
 TAN. Tangent
 TECH. Technical
 TEL. Telephone
 TEL.CAB. Telephone Cabinet
 TV Television
 TV.M. Television Monitor
 TEMP. Temperature
 TEMP.GL. Tempered Glass
 T.W. Tempered Water
 T.U. Terminal Unit

SECTION 014213
ABBREVIATIONS

TERR.	Terrazzo	V	W.M.	Wire Mesh
T.B.	Test Boring		W/	With
T.	Thermostat		W/O	Without
THK.	Thick/Thickness	VAC.	WD.	Wood
T.S.	Thickened Slab	V.B.	W.L.	Working Line
M (1000)	Thousand	V.C.O.	W.P.T.	Working Point
K (KIP)	Thousand Pounds		W.I.	Wrought Iron
THD.	Thread/Threaded	V.BARR.		
THRESH.	Threshold	VAR.		
THRU.	Through	V.A.V.		Y
T.	Tile	VARN.		
T./TOIL.	Toilet	VNR		
T.P.D.	Toilet Paper Dispenser	V. PLAS.		
		V.	YD.	Yard
T.P.H.	Toilet Paper Holder	V.T.R	Y.P.	Yield Point
T & G	Tongue And Groove	VENT.	Y.S.	Yield Strength
T & B	Top & Bottom	V.I.F.	YR.	Year
T/C	Top Of Cover/Curb	VS.		
T/EL.	Top Elevation	VERT.		Z
T/F	Top Of Footing	VERT.C.		
T/M	Top Of Masonry	VEST.		
T/P	To Of Pavement	V.I.		
T/R	Top of Rail	VNY.	Z.C.	Zinc-Coated
T/R	Top of Rim	V.C.T.		
T/S	Top of Steel			
T/W	Top of Wall	VIN.FAB.		
T.B.	Towel Bar	V.R.S.		
T.D.	Towel Dispenser	VIT.		
T.D. & W.R.	Towel Dispenser & Waste Receptacle	V.C.P.		
		VOL.		
T.G.	Transfer Grille	V.D.		
TRFR.	Transformer	V		
TRAN.	Transom			
T	Tread			
T.D.	Trench Drain	W		
T.S.	Tube Section			
T.V.	Turning Vane			
T.T.	Twin Tee			
TYP.	Typical			
	U			
U.C.	Undercut	WAINS.		
U.G.	Underground	W.CAB.		
U.L.	Underwriters' Laboratories, Inc.	W.CO.		
		W.H.		
ULT.	Ultimate	WW		
UNFIN.	Unfinished	W.V.		
U.H.	Unit Heater	WHSE.		
U.SUB.	Unit Substation	W.F.		
U.V.	Unit Ventilator	W.		
U.S.G.S.	United States Geological Survey	W & V		
		W.R.		
U.O.N.	Unless Otherwise Noted	W.C.		
		W.G.		
U.S.A.	Untempered Supply Air	W.H.		
		WP.		
UR.	Urinal	W.P.		
		W.STPG.		
		WT.		
		W.W.F		
		W		
		W.B.		
		W.		
		W-x-		
		WT		
		W.O.		
		W.GL.		

STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: Standards and Definitions
Definitions
Specification Content
Quality Standard of the Industry

1.2 DEFINITIONS

- A. Certain terms used in the Contract Documents are defined generally in this article. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the work to extent not stated more explicitly in another provision of the Contract Documents.
- B. Construction Manager: the term "Construction Manager" used in these Specifications shall mean the General Contractor.
- C. Indicated: A cross-reference to details, notes or schedules on the drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- D. Furnish: Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
- E. Install: Perform operations at project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing protecting, cleaning and similar operations, as applicable in each instance.
- F. Provide: Furnish and install, complete and ready for intended use, as applicable in each instance.
- G. Installer: The entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.

1.3 FORMAT AND SPECIFICATION EXPLANATIONS

- A. Specification Production: None of these explanations will be interpreted to modify substance of requirements. Portions of these Specifications have been produced by Architect's/Engineer's standard methods of editing master Specifications, and may contain minor deviations from traditional writing formats. Such deviations are a normal result of this production technique, and no other meaning will be implied or permitted.
- B. Format Explanation: The format of principal portions of these Specifications can be described as follows; although other portions may not fully comply and no particular significance will be attached to such compliance or non-compliance:

1. Sections and Divisions: For convenience, basic unit of Specification text is a "section", each unit of which is named and numbered. These are organized into related families of sections, and various families of sections are organized into "divisions", which are recognized as the present industry-consensus on uniform organization and sequencing of Specifications. The section title is not intended to limit meaning or content of section, nor to be fully descriptive of requirements specified therein, nor to be an integral part of text.
2. Each section of specifications has been subdivided into 3 (or less) "parts" for uniformity and convenience (Part 1 - General, Part 2 - Products, and Part 3 - Execution). These do not limit the meaning of and are not an integral part of text which specifies requirements.
3. Imperative Language: Requirements expressed imperatively shall be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by Contractor, or when so noted, by others.
4. Section Numbering: Used to facilitate cross-reference in Contract Documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of project Manual must be consulted to determine numbers and names of specification sections in the Contract Documents.
5. Page Numbering: Numbered independently for each section; recorded in listing of sections (Index or Table of Contents) in Project Manual. Section number is shown with page number at bottom of each page, to facilitate location of text in Project Manual.

1.4 SPECIFICATION CONTENT

- A. Specifying Methods: The techniques or methods of specifying to record requirements varies throughout text, and may include "prescriptive", "open generic-descriptive", "compliance with standards", "performance", "proprietary", or a combination of these. The method used for specifying one unit of work has no bearing on requirements for another unit or work.
- B. Overlapping and Conflicting Requirements: Where compliance with 2 or more industry standards or sets of requirements is specified, and overlapping of these different standards or requirements establishes different or conflicting minimums of levels of quality, most stringent requirement (which is generally recognized to be also most costly) is intended and will be enforced, unless specifically detailed language written into the Contract Documents (not by way of reference to an industry standard) clearly indicated that a less stringent requirement is to be fulfilled. Refer apparently equal but different requirements, and uncertainties as to which level of quality is more stringent, to Architect for a decision before proceeding.
 1. Contractor's Options: Except for overlapping or conflicting requirements, where more than one set of requirements are specified for a particular unit of work, option is intended to be Contractor's regardless of whether specifically indicated as such.
- C. Specified Quality Standards: The fact that a specified product or model number is in conflict with specified quality requirements such as "concealed fasteners" or "special colors" such specification shall be construed to mean that acceptance is contingent upon manufacturer or fabricator modifying the product to comply with the Specifications.

- D. Minimum Quality/Quantity: In every instance, quality level or quantity shown or specified is intended as minimum for the work to be performed or provided. Except as otherwise specifically indicated, actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable limits. In complying with requirements, indicated numeric values are either minimums or maximums as noted or a appropriate for context of requirements. Refer instances of uncertainty to Architect for decision before proceeding.
- E. Specialists; Assignments: In certain instances, specification text requires (or at least implies) that specific work be assigned to specialists or expert entities, who must be engaged for performance of those units of work. These must be recognized as special requirements over which Contractor has no choice or option. These assignments must not be confused with (and are not intended to interfere with) normal application of regulations, union jurisdictions and similar conventions. One purpose of such assignments is to establish which party or entity involved in a specific unit of work is recognized as "expert" for indicated construction processes or operations. Nevertheless, final responsibility for fulfillment or entire set of requirements remains with Contractor.
- F. Abbreviations: The language or Specifications and other Contract Documents is of the abbreviated type in certain instances, and implies word and meanings which will be appropriately interpreted. Actual work abbreviations of a self-explanatory nature have been included in the text. Specific abbreviations have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on drawings and in schedules. These are frequently defined in sections at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.

1.5 QUALITY STANDARDS OF THE INDUSTRY

- A. General Applicability of Standards: Applicable standards of construction industry have same force and effect (and are made a part of Contract Documents by reference) as if copied directly into Contract Documents, or as if published copies were bound herewith.
 - 1. Reference standards (referenced directly in Contract Documents or by governing regulations) have precedence over non-referenced standards.
 - 2. Non-referenced standards have no particular applicability except as a measure of compliance with standards recognized in construction industry.
- B. Copies of Standards:
 - 1. Where copies of standards are needed for proper performance of the work, the Contractor is required to obtain such copies directly from the publication source.
 - 2. The Architect reserves the right to reasonably require the Contractor to submit, or maintain at the jobsite, copies of all applicable standards as needed for enforcement of the requirements.
- C. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with standard in effect as of date of Contract Documents.
- D. Abbreviations and Names: Acronyms or abbreviations used in Contract Documents mean the industry recognized name applicable to context of text provision.

1.6 DRAWINGS, DETAILS, SCHEDULES

- A. Large scale details are provided to show arrangement, attachment, and otherwise indicate relationships of component materials and for purposes of clarify often do not show all materials. The fact that a material is, or is not indicated on such details shall not act to relieve the Contractor of responsibility for providing a specified item.
- B. Schedules are provided for convenience of reference only. In the event of an omission or conflict between schedules and other documents, the more restrictive document shall govern as directed by the Architect.

1.7 CODES AND STANDARDS

- A. Comply with latest revisions to date of all Governing Codes and with all other legal provisions relating to the Work. Other standards and references shall be current edition as of date of issue of Bidding Documents.
- B. Conform to all laws, ordinances and regulations affecting the erection, sequence of erection, and completion of the whole or any part of the work; and conform to the requirements of the Owner and of public authorities having lawful or customary jurisdiction.
- C. These requirements shall take precedence over the Contract Documents except where the Contract Documents require higher standards also acceptable to the authorities.

1.8 PERMITS, CODES, ORDINANCES AND NOTICES

- A. See General Conditions for permits.
- B. Obtain and keep available at the job, copy of building ordinances pertinent to the work.
- C. Inform the Owner and the Architect, in writing, of the manner and time in which each of the requirements of the General Conditions concerning permits are complied with.
- D. Make all necessary arrangements and obtain permits for blockage of streets and for all interference with the public right of way.
- E. Special Inspections: All special inspections required to be made under provisions by building code of utility company regulations shall be arranged and paid for by the Contractor whose work requires such inspection.

****END OF SECTION****

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. DRAWINGS AND GENERAL PROVISIONS of Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work of this section.

1.2 SUBMITTALS

- A. Substitution Request Submittal: Requests for substitution will be considered if presented to the Architect at least 10 days in advance of bid due date.
1. Identify the product, or the fabrication to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
 - b. Samples, where applicable or requested.
 - c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
 - d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 - e. A Statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - f. Cost information, including all related costs under this Contract and excluding Architect's redesign costs, net change, if any, in the Contract Sum, and waiving all claims for additional costs related to the substitution which subsequently became apparent.
 - g. Certification by the Contractor that the substitution proposed is appropriate in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
- B. Product Presentation: Conduct a presentation at the Architect's office if required by the Architect to prove appropriateness to the specified product.
- C. Architect's Action: Within one (1) week of receipt of Bids, the Architect may request additional information or documentation necessary for evaluation of the request. Within two (2) weeks of receipt of the request, or one (1) week of receipt of the additional information or documentation, whichever is later, the Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute is not made or obtained within the time allocated, use the product specified by name. If acceptance is made prior to award, it will be included in the Contract Amount. If acceptance is made after Award, it will be in the form of a Change Order.

1.3 GENERAL REQUIREMENTS FOR SUBSTITUTIONS

A. Substitutions During Bidding:

1. Substitutions shall be included in the proposal under the following conditions only and shall follow all requirements of "Acceptance of Substitutions."
 - a. When the Contractor is unable to obtain competitive prices from more than one of the specified manufacturers.
 - b. When the Contractor knows of another product of equal or better quality and performance.
 - c. When the Contractor has had unsatisfactory experience with one or more of the specified products or has reason to believe that the specified Manufacturer will not provide the necessary guarantees or assume responsibility for performance.

B. Substitutions After Contract:

1. Substitutions proposed after Award of the contract will only be considered for the following reasons.
2. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

C. Acceptance of Substitutions:

1. Substitutions will be considered for any manufacturer except those followed by the words "No Substitutions" in the Specifications.
2. In all cases where substitutions are proposed by the Contractor, it shall be the sole responsibility of the Contractor to provide adequate data and samples as required by the Architect to evaluate the substitution.
3. The Architect shall not be obliged to justify his reason for rejecting a proposed substitution.
4. In the event that a substitution is accepted conditionally on the Contractor's agreement to assume full responsibility for equality and performance, the Contract shall provide a full value warranty and agree to make good all damages resulting from the failure of the substitute product.

1.4 ACCEPTANCE OF MATERIALS AND MANUFACTURERS

A. Standard Materials:

1. Architect's acceptance applies to the Manufacturer only and shall not act to permit any deviation from other requirements of the Specifications.

2. Acceptance will be based on the Manufacturer's specifications at time of issuance of Bidding Documents. Deviations from such specifications shall be considered as a substitution.
 3. Requests for acceptance shall be in tabular form stating Specification paragraph and material selected, except as otherwise provided.
 4. Shop Drawings shall not indicate any material for which acceptance has not been received, unless accompanied by a separate request for approval. In no case shall Architect's review and return of Shop Drawings constitute and acceptance of either specified or substitute manufacturers or materials.
- B. Materials Involving Supplementary Warranty of Maintenance Contract:
1. These materials shall be submitted as a request for acceptance over the signature of a qualified technical representative in the direct employ of the Manufacturer of such other person as the manufacturer may authorize in writing. Request for acceptance shall contain the following information.
 - a. Name of project.
 - b. Name of Contractor, Subcontractor or other party to whom material is furnished.
 - c. Reference to Specification Section and Article where material is specified and other Contract Documents necessary for identification.
 - d. Statement of acceptance of documents, conditions, and performance requirements:
 - 1) Statement that documents as issued are in accordance with manufacturer's recommendations for use of specified materials, or
 - 2) Recommended modification of detail, use, application or for substitution of different product by same manufacturer as being more suitable for the performance requirements of the warranty.
 - e. Statement that detailed installation instructions will be provided.
 - f. Extent of job site technical services, consultants or instructors proposed, if any.
 - g. Statement that warranty will be provided.
 - h. Special provisions required to keep warranty in force.
 2. Requests for acceptance may be in the form of a letter including the above items and addressed to the subcontractor responsible for installation of the material, or may be according to a sample form of Material Proposal, provided by the Architect.
 3. Upon receipt of the manufacturer's proposal, the subcontractor shall add his own statement agreeing to comply with the manufacturer's requirements and warranting his own workmanship.
 4. The Contractor shall submit letter of endorsement of copies of all documents, including letters of comment, to the Architect for approval. In the event that the request for approval recommends a change in the work, modification of detail, or substitution of material, the Contractor shall indicate his concurrence with the change as being within the scope of the Contract or indicate the change in the Contract Sum for making such change, or state his objections to the change.

END OF SECTION

EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for standards of construction operations and procedures of a repetitive or general nature.

1.2 MANUFACTURER'S REVIEW

- A. Manufacturer's review of documents and conditions of use is a statement by the manufacturer or a representative or agent thereof that it has reviewed the documents pertaining to the work and verified the proposed use of the material including details and instructions for applications or installation, is suitable for the intended purpose, and under similar conditions of use.
- B. Obtain and submit a statement from the manufacturer indicating that they have no objection to the proposed details or method of installation, and that instructions for applications or installation are in conformance with manufacturer's recommendations. Statement shall include any additional precautions or protective measures which should be taken.
- C. Manufacturer's review shall recognize adjacent materials and state if there is, in its opinion, a serious question of compatibility including possibility of damage to other materials, or damage to the material or assembly by other materials. Such conditions shall be reconsidered and adjustments made, previous approvals notwithstanding.

1.3 APPROVED APPLICATOR

- A. An approved applicator or installer is one whom the manufacturer has reason to believe is experienced and qualified in the work and is familiar with the product and with the manufacturer's recommendations for use and installation.
- B. Obtain and submit a statement from the manufacturer that the proposed applicator or installer is approved and indicate whether or not this approval is subject to review and observation of the work by the manufacturer's representative.
- C. Manufacturer shall not approve an installer or applicator if, because of past history of performance or other reasons, there is a reasonable doubt that it can be relied upon to perform in accordance with the Contract Documents.
- D. Upon completion of the work, manufacturer shall certify that approved material in the proper quantities have been delivered to the approved applicator for use on the Project.
- E. In the event that manufacturer declines to approve proposed applicator, submit a statement as to whether or not on-site instruction or manufacturer's supervision is recommended.

1.4 MATERIAL HANDLING, STORAGE AND DELIVERY

- A. Where applicable, deliver all packaged materials to the site in manufacturer's original unopened containers.

- B. Properly pack all materials in appropriate containers for shipment. Identify contents with piece marks referenced to shop drawings and as far as possible in some sequence as erection. Provide packing, wrapping and other protection as required to insure satisfactory condition of materials and finishes at time of erection.
- C. Inspection and acceptance will be made on the basis of materials as delivered to the job site.
- D. Provide adequate quantities to allow for damage and breakage during shipment and delivery and for replacement of all materials damaged prior to final acceptance. All such replacement of damaged materials shall be at no additional cost to the Owner.
- E. Store materials and equipment which are subject to degradation by outside exposure in a weathertight enclosure.

1.5 MIXING, THINNING AND STORAGE

- A. Store and mix paints only in areas designated, and provide proper protection for walls and floors.
- B. Mix and thin paints in strict accordance with recommendations of the manufacturer.
- C. Deliver and store paints and flammable materials in the manufacturer's original unopened containers, as far as practicable. Keep partially used materials in tightly closed containers.
- D. Do not store oil or paint soaked rags inside the building. Do not store materials in any room containing a direct fired heating unit.

1.6 ON SITE INSTRUCTION

- A. On-site instruction shall consist of inspection and instruction performed by a qualified representative of the manufacturer.
- B. Obtain and submit a statement from the manufacturer that its authorized representative will provide the specified inspection and instruction and submit a record of the date on which specified services were provided.
- C. Service shall consist of:
 - 1. Preliminary inspection of substrates and all other conditions which would affect the performance of the work.
 - 2. Give notice of all unacceptable conditions and recommend remedial action.
 - 3. Recommend proper procedures for conditions as encountered at the site.
 - 4. Verify that workers are qualified and have received proper instructions.

1.7 MANUFACTURER'S SUPERVISION

- A. Manufacturer's supervision, in addition to all services specified for on- site instruction, consists of continuing inspection and verification that the work has been performed in accordance with the Contract.

- B. Obtain and submit a statement from the manufacturer that complete supervision will be provided.
- C. Where supervision is specified, all costs shall be included in the Base Bid. Where supervision is recommended as a modification, submit a proposal indicating the extent and additional cost, if any, of such service.
- D. Upon completion submit a report giving dates of inspections and include pertinent information as applicable to the particular trade such a procedures, coats, coverages, tests as necessary to verify conformance and certify that the proper types and quantities of materials were installed.

1.8 WORKMANSHIP

- A. Employ skilled mechanics and fabricate all work in the best and most workman-like manner and in strict accordance with the detail drawings, by fabricating contractors regularly engaged in the particular type or work.
- B. Conform to the acceptable fabrication and erection standards of the manufacturer and to the applicable rulings of Code Authorities.

1.9 FABRICATION

- A. Fabricate and install all items plumb, true, straight, square, level and in proper elevations, plane, locations and alignment with other work. Design all work for adjustment to field connection, fitted with proper joints and intersections, adequately anchored in place. Complete work in every detail.
- B. Design and anchor work so that work will not be distorted not fasteners overstressed from expansion and contraction due to temperature change.
- C. All fasteners for exposed surface where not otherwise indicated shall be concealed.
- D. Fabricated Items:
 - 1. Model numbers of Manufacturers as listed herein are intended to indicate design and detail for each item. Variations affecting function or appearance will not be accepted.
 - 2. Identifying Markings: Where the manufacturer's name, patent number, model number or similar identifying marks are required, locate such markings in as inconspicuous as possible location. In no case will such marks be acceptable as part of the basic design.
 - 3. Hardware for all Units: Concealed fasteners and hardware. Butt hinges are not acceptable as a substitute where item scheduled in Specification is manufactured with concealed pivots or piano hinges.

1.10 INSTALLATION

- A. Accurately locate, carefully plumb and level, and securely attach all accessories.
- B. Provide concealed grounds and backing or other anchorages devices, properly located, as required for fastening.
- C. Use manufacturer's standard mounting devices as best suited to installation conditions and as accepted by the Architect. Make all attachments by positive mechanical fastening devices, except where other installation methods are indicated.

- D. Where so recommended by the manufacturer, install the work under direct supervision of the authorized representative of the manufacturer. Employ workers experienced and qualified in the trade.
- E. Install units true and plumb in the opening maintaining proper contact with frames or adjacent materials and fitting closely to detail at intersection with other materials to provide for proper operation.
- F. Connect and properly adjust all operating devices and equipment to operate smoothly and perfectly.
- G. Upon completion or when directed, conduct careful inspection and correct defective work. Perform necessary adjustments as required to leave the completed installation in efficiently operable condition.

1.11 PREPARATION OF SURFACES FOR COATINGS AND COVERINGS

- A. Inspect all surfaces and verify that all required cants and chamfers are provided, and that all surfaces are free from irregularities of projections which would interfere with proper application.
- B. Thoroughly clean surfaces; remove all loose materials, grease, oil and foreign matter.
- C. Allow surfaces to completely dry before applying materials.
- D. Report all unsatisfactory surface to contractor for correction before proceeding. Otherwise proceeding will constitute acceptance of surface by Contractor.
- E. Note: Interior application of solvent type adhesives and systems require special ventilation or special solvents if ventilation is not possible.

1.12 BUILDING-IN, ANCHORS, INSERTS

- A. Unless otherwise stipulated, each trade generally shall promptly furnish anchorage and insert devices, together with adequate setting information, where necessary for building into the work by other trades.
- B. Verify the accuracy of all built-in anchors and inserts.
- C. Delays and errors shall be corrected by the trade responsible therefor.
- D. Power driven anchors of equivalent capacity and function may be accepted, subject to written acceptance, where approved by local jurisdictional authorities.
- E. Do not endanger or alter the work of any other trade without obtaining prior written consent.
- F. Furnish all supports necessary for proper installation of equipment.

END OF SECTION

CUTTING AND PATCHING OF SINGLE PLY ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 6. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

- B. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer to cut and patch exposed Work listed below:
 - a. EPDM Single Ply Membrane Roofing
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
1. Existing Roof: The existing roof is a roof system which is still under warranty. Comply with the following requirements when modifying the existing roof and adding new penetrations:
 - a. Notify original roof manufacturer prior to beginning any work and comply with all manufacturer guidelines and requirements.
 - b. Provide original roof manufacturer with a brief description of the proposed work, including any required submittals.
 - c. Work shall not begin until written approval is received from original roof manufacturer.
 - d. Work must be done by an approved manufacturer's contractor.
 - e. Original roof manufacturer shall inspect all modifications to the original roof system.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. Review proposed procedures with original Roof Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Proceed with patching after construction operations requiring cutting are complete.

3.4 ROOF FLASHING INSTALLATION AROUND NEW PENETRATIONS

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing as recommended by manufacturer.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings.
- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

SECTION 017327
CUTTING AND PATCHING
OF SINGLE PLY ROOFING

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will eliminate evidence of patching and refinishing.

****END OF SECTION****

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 02 Section "Selective Demolition" for demolition of selected portions of the building for alterations.
 - 2. Divisions 02 through 35 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Roofing: When modifying an existing roof and adding new penetrations comply with the following requirements:
 1. Notify original roof manufacturer prior to beginning any work and comply with all manufacturer guidelines and requirements.
 2. Provide original roof manufacturer with a brief description of the proposed work, including any required submittals.
 3. Work shall not begin until written approval is received from original roof manufacturer.
 4. Work must be done by an approved roofing manufacturer's contractor.
 5. Original roof manufacturer shall inspect all modifications to the original roof system.
- B. Structural Elements: Do not cut and patch the following structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Foundation construction.
 - b. Bearing walls.
 - c. Structural concrete.
 - d. Structural steel.
 - e. Lintels.
 - f. Structural decking.
 - g. Miscellaneous structural metals.
- C. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that would result in increased maintenance or decreased operational life or safety.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related elements:
 - a. Primary operational systems and equipment.
 - b. Air or smoke barriers.
 - c. Fire-protection systems.
 - d. Control systems.
 - e. Communication systems.
 - f. Electrical wiring systems.
- D. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their

capacity to perform as intended, or that would result in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtainwall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise- and vibration-control elements and systems.
- E. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
 - a. Roofing.
 - b. Firestopping.
 - c. Window wall system.
- F. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
1. Existing Roof: The existing roof is a roof system which is still under warranty. Comply with the requirements stated in the "Quality Assurance" paragraph above.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill. For salvaged existing brick refer to detailed requirements in Division 04 Section "Unit Masonry".
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.

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5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang existing ceilings or portions of existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition. For salvaged existing brick refer to detailed requirements in Division 04 Section "Unit Masonry".

END OF SECTION

WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: Warranties and continuing services required to be provided by manufacturers of materials and systems where required for proper performance.
- B. The word "Guarantee" when appearing in any Contract Document or construction correspondence shall be defined as warranty in accordance with Article 9.4 of the General Conditions.

1.2 SUBMITTALS

- A. Submit warranties in accordance with Article 9.4 of the General Conditions as modified by Supplementary Conditions and additional requirements specified under the individual Trade Sections.
- B. Required types of warranties and additional services are scheduled and listed in the Trade Sections.
- C. In all cases where "Special Warranties" or "Service Contracts" are required, the request for approval of materials will be accepted by the Owner and the Architect on the understanding that manufacturer agrees to provide the specified warranty or other service unless stated otherwise in the request.
- D. The Owner will not be bound to accept any limitations or variations from the specified warranty which were not filed with the request for acceptance and accepted prior to purchase of materials.
- E. Warranties shall be submitted prior to request for payment for 100% completion in each case, shall acknowledge the responsibilities defined under Supplementary Conditions and shall include:
 - 1. Manufacturer's warranty that all materials comply with its published standards, comply with the requirements of the Specifications and where specified, are adequate for the proposed use.
 - 2. Subcontractor's warranty that all workmanship complies with the requirements of the Specifications and of the manufacturer
 - 3. Contractor's warranty covering the entire work and accepting responsibility for all limitations imposed by the manufacturer or sub- contractor except where such limitations have been previously accepted by the Architect.
 - 4. Certification and verification of previously submitted information including statement of all limitations, required maintenance and similar conditions of the warranty.

1.3 STANDARD WARRANTIES

- A. A standard warranty is a warranty whose terms are essentially the same as normally offered by the manufacturer of standard with the industry.

- B. General Conditions require that standard warranties apply as a minimum requirement notwithstanding the fact that submittal of a copy of the warranty is not required.
- C. Unless otherwise specified a standard warranty shall be for a period on one (1) year from Date of Substantial Completion.
- D. Contractor shall obtain and furnish to the Owner from each manufacturer of materials or equipment incorporated into the Work a warranty at least as favorable to Owner as that customarily given by such manufacturer to others. Contractor shall inform itself as to any conditions precedent to the effectiveness of each manufacturer's warranty and comply with all such conditions (or obtain waivers thereof from the manufacturer) so that such warranty shall be fully effective. If any event occurs which might invalidate any manufacturer's warranty, Contractor shall promptly notify the Owner and the Architect.
- E. All warranty periods shall commence on the Date of Substantial Completion except that, if it is discovered after said date that certain work or materials were not in fact in conformance with the requirements of the Contract Documents, the applicable warranty period shall re-commence from the completion of the repair or replacement of such Work to make it so conform.
- F. The fact that a manufacturer's warranty differs in its terms from those of the Contractor or any Subcontractor, the acceptance by the Owner of any warranty of a manufacturer or Subcontractor, or the fact that the Owner has claimed initially on such warranty, shall not in any way release Contractor from his warranty obligations under the Contract.

1.4 SPECIAL WARRANTIES

- A. A special warranty is one whose terms, in addition to the standard coverage offered by the manufacturer, contain other special provisions, including:
 - 1. Acknowledgment of specified list of items which shall be specifically noted as being covered by the warranty.
 - 2. Acknowledgment of specific conditions for use or exposure.
 - 3. Extension of warranty to waive standard exceptions or to extend limits including time.
 - 4. Requirements for specific performance by other trades including method of separation and protection from, or assurance of compatibility with, adjacent materials.
 - 5. Assemblies and systems which may include products of other manufacturers.
 - 6. Conditions where certain performance criteria are specified and must be either acknowledged or actual limits are required to be determined by performance testing subject to Owner's review and acceptance.
 - 7. Conditions where manufacturer's continuing involvement such as maintenance or advisory service is required.
- B. Maintenance Service During Warranty Period:
 - 1. Reference to routine maintenance required to be performed by the Owner during the warranty period shall be listed in the original submittal of proposed warranty.

2. All other administration and maintenance service required during the warranty period, including installation of items repaired or replaced under the terms of the warranty shall be included in the original Contract.

1.5 SERVICE CONTRACTS

- A. Required types of Service Contract Proposals are scheduled under Schedule of Required Submittals and are listed in the Trade Sections.
- B. Where specified, the Subcontractor or Manufacturer originally supplying services and skills required for proper maintenance and agreeing to maintain availability of replacement parts and materials.
- C. The Service Contract is in addition to, and independent of, the Warranty and shall not act to either extend the Warranty or to reduce the Contractor's responsibilities thereunder.
- D. Unless otherwise specified or agreed, Service Contracts shall be written for a period of five (5) years starting with the termination of similar services included under the warranty and shall include cancellation privilege annually when exercised at least 60 days prior to anniversary date.
- E. The Contractor shall:
 1. Prior to submittal of Manufacturer of Subcontractor for approval, verify that specified service is available and will be offered.
 2. Secure from the Manufacturer of Subcontractor a bona fide proposal to perform the specified services.
 3. When so directed, assist the Architect in obtaining proposals for the performance of the specified services by other competent parties.

1.6 ADVISORY AND INSPECTION SERVICE

- A. Advisory and Inspection Service consists of:
 1. Periodic inspection on a regular scheduled basis. Include schedule of proposed inspections in the agreement.
 2. All necessary information, including special training, where required to adequately instruct Owner's maintenance personnel in preventative maintenance procedures, and periodic inspection to verify that such procedures are adequate.
 3. Providing recommendations for additional preventative maintenance repairs and treatments. If such maintenance work is recommended:
 - a. Obtain or submit price quotations for recommended work.
 - b. When so instructed by the Owner, make all necessary arrangements for the performance of the Work.
- B. Parts and Materials Agreement:
 1. Where standard commercially available parts of materials are suitable for maintenance or repair, inform Owner concerning trade name or description and location where they may be obtained.

2. Where parts or materials are not readily available maintain replacement stocks at a location as required to prevent undue delay in repairs or loss of use of equipment pending delivery.

1.7 MAINTENANCE SERVICE

- A. A Maintenance Service Contract is an agreement that in addition to Advisory and Inspection Service, the Manufacturer will provide, or otherwise make available through his agent, a regular maintenance service program scheduled during normal working hours.
- B. Proposals shall schedule proposed times for servicing and list the services to be performed.
- C. Maintenance service of equipment shall be performed solely by the original Equipment Contractor and shall not be assigned or transferred to any agent or subcontractor without the approval of the Owner.
- D. Repairs:
 1. Permanent repairs shall be started within seven (7) days after notification by the Owner.
 2. In the event that emergency and permanent repairs are not started within the specified time limits, or if the work is stopped without the Owner's consent, the Owner shall have the same options to have repairs performed by others as specified under Warranties without invalidating this agreement.
- E. Equipment maintenance shall include systematic examinations, and adjustments and lubrication of all equipment. The Equipment Maintenance Contractor shall repair and replace electrical and mechanical parts whenever required using only genuine standard parts recommended or produced by the manufacturer of the equipment.
- F. Addition work when so directed by the Owner shall be included under the work of the Maintenance Contract and the Contractor shall be reimbursed at the then prevailing rate for the cost of materials, labor and services. Such additional work shall include:
 1. Repairs or replacement required as a result of negligence, abuse, or other actions contrary to the Equipment Contractor's operating instructions.
 2. Improvement or additional equipment required by the Owner, Insurance Companies, or Governmental Authorities.
 3. Except for emergency service, the additional cost for overtime work based on the difference between regular and overtime labor when the Owner requests that such work be performed outside of regular working and so authorized in writing.
- G. Additional requirements for specific maintenance contracts are specified in the various Trade Sections.

1.8 CERTIFICATION

- A. Product Certification: See Division 1.
- B. Workmanship Certification is a statement by the applicator or installer that all materials and workmanship in connection with the system, have been furnished and installed in complete conformance with Contract Documents, and with the manufacturer's specifications and requirements for the particular type of use specified.

- C. A product certification where specified as a requirement shall be in a form similar to the following:

"We, the (Manufacturing Company), certify that the complete system as detailed and specified can be installed and will perform in accordance with the requirements of the specifications and the ASTM Standards referenced therein for the guarantee period of one year or such longer period as may be negotiated between the Owner and the (Manufacturing Company).

Upon completion of the Project we will inspect the work and certify to the Owner that the system as installed is in accordance with the Manufacturer's requirements or indicated in writing what remedial action is necessary in order that it does so conform."

****END OF SECTION****

ELECTRONIC PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for preparation and submittal of Project Record Documents.

1.2 DEFINITIONS

- A. Record Documents: Copies of the Contract Documents, Shop Drawings, Product Data and Samples maintained at the site for purpose of recording changes and other project information.
- B. Maintenance and Parts Manuals: Annotated PDF file format Brochures, instructions, parts lists and similar documents, published by manufacturers and suppliers of materials and equipment for purpose of providing information necessary to maintenance, repair and replacement.
- C. "As-Built" Drawings: Except for "as-built" corrections to the Shop Drawings the only record of architectural as-built conditions required will be clean copy of the Contractor's notations on the Record Drawings in Annotated PDF file format, unless otherwise specified.
- D. "As-Built" drawings for Mechanical, Electrical and Life Safety or Security Systems shall be fully dimensioned and detailed drawings, in Annotated PDF file format, showing all systems as they exist at the completion of Work.

1.3 SCHEDULES

- A. Prepare schedule listing required Record Drawings and Maintenance Manual submittals in accordance with "Submittals" Section of this Division 01.
- B. Keep schedule up to date listing record drawings and other documents as they are received from Manufacturers, Suppliers and Subcontractors.
- C. Hold all such material until completion of the project and submit when directed.

1.4 DRAWINGS AND SPECIFICATIONS AT THE SITE

- A. Each Contractor shall maintain at the site and available for reference by the Owner and the Architect one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders and other Modifications applicable to their portion of the Work, in good order and marked to record all changes made during construction.
- B. The Drawings, marked to record all changes made during construction, shall be delivered to the Owner upon completion of the Work in Annotated PDF file format.
- C. Record Documents: At the date of Final Completion and as condition precedent to Final Payment, each Contractor shall furnish the following documents to the Owner:

1. Record Drawings in PDF file format showing the field changes affecting the general construction, mechanical, electrical, and all other Work, and indicating the Work as actually installed in the building.
 - a. These shall consist of carefully drawn markings on a set of black and white prints of the Construction Documents obtained especially for the purpose unless otherwise specified. The prints can be scanned into a PDF file when project is completed or the contractor can keep an Annotated PDF file on site.
 - b. The Contractor shall maintain at the job site one set of Construction Documents and indicate thereon each field change as it occurs.
2. A neatly arranged searchable PDF file containing the wiring and control diagrams, operating and maintenance instructions, cuts of all mechanical and electrical equipment and fixtures, as installed including catalogues or parts lists from the prime manufacturer. Said lists shall not be based on local dealer stock number systems.

1.5 RECORD DRAWINGS

- A. Record Drawings are required to establish the location of concealed work deviations from details or dimensions indicated on the construction drawings. Where location or dimensions of portions of the work is indicated by note or line drawings or otherwise indicated to be at the option of the Contractor, the final determination of such options shall be indicated in the Record Drawings.
- B. Record Drawings are required for information only but are intended to provide complete information for as-built drawings.
- C. Final PDF file record copy of all Shop Drawings shall be submitted showing all corrections made and also indicating all field changes or other variations from the details as originally reviewed by the Contractor and the Architect.

1.6 OPERATING AND MAINTENANCE MANUALS

- A. Prior to completion of work in this Contract, each Contractor shall submit for review by the Architect searchable PDF file of manufacturer's catalog data covering all fixtures, equipment and finish materials incorporated into the project. Manufacturer's catalog data shall include full identification of the equipment or fixture capacities, current characteristics, dimensions, and identification of all replacement parts. Operating instructions for all installed equipment, including supplier's names and telephone numbers shall be placed on or lettered on the front page of each catalog or manual.
- B. Maintenance procedure descriptions shall be submitted for all materials requiring special treatments or continued maintenance work and for all assemblies, which may require parts replacement during the life of the installation. Manuals shall indicate recommended schedule for routine service and shall provide complete instructions for performing such service.
- C. Manuals and catalogs shall be searchable PDF format. Each item shall be tab and shall have an index. All material shall be grouped together by specification number.

- D. Contractor shall arrange and provide for the services of factory representatives or other authorized qualified specialists to provide operating and maintenance instruction sessions directly with Owner's related operating and maintenance personnel for the systems, equipment and materials involved.
- E. These requirements are in addition to other similar requirements stated elsewhere in the Contract Documents including those of "Warranties" Section of Division 01.
- F. Equipment Operation manuals and operating instructions for each item of mechanical and electrical equipment:
 - 1. Operation and Maintenance Charts: Searchable PDF and one (1) hard copy of an operating and maintenance instruction chart which will incorporate applicable comprehensive descriptive instructions, lay-outs, diagrams or any other information that will necessary and/or of value to the operating and maintenance personnel. Hard copy of the charts shall be framed and glazed and mounted at a designated location, and the other three sets shall be included in the operation and maintenance manuals.
 - 2. Operation and Maintenance Manuals: Searchable PDF file of an operation and maintenance manual which shall contain complete instructions for overall operation and maintenance of the facility and its component parts. The manual shall also contain the operating and maintenance instruction charts as specified.

****END OF SECTION****

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Demolition and removal of selected portions of a building or structure.
- 2. Demolition and removal of selected site elements.
- 3. Repair procedures for selective demolition operations.

- B. Related Sections include the following:

- 1. Division 01 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
- 2. Division 15 Sections for demolishing, cutting, patching, or relocating mechanical items.
- 3. Division 16 Sections for demolishing, cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- B. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.5 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of stairs.
 - 5. Locations of temporary partitions and means of egress.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Predemolition Photographs or Videography: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
- F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.

- E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1. Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

1. If possible, retain original Installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage original Installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Roofing.
 - b. Firestopping.
 - c. Window wall system.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 5. Refer to Divisions 15 and 16 for other applicable requirements and limitations.

3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 3. Protect existing site improvements, appurtenances, and landscaping to remain.
 4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
- C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- F. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - a. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
 10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
 11. Explosives: Use of explosives is not permitted.
- B. Existing Facilities: Comply with building manager's requirements for using and protecting stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- C. Removed and Salvaged Items: Comply with the following:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area on-site.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- F. Concrete: Demolish in small sections. Cut concrete to a depth of at least **3/4 inch (19 mm)** at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- G. Structural Steel: Dismantle field connections without bending or damaging steel members. Do not use flame-cutting torches unless otherwise authorized by Architect.
- H. Below-Grade Construction: Demolish in sections. Remove below-grade construction, including basements, foundation walls and footings, completely to at least 12 inches below grade unless otherwise indicated on Drawings.
- I. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- J. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- K. Building Components: Remove metal gratings, metal ladders, doors, windows, door hardware, cabinets, mirrors, chalkboards and marker boards, tackboards, toilet accessories, plumbing fixtures, and light fixtures, as whole units, intact and undamaged.
- L. Equipment: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.
- M. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.
- N. Carpet and Pad: Remove in large pieces and roll tightly after removing demolition debris, trash, adhesive, and tack strips.
- O. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- P. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 07 Section for new roofing requirements.
- Q. Existing Utilities: Unless otherwise indicated on Drawings, demolish existing utilities and below-grade utility structures that are within 5 feet (1.5 m) outside of footprint indicated for new construction. Abandon utilities outside this area.
1. Piping: Disconnect piping at unions, flanges, valves, or fittings.

2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 1 Section "Cutting and Patching."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

CONCRETE WATER VAPOR REDUCING ADMIXTURE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Water vapor reducing admixture (WVRA).

1.3 RELATED SECTIONS

- A. Division 03 Section "Cast-In-Place Concrete" for concrete slabs to receive WVRA.

1.4 REFERENCES

- A. ASTM International (ASTM):
ASTM C494-Standard Specification for Chemical Admixtures for Concrete
ASTM D5084 - Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
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.
ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.5 SUBMITTALS

- A. Product Data: Submit for each product specified.
- B. Material Certificates: For each material specified, signed by the manufacturer, certifying that materials meet or exceed specified requirements.
- C. Material Test Reports: For each material specified, from a qualified testing agency, indicating compliance with requirements.
- D. Warranty: Submit sample special warranty specified in this section.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A firm with not less than 10 years' experience in manufacturing concrete water vapor reducing admixture of the type specified, capable of providing test reports indicating compliance with specified performance requirements, and able to provide on-site technical representation. Selected product must have ASTM C494 Type S Concrete Admixture approval from and independent AASHTO approved laboratory.
- B. **Preinstallation Conference:** Conduct conference at time and location specified by Construction Manager. Attendees shall include Contractor, concrete water vapor reducing admixture manufacturer or authorized representative, concrete supplier, and concrete finisher to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements. Concrete suppliers and finishers must be certified.
- C. **Concrete Supplier Qualifications:** The concrete supplier must be Certified by the WVRA manufacturer prior to bid, Certificates issued by the manufacturer must be submitted with bid documents.
- D. **Concrete Finishers Qualifications:** The concrete finisher must be Certified by the WVRA manufacturer prior to bid, Certificates issued by the manufacturer must be submitted with bid documents
- E. **Moisture Testing:** The WVRA supplier will perform all moisture testing. WVRA manufacturer will issue warranty prior to start of installation of flooring and moisture sensitive adhesives and coatings of any type.
- F. **Bond Testing:** Warranted moisture sensitive coatings and adhesives must be installed by each subcontractor in coordination with WVRA manufacturer. Bond test results will be evaluated by WVRA manufacturer as part of the Warranty process.
- G. **Source Limitations:** Obtain each type of concrete water vapor reducing admixture from same manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's original, undamaged containers with identification labels intact.
- B. Comply with manufacturer's written instructions for handling prior to adding to concrete batch.
- C. Comply with manufacturer's written instructions for storage of WVRA.

1.8 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer's standard form warranty document executed by an authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under provisions of the Contract Documents.
Warranty Period: 10 years from date of Substantial Completion.

Warranty covers performance of concrete water vapor reducing admixture as well as labor and material for flooring replacement in accordance with manufacturer's current standards and applicable test results performed in accordance with ASTM D5084.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The concrete water vapor reducing admixture is based on Vapor Lock 20/20 manufactured by Specialty Products Group (SPG), 6254 Skyway Road, PO Box 915, Smithville ON, LOR 2A0, Canada; telephone: 877-957-4626; fax: 905-527-0606; Email: info@spggogreen.com; Web Site: <http://spggogreen.com>.
- B. Substitutions will be considered, subject to compliance with requirements of this section, under provisions of the Division 01 Section "Product Requirements."

2.2 MATERIALS

- A. Concrete Water Vapor Reducing Admixture (WVRA): A complex admixture for cementitious materials, free of volatile organic compounds (VOC), designed to naturally chemically react with pre-existing elements within the cementitious material to eliminate the route of moisture vapor emission by integrally and permanently closing the capillary system in the concrete with the following characteristics:

Waterproofing: Minimum 1×10^{-8} cm/s in accordance with ASTM D5084.

Toxicity: None.

Flammability: None.

Solvent: Water.

Acid Resistance: Excellent.

Hazardous Vapors: None.

Capillary Break: Calcium Silicate Hydrate.

Installation: All cementitious materials.

VOC Levels: Zero (0).

Inhibit mold and bacteria growth by eliminating moisture vapor emission.

2.3 RELATED MATERIALS

- A. Sheet Vapor Retarder: ASTM E1745, Class A, except with a permeance of less than 0.01 perms. Minimum thickness of material equal to 15 mils. Include manufacturer's recommended adhesive or pressure-sensitive tape.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with requirements of Division 03 Section "Cast-In-Place Concrete" for concrete mixing, placement, and curing.

- B. Sheet Vapor Retarders for Slabs on Grade: Place, protect, and repair sheet vapor retarder under provisions of ASTM E1643 and manufacturer's written instructions.
- C. Add water vapor reducing admixture to concrete in accordance with supplier's written instructions.
- D. Obtain approval of the WVRA supplier for the mix design. WVRA supplier will provide specific testing and warranty information in accordance with application requirements.
- E. Notify WVRA supplier a minimum of 10 days prior to the placement of the first batch of treated concrete.
- F. Dispense WVRA in compliance with mix design and supplier's recommendations.
- G. The use of other admixtures with WVRA in the same concrete batch is acceptable when included in the approved mix design.

3.2 CURING

- A. Curing is typically not necessary for WVRA treated slabs except in hot, cold, rainy or windy conditions. Cure finished concrete by placing 2-mil thick polyethylene plastic on top of the concrete slab. Consult with manufacturer for additional recommendations in accordance with application requirements.

3.3 FIELD QUALITY CONTROL

- A. Testing: Retain a qualified testing agency to perform tests and to submit reports.
- B. Concrete Tests:
 - 1. Maintain four (4) inch concrete cylinders for a minimum of one (1) year from date of Substantial Completion.
 - 2. Test cylinders as required by warranty or in accordance with supplier's recommendations.
 - 3. Test cylinders to demonstrate that the minimum waterproofing is 1×10^{-8} cm/s in accordance with ASTM D5084.
 - 4. Frequency: Test one (1) cylinder per project with the cost borne by the admixture supplier.
 - 5. Report test results in writing to Architect, WVRA supplier, and Contractor within 48 hours of testing. Test reports shall contain project name and number, date of WVRA application, name of testing agency, location of concrete batch in Work, concrete mix proportions and materials, and waterproofing capability.
 - 6. Additional Tests: Testing agency shall make additional tests of concrete when test results indicate that water vapor reducing admixture capability requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders or by other methods as directed by Architect.
 - 7. Additional testing, at Contractor's expense, will be performed to determine compliance of

replaced or additional work with specified requirements.

8. Correct deficiencies in the Work that test reports indicate do not comply with the Contract Documents.

3.4 REPAIRS

- A. Repair concrete slabs in accordance with other Division 03 sections and as recommended in manufacturer's written instructions.

****END OF SECTION****

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Slabs-on-grade.
3. Waterstops.
4. Concrete curing process and procedures.
5. Curing compounds, sealers and hardeners.
6. Under-slab vapor barriers.

- B. Related Sections:

1. Division 03 Section "Concrete Water Vapor Reducing Admixture (WVRA)" for water vapor reducing admixtures to concrete slabs-on-grade.
2. Division 07 Section "Building Insulation" for underslab insulation.
3. Division 09 Sections for requirements relating specified floor coverings to finishing and curing of interior concrete floor slabs.
4. Division 31 Section "Backfill" for course graded granular sub-base and fine graded granular capillary break or blotter course under slabs-on-grade.
5. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Action Submittals: Mandatory submittals by the Sub-Contractor which require action on the part of the General Contractor, Construction Manager and Design Professional.

1. General Contractor and Construction Manager: Review, Stamp and Forward to the Design Professional.
2. Design Professional: Review, Stamp and Return to the General Contractor or Construction Manager.

- B. Informational Submittals: Mandatory submittals by the Sub-Contractor to the General Contractor, Construction Manager and Design Professional which are not returned but kept by each for their project record.

- C. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Mix design submittal shall include:
 - a. Project name
 - b. Project component which pertains to submitted mix design
 - c. Admixtures
 - d. Historical break data from past projects on which the proposed mix was used
 - e. General Contractor or Construction Manager review stamp
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure and/or floor slabs.
 - 1. Location of construction joints is to be coordinated with control joint layout and is subject to approval of the Architect.
- E. Samples: For vapor barrier.

1.5 INFORMATIONAL SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Qualification Data: For Installer and noted manufacturers.
- C. Product Data: For each type of product indicated or proposed for use on the project.
- D. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
 - 4. Waterstops.
 - 5. Curing compounds.
 - 6. Floor and slab treatments.
 - 7. Bonding agents.
 - 8. Adhesives.
 - 9. Vapor barriers.
 - 10. Semi-rigid joint filler.
 - 11. Joint-filler strips.

- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Note: Prior to submittal of proposed mix designs, include aggregate supplier's service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity (AAR) or alkali silica reactivity (ASR).
- F. Minutes of pre-installation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Services
 - 1. The Construction Manager/Owner will secure and pay for the services of a qualified, independent materials engineer to perform quality assurance testing of concrete materials, to confirm re-bar placement, to verify compliance of materials with specified requirements, and to perform required field and laboratory testing. Testing Agency shall be acceptable to the architect and the owner and shall be licensed to practice in the state in which the project is located.
 - 2. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
 - 3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. CRSI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. MSP-1, "Manual of Standard Practice."
- G. Pre-installation Conference: Conduct conference at time and location specified by Construction Manager.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, vapor-barrier installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.8 PROJECT CONDITIONS

- A. Cold-Weather Concreting: Comply fully with the recommendations of ACI 306.
 1. Well in advance of proposed concreting operations, advise the architect of planned protective measures including but not limited to heating of materials, heated enclosures, and insulating blankets.
- B. Hot-Weather Concreting: Comply fully with the recommendations of ACI 306.
 1. Well in advance of proposed concreting operations, advise the architect of planned protective measures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Wire: ASTM A 82, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I, II or I/II. At contractor's option supplement with the following (only if historical mix design break data is available for submittal):
 - a. Fly Ash: ASTM C 618, Class C or F.

- b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- 2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded - typical except for architecturally exposed concrete. Provide Class 5S for architecturally exposed concrete. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Foundations: Nominal Maximum Aggregate Size: 1-1/2 inches.
 - 2. Floor Slabs on Grade: Nominal Maximum Aggregate Size: 1 inch.
 - 3. Topping Slabs: Nominal Maximum Aggregate Size: 3/8 inch.
- C. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Water Vapor Reducing Admixture (WVRA):
 - 1. Product: As specified in Division 03 Section "Concrete Water Vapor Reducing Admixture".

2.7 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, nominally sized 3/4 by 1 inch. Coordinate selected sizes with reinforcing bar cover requirements.
 - 1. Available Products:
 - a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
 - b. Concrete Sealants Inc.; Conseal CS-231.
 - c. Greenstreak; Swellstop.
 - d. Henry Company, Sealants Division; Hydro-Flex.
 - e. JP Specialties, Inc.; Earthshield Type 20.
 - f. Progress Unlimited, Inc.; Superstop.

- g. TCMiraDRI; Mirastop.

2.8 VAPOR BARRIERS

- A. Vapor Barrier must meet or exceed the following standards:
 - 1. ASTM E 1745, Class B or better.
 - 2. ASTM E 96 Water Vapor Transmission Rate: Less than or equal to 0.009 Grains/Ft.²/Hr.
- B. Available Products:
 - 1. "Stego Wrap 15 Mil. Vapor Barrier" by Stego Industries: (877) 464-7843
 - 2. "Vapor Block 15" by Raven Industries: (605) 336-2750
 - 3. "Perminator 15 Mil. Under-Slab Vapor Barrier" by W.R. Meadows: (800) 214-2100
 - 4. "Reflex 275" by Carlisle Coatings & Waterproofing: (800) 527-7092
- C. Accessories
 - 1. Manufacturer's recommended pressure-sensitive seam tape.
 - 2. Manufacturer's recommended vapor-proofing mastic.
 - 3. Manufacturer's recommended termination and seal appliances.
 - 4. Pipe Boots: Construct penetration seals from vapor barrier material, pressure-sensitive seam tape and/or mastic in accordance with the manufacturer's instructions.
- A. Granular Sub-Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; generally either an MDOT Class II sand or 21AA gravel will meet this requirement.
- B. Blotter Course or Capillary Break Course: Naturally or artificially graded mixture of natural or crushed sand; ASTM D 2940; generally an MDOT Class II sand.

2.9 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing 3/8-inch sieve, unless otherwise indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following-
 - a. Anti-Hydro International, Inc.; Emery.
 - b. Dayton Superior Corporation; Emery Non-Slip.
 - c. Emeri-Crete, Inc.; Emeri-Topcrete.
 - d. Lambert Corporation; EMAG-20.
 - e. L&M Construction Chemicals, Inc.; Grip It.
 - f. Metalcrete Industries; Metco Anti-Skid Aggregate.
- B. Penetrating Liquid Floor Treatment (noted on architectural drawings as Concrete Hardener and Sealer): Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Products: Subject to compliance with requirements, provide one of the following-

- a. Burke by Edoco; Titan Hard.
- b. ChemMasters; Chemisil Plus.
- c. ChemTec International; ChemTec One.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
- e. Curecrete Distribution Inc.; Ashford Formula.
- f. Dayton Superior Corporation; Day-Chem Sure Hard.
- g. Euclid Chemical Company (The); Euco Diamond Hard.
- h. Kaufman Products, Inc.; SureHard.
- i. L&M Construction Chemicals, Inc.; Seal Hard.
- j. Meadows, W. R., Inc.; Liqui-Hard.
- k. Metalcrete Industries; Floorsaver.
- l. Nox-Crete Products Group, Kinsman Corporation; Duranox.
- m. Symons Corporation, a Dayton Superior Company; Buff Hard.
- n. US Mix Products Company; US Spec Industraseal.
- o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS.

2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products: Subject to compliance with requirements, provide one of the following-
 - a. Axim Concrete Technologies; Cimfilm.
 - b. Burke by Edoco; BurkeFilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film.
 - f. Euclid Chemical Company (The); Eucobar.
 - g. Kaufman Products, Inc.; Vapor Aid.
 - h. Lambert Corporation; Lambco Skin.
 - i. L&M Construction Chemicals, Inc.; E-Con.
 - j. MBT Protection and Repair, Div. of ChemRex; Confilm.
 - k. Meadows, W. R., Inc.; Sealtight Evapre.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
 - n. Sika Corporation, Inc.; SikaFilm.
 - o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
 - p. Unitex; Pro-Film.
 - q. US Mix Products Company; US Spec Monofilm ER.
 - r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Clean and Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, non-dissipating.

1. Products: Subject to compliance with requirements, provide one of the following-
 - a. Anti-Hydro International, Inc.; AH Clear Cure WB.
 - b. Burke by Edoco; Spartan Cote WB II.
 - c. ChemMasters; Safe-Cure & Seal 20.
 - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Cure and Seal WB.
 - e. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - f. Euclid Chemical Company (The); Aqua Cure VOX.
 - g. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
 - h. Lambert Corporation; Glazecote Sealer-20.
 - i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - j. Meadows, W. R., Inc.; Vocomp-20.
 - k. Metalcrete Industries; Metcure.
 - l. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 150E.
 - m. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
 - n. Tamms Industries, Inc.; Clearseal WB 150.
 - o. Unitex; Hydro Seal.
 - p. US Mix Products Company; US Spec Hydrasheen 15 percent
 - q. Vexcon Chemicals, Inc.; Starseal 309.

2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.12 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

- A. Review: Do not begin concrete operations until proposed mix has been reviewed by architect.
- B. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- C. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- D. Mix design submittal shall include:
1. Project name
 2. Project component which pertains to submitted mix design
 3. Admixtures
 4. Historical break data from past projects on which the proposed mix was used
 5. General Contractor or Construction Manager review stamp
- E. Cementitious Materials: Do not use Fly Ash or Ground Granulated Blast-Furnace Slag in exposed concrete mix designs. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 25 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 25 percent portland cement minimum, with fly ash or pozzolan not exceeding 20 percent.
- F. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- G. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing or high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F.

4. Use air-entraining admixture in exterior exposed concrete.
5. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Minimum cement content – 470 # /cy, Maximum W/C 0.55
3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

B. Slabs-on-Grade (Interior): Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Minimum cement content – 517 # /cy, Maximum W/C 0.50
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
5. Provide Water Vapor Reducing Admixture: Vapor Lock 20/20

C. Topping slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum cement content – 564 # /cy, Maximum W/C 0.45
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent
5. Provide Water Vapor Reducing Admixture: Vapor Lock 20/20

D. Exterior Exposed Concrete: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum cement content – 564 # /cy, Maximum W/C 0.45
3. Slump Limit: 4 inches.
4. Air Content: 6 percent, plus or minus 1.0 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

E. Mix Adjustments: Provided that no additional expense to owner is involved, contractor may submit for architect's review requests for adjustment to approved concrete mixes when circumstances such as changed project conditions, weather, or unfavorable test results occur. Include laboratory test data substantiating specified properties with mix adjustment requests.

2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2.17 CONCRETE FORM TOPPING

- A. Examination and Verification:
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
 - 2. Examine subfloor surfaces for conditions affecting the work. Coordinate observation with requirements of finish floor materials specified as part of the work.
 - 3. Determine size, location and depth of height of area to receive floor topping materials.

2.18 SUBSTRATE PREPARATION

- A. Prepare substrates to receive manufactured floor topping compounds in accordance with manufacturer's product data submitted to and approved by Architect. Top surface of substrate must be sufficiently roughened to assure a fully bonded topping.
- B. Clean substrates of adhesives oil, grease, loose or foreign materials and substrates which would impair bond.
- C. Prior to installing any topping materials, temporary dams to prevent concrete topping migrating through floors or onto adjacent construction.

2.19 FLOOR TOPPING APPLICATION

- A. Existing concrete: Apply epoxy bonding adhesive, mixed according to manufacturer's written instructions, and scrub into dry base slabs to a thickness of 1/16 to 1/8 inch (1.6 to 3mm), without puddling. Place floor topping while adhesive is still tacky.
- B. Place concrete floor topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop without pour strip.
 - 1. Screed surface with a straightedge and strike off to correct elevations.
 - 2. Slope surfaces uniformly where indicated.
 - 3. Begin initial floating using bull floats to form a uniform and open textured surface place free of humps or hollows.

- C. Finishing: Consolidate surface with power driven floats as soon as concrete floor topping can support equipment and operator. Restraighten, cut down high spots and fill low spots. Repeat float passes and restraightening until concrete floor topping has a uniform, smooth granular texture.
 - 1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate concrete floor topping by power driven trowel without allowing blisters to develop. Continue troweling passes and restraighten until surface is smooth and uniform in texture.
 - 2. Finish and measure surface so gap at any point between surface and an unleveled freestanding 10 foot (3----) long straightenedge, resting on 2 high spots and placed anywhere on the surface, does not exceed ¼ inch (6mm).
- D. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of concrete floor topping, at locations indicated or as approved by Architect.
- E. Control Joints: Form weakened plane control joints with power saws equipped with shatterproof abrasive or diamond rimmed blades. Cut 1/8 inch (3 mm) wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random control cracks develop at locations indicated or as approved by Architect.
 - 1. Construct control joints with a depth of ¼" in topping slab for a combined depth equal to topping thickness and not less than one-fourth of base slab thickness.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR BARRIERS

- A. Vapor Barriers: Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Place vapor barrier sheeting with the longest dimension parallel with the direction of the concrete pour.
 - 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate barrier at the top of the slab, otherwise:
 - a. At a point acceptable to the architect or:
 - b. Where obstructed by impediments such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier.

3. At the point of termination, seal vapor barrier to the foundation wall, grade beam of slab.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Provide all manufacturer's recommended appliances and accessories necessary to achieve appropriate seals and terminations.
6. Apply seam tape to a clean and dry vapor barrier.
7. Seal all penetrations using site constructed boots, mastic, pressure-sensitive tape, etc.
8. Avoid the use of non-permanent stakes driven through vapor barrier.
9. If non-permanent stakes are driven through vapor barrier, repair as recommended by vapor barrier manufacturer.
10. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile strengths.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Interrupt placement sequence as needed for practical or logistical placement. Install construction joints such that strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. If not indicated, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction (Control) Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. General: Install and locate joints in concrete slabs according to concrete institute standards and where indicated in the Drawings.
 - a. Drawing locations are schematic.
 - b. Review and coordinate exact locations with the Architect and proposed joints in finish materials.
 2. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 3. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- 3.7 WATERSTOPS
- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable. Maintain minimum concrete cover requirements.
- 3.8 CONCRETE PLACEMENT
- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect as part of the original mix design review process.

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- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - a. Monitor floor structure deflection during placement and supply concrete in sufficient quantity necessary to achieve specified floor elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING - GENERAL

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING - FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbed. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
 - 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings or mortar setting beds for ceramic or quarry tile, portland cement terrazzo or other bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to entrance slabs and similar surfaces. Apply according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
 - 2. After broadcasting and tamping, apply float finish.
 - 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTING AND CURING - GENERAL

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs on temporary formwork, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.

- c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.13 CONCRETE PROTECTING AND CURING – INTERIOR FLOORS AND SLABS

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1 by:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for three to seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

3.14 LIQUID FLOOR TREATMENTS (CONCRETE HARDENER AND SEALER)

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than seven days' old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
 4. Install concrete hardener and sealer at all exposed floor surfaces where floors do not receive other finished material.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least six month(s) or as long as possible given the project schedule. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

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1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through un-reinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Construction Manager/Owner will engage a special inspector and/or a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Verification of use of required design mixture.
3. Sides of excavations for earth-formed concrete.
 - a. All sides of earth formed foundations must be within 1/2 inch of vertical from the bottom of footing excavation to the proposed top of footing.
 - b. Any foundation excavations which do not meet this tolerance shall be rejected and reconstructed using conventional formwork.
 - c. Testing Agency inspector shall be present for all foundations constructed using the earth-formed method.
 - d. Inspector shall be responsible for confirming the acceptability of the excavation

- and given the authority to reject non-conforming work.
- e. Inspection reports shall accurately indicate all locations for which foundations have been constructed utilizing the earth-formed method.
4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 9. Test results and Inspection Reports shall be reported in writing to Architect, concrete supplier / manufacturer, Contractor, and Authorities having jurisdiction within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting

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agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

****END OF SECTION****

UNIT MASONRY

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. Concrete masonry units.
2. Removed existing brick.
3. Mortar and grout.
4. Masonry-joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.

C. Related Requirements:

1. Division 05 Section "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Division 05 Section "Metal Fabrications" for furnishing loose steel lintels for installation in unit masonry openings
3. Division 07 Section "Firestop Joint Systems" for head-of-wall joints.
4. Division 08 Section "Standard Steel Doors and Frames" for hollow metal frames in unit masonry openings.
5. Division 09 Section "Painting" for field-applied sealer at all exposed concrete masonry units.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).

1.4 QUALITY ASSURANCE

A. Testing Agency Services

1. The Construction Manager/Owner will secure and pay for the services of a qualified, independent materials engineer to perform quality assurance testing of mortar and grout materials, to confirm re-bar and anchorage placement, to verify compliance of materials with specified requirements, to observe and document compliance with hot and cold weather construction methods, and to perform required field and laboratory testing. Testing Agency shall be acceptable to the architect and the owner and shall be licensed to practice in the state in which the project is located.

B. Masonry Inspection Requirements:

1. Testing Frequency for Non-Essential Facilities - Level B Quality Assurance:
 - a. Assurance level to be in accordance with Table 4 of the **MSJC** Specification for Masonry Structures.
 - b. Frequency level for Category I, II or III buildings to be in accordance with Table 1704.5.1 Level 1 Special Inspections of the Michigan Building Code.
2. For this project, the testing and inspecting agency will be hired by the Owner or the Owner's representative.
3. Contractor may retain a qualified consultant to review procedures and construction methods to comply with this specification, industry standards and construction codes.

C. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

D. Masonry Standard: Comply with the **MSJC** Code unless modified by requirements in the Contract Documents.

E. Single source responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

F. Single source responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.5 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths (f'm) at 28 days.

B. Determine net-area compressive strength (f'm) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in Section 1.4 of the MSJC Code. Provide f'm for concrete masonry construction according to the following:

Use	Compressive Strength, f'm (psi)	Unit Strength (psi)	Grout Strength (psi)	Mortar Type
Typical, unless noted otherwise	20000 min.	2800 min.	2000 min.	M or S

1.6 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements.
- B. Shop Drawings: For the following:
 - 1. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Each type of masonry unit required.
 - a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
 - b. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.
 - 2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
 - 3. For each combination of masonry unit type and mortar type, include a written statement identifying the following:
 - a. Net-area compressive strength of masonry units.
 - b. Mortar type.
 - c. Net-area compressive strength of the completed masonry system determined according to Tables 1 and 2 in Section 1.4 of the **MSJC Code**.
 - 4. Each combination of masonry unit type and mortar type specified to be manufactured with integral water repellent.
 - 5. Each material and grade indicated for reinforcing bars.
 - 6. Each type and size of joint reinforcement.
 - 7. Each type and size of anchor, tie, and metal accessory.

- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports from past projects which were performed in accordance with ASTM C 780, for mortar mixes intended for this project required to comply with property specification.
 - 2. Include test reports from past projects which were performed in accordance with ASTM C 1019, for grout mixes intended for this project required to comply with compressive strength requirement.
 - D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in Section 1.4 of the **MSJC Code**.
 - E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
 - F. Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with hot-weather requirements.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver masonry materials to project in undamaged condition.
 - B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.
 - 1. Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.
 - C. Store cementitious materials off the ground, under cover and in dry location.
 - D. Store aggregates where grading and other required characteristics can be maintained.
 - E. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.
- 1.9 PROJECT CONDITIONS
- A. Protection of work: During erection, cover top of walls with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.
 - B. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - C. Do not apply uniform floor or roof loading for at least 3 days after building masonry walls or columns.
 - D. Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.
 - E. Protect base of walls from rain-splashed mud and mortar splatter by means of covering spread on ground and over wall surfaces.

- F. Protect sills, ledges and projections from droppings of mortar.

1.10 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at time and location specified by Construction Manager.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. General: Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide bullnose units for outside corners unless otherwise indicated on drawing and below.
 - a. Stop bullnose at bulkhead/soffits.
 - b. Provide square corners at door frame even with block and bullnose where door frame is set back from corner.
 - c. Provide square corners where gypsum board partitions and/or soffits are intended to be flush with concrete masonry.

- B. Concrete block: Provide units complying with characteristics indicated below for Grade, Type, face size, exposed face and, under each form of block included, for weight classification.

1. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
 - a. Regular (Standard) Concrete Masonry Units using standard aggregate:
 - 1) Manufacturers: Subject to compliance with requirements provide products from one of the following:
 - a) Best Block Company
 - b) Fendt Builder's Supply, Inc.
 - c) National Block Company
 - d) Grand Blanc Cement Products

2. Grade N.
 - a. Grade N except Grade S may be used above grade in exterior walls with weather protective coatings and in walls not exposed to weather.
3. Size: Manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual) x thicknesses indicated.
4. Hollow Load bearing or Non-load bearing Block: ASTM C 90 and as follows:
 - a. Unit Compressive Strength: Provide units with minimum average net-area compressive strength specified under the Performance Requirements of Article 1.4.B above.

- b. Exterior Walls: Normal or Medium weight – Cavity/Veneer Walls Only
 - c. Exterior Walls: Normal weight – Singly Wythe Walls
 - d. Interior Load or Non-Load Bearing Walls: Lightweight or Medium weight.
5. Solid Load bearing or Non-load bearing Block: ASTM C 145 and as follows:
- a. Unit Compressive Strength: Provide units with minimum average net-area compressive strength specified under the article "Performance Requirements" above.
 - b. Exterior Walls: Normal or Medium weight – Cavity/Veneer Walls Only
 - c. Exterior Walls: Normal weight – Singly Wythe Walls
 - d. Interior Load or Non-Load Bearing Walls: Lightweight or Medium weight.

2.2 REMOVED EXISTING BRICK

- A. General: Provide whole, undamaged bricks prepared for reinstallation in new masonry work as described elsewhere in this Section.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.
- B. Masonry Cement: ASTM C 91.
 - 1. For colored pigmented mortar use premixed colored masonry cements of formulation required to produce color(s) indicated. Subject to compliance with requirements provide products of Solomon Grind-Chem Services, Inc.
 - a. Color: Architect shall select up to two (2) colors from manufacturer's standards.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.
- E. Aggregate for Grout: ASTM C 404.
- F. Water: Clean and potable.

2.4 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

- A. Materials: Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:
 - 1. Hot-Dip Galvanized Steel Wire: ASTM A 82 for uncoated wire and with ASTM A 153, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.
- B. Joint Reinforcement: Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10', with prefabricated corner and tee units, and complying with requirements indicated below:

1. Width: Fabricate joint reinforcement in units with widths of approximately 2" less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.
 2. Wire Size for Side Rods: 0.1483" diameter.
 3. Wire Size for Cross Rods: 0.1483" diameter.
 4. For single-wythe masonry provide type as follows with single pair of side rods:
 - a. Ladder design with perpendicular cross rods spaced not more than 16" o.c.
 5. For multi-wythe masonry provide type as follows:
 - a. Ladder design with perpendicular cross spaced not more than 16" o.c., unless otherwise indicated on Drawings, and number of side rods as follows: One side rod for each face shell of concrete masonry back-up and one rod for brick wythe.
 - b. Number of side rods for Composite Construction: One side rod for each face shell of concrete masonry back-up and one rod for Decorative CMU wythe.
 - c. Use units with adjustable 2-piece rectangular ties where horizontal joints of facing wythe do not align with those of back-up.
 - 1) Products: Subject to compliance with requirements, provide the following:
 - a) "Series 800 Hook and Eye"; Wire Bond.
 - b) "AA525" Adjustable Econo-Eye-Lok", AA Wire Products.
 - c) "Ladur-Eye"; Dur-O-Wal, Inc.
 - d) "Lox-All Adjustable Eye-Wire"; Hohman & Barnard, Inc.
- C. Flexible Anchors: Where flexible anchors are indicated for connecting masonry to structural framework, provide 2-piece anchors as described below which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall.
1. For anchorage to steel framework provide manufacturer's standard anchors which fasten thru exterior sheathing and extent thru rigid insulation.
 - a. Wire Size: 0.1875" diameter.
 - b. Products: Subject to compliance with requirements, provide the following:
 - 1) "HCL-911", Wire-Bond as distributed by Masonpro. Phone No. 800-659-4731
 - 2) RAP-TIE, Fero Corporation as distributed by Masonpro Phone No. 800-659-4731
 2. Joint Stabilizing Anchors: Single-piece assembly with sliding rods held in receiver which allows vertical and horizontal movement but resists tension and compression forces perpendicular to plane of wall.
 - a. Receiver Section: Fabricated with stainless steel 1/32 inch sheet steel sleeves, one side embedded in masonry, the other connected to the steel frame with self tapping screws for full capacity of the anchor assembly.
 - b. Tie Section: Two 8 gauge stainless wires encased in plastic sleeves held in the receiver section.
 - 1) Dur-O-Wal # D/A 2200 or approved equal.

- D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel.
 2. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel.
- E. Masonry Veneer Anchors (Interior use only): Not less than 22 gauge and not less than 7/8 inch wide and 7 inches long, with one end crimped for attachment to substrate. Size shall extend within 3/4" of face of masonry veneer.
- F. Galvanized steel channel slot anchors for anchoring new masonry to existing.
1. Provide Heckmann No. 133/133-P continuous channel and mounting plate, with standard triangular type wire tie.
- G. Rigid Anchors: Provide straps of form and length indicated, fabricated from metal strips 1-1/2 inches wide x 1/4 inch thick (12 inches long) unless other sizes indicated.
- H. Un-coated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- I. Intersecting Wall Anchors
1. Exterior Walls and Interior Bearing Walls: Fabricate steel bars as follows:
 - a. 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.
 - b. Finish: Hot-dip galvanized to comply with ASTM A 153.
 - c. Lay-up in alternate courses between adjacent intersection walls which are not interlocked or at control joint locations.
 2. Interior Non-Bearing Walls and Interior Partitions:
 3. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

2.5 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch (0.40 mm) thick.
 2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
 3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
 4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.

5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing **1/2 inch (13 mm)** out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least **3 inches (76 mm)** into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
7. Fabricate metal drip edges from stainless steel. Extend at least **3 inches (76 mm)** into wall and **1/2 inch (13 mm)** out from wall, with outer edge bent down 30 degrees and hemmed.
8. Fabricate metal expansion-joint strips from stainless steel copper to shapes indicated.
9. Solder metal items at corners.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than **0.030 inch (0.76 mm)**.
 - a. Manufacturers:
 - 1) Grace Construction Products
 - 2) W.R. Meadows, Inc.
 - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing or flexible flashing with a metal drip edge.
4. Where flashing is fully concealed, use flexible flashing.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. Termination Bars for Flexible Flashing: Stainless-steel sheet **0.019 inch by 1-1/2 inches (0.48 mm by 38 mm)** with a **3/8 inch (10-mm)** sealant flange at top.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Control Joint Strips: Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D 1056, Grade RE41E1, capable of compression up to 35%, of width and thickness indicated.

- B. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- C. Steel Column Isolation Material: 1/2 inch thickness asphalt impregnated fiberboard.

2.7 MASONRY CLEANERS

- A. Job-mixed Detergent Solution: Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.
 - 1. Available Products: Subject to compliance with requirements, a product which may be used to clean unit masonry surfaces includes, but is not limited to, the following:
 - a. "Sure Klean" No. 600 Detergent; ProSoCo, Inc.

2.8 MORTAR AND GROUT MIXES

- A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.
 - 1. Water-Repellent Admixture: Provide at all mortar joints in concrete masonry exposed to the exterior.
- B. Mixing: Combine and thoroughly mix cementitious, water and aggregate in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.
- C. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- D. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specifications, for types of mortar required, unless otherwise indicated.
 - 1. Limit cementitious materials in mortar to Portland cement-lime.
 - 2. Use Type M mortar for masonry below grade and in contact with earth, and where indicated.
 - 3. Use Type M or S mortar for reinforced masonry and where indicated.
 - 4. For interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 5. For veneers, use Type N. Coordinate with other architectural requirements specified herein for veneer mortars.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 7 of the MSJC Code for dimensions of grout spaces and pour height. Fine grout shall not be used unless absolutely necessary to comply with Table 7.
 - 2. Proportion grout in accordance with ASTM C 476, Paragraph 4.2.2 for specified 28-day compressive strength indicated by Article 1.4.B Performance Requirements of this specification, but not less than 2000 psi.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Wetting Clay Brick: Wet brick made from clay or shale that have ASTM C 67 initial rates of absorption (suction) of more than 30 grams per 30 sq. in. per minute. Use wetting methods which ensure each clay masonry unit being nearly saturated but surface dry when laid.
- E. Do not wet concrete masonry units.
- F. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- G. Thickness: Build composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.
- H. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

- I. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
- J. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.
- K. Use dry cutting saws to cut concrete masonry units.
- L. Matching Existing Masonry Work: Match coursing, bonding, color and texture of new masonry work with existing work. Tooth masonry infill into existing masonry coursing.
- M. Bond Break: Provide a continuous bond breaker strip in all mortar joints between clay masonry and concrete masonry.
- N. Sealer: Apply two (2) coats of sealer complying with requirements in Division 9 Section "Painting" at the following locations:
 - 1. At exposed interior Regular (Standard) Concrete Masonry Units that are not scheduled to be otherwise painted, where indicated on Drawings.

3.3 CONSTRUCTION TOLERANCES

- A. Variation From Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.
- B. Variation From Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.
- C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
- D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".
- E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.4 LAYING MASONRY WALLS:

- A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
- B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

- C. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.
- D. Grind miter internal corner to match intersection of bullnose.
- E. Stopping and Resuming Work: Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.
- F. Built-in Work: As the work progresses, build-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.
 - 1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 - 2. Column Wrap: Wrap steel columns with corrugated, asphalt impregnated, cardboard prior to grouting or building into masonry surrounds.
 - 3. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
 - 4. Fill cores in hollow concrete masonry units with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.
- G. Masonry walls indicated to extend to the roof deck shall terminate 1" below the underside of the deck and resulting space shall be filled with a firestop joint assembly suitable for permanent placement and complying with Division 07 Section "Firestop Joint Systems". Unless otherwise noted or detailed provide a 4 x 4 x 12 gauge x 8" long angle at 5'-0" (+ or -) o.c. at each face of wall.
 - 1. Where run of wall is parallel to deck flutes, provide a supplemental 12 gauge plate to link both opposing angles. Width of plate and angles shall be 8".
 - 2. Where run of wall is perpendicular to the deck flutes, the supplemental plate can be omitted and length of angle sized to bridge two flutes. Secure assembly to metal deck with two #12 tech screws per side. Do not weld.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay solid brick size masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
- B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.
- D. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.
- E. Tool exposed joints slightly concave for brick and slightly concave for block including scored joint using a jointer larger than joint thickness, unless otherwise indicated.

- F. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

- 1. Wet joint surfaces thoroughly before applying mortar.

3.6 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together using one of the following methods:

- 1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

- a. Where bed joints of both wythes align, use tab-type reinforcement.
 - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.

- 2. Header Bonding: Provide masonry unit headers extending not less than **3 inches (76 mm)** into each wythe. Space headers not more than **8 inches (203 mm)** clear horizontally and **16 inches (406 mm)** clear vertically.

- B. Bond wythes of composite masonry together using bonding system indicated on Drawings.

- C. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

- D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.

- 1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.

- E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

- 1. Provide individual metal ties not more than **8 inches (203 mm)** o.c.

- 2. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.

- 3. Provide rigid metal anchors not more than **24 inches (610 mm)** o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.7 HORIZONTAL JOINT REINFORCEMENT

- A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls, 1/2" elsewhere. Lap reinforcing a minimum of 6".

- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

- C. Reinforce walls with continuous horizontal joint reinforcing unless specifically noted to be omitted.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
1. Provide an open space not less than **1 inch (25 mm)** wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than **24 inches (610 mm)** o.c. vertically and **36 inches (915 mm)** o.c. horizontally.

3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joints in unit masonry where indicated in Drawings but not spaced more than 20'-0" apart. Build-in related items as masonry progresses. Do not form a continuous span through movement joints. Verify control joint locations with Architect.
- B. Form control joints in concrete masonry as follows using one of the following methods:
1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 4. Location and spacing of control joints shall comply with industry standards.
 5. Interrupt joint reinforcing each side of joint.
- C. Form expansion joints in brick as follows:
1. Build flanges of factory-fabricated, expansion-joint units into masonry.
 2. Form open joint of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."
- B. Build in horizontal, pressure-relieving joints where required and indicated; construct joints by either leaving an air space or inserting a compressible filler of width required."
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.10 LINTELS

- A. Provide steel lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels.
- B. Refer to Division 05 Section "Metal Fabrications" for additional information.
- C. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.
- D. One end of lintel shall remain un-connected to allow for movement. The choice of which end to remain free is arbitrary, but if possible, it end should be located adjacent to the nearest control joint.

3.11 FLASHING OF MASONRY WORK

- A. General: Provide concealed flashing in masonry work at, or above, shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar. Extend flashings through exterior face of masonry and turn down to form drip. Do not allow any penetrations in flashing.
- B. Extend flashing the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills turn up ends not less than 2" to form a pan/end dam.
- C. Fabricate through-wall metal flashings embedded in masonry with ribs formed in sawtooth pattern at 3-inch intervals along length of flashing to provide a 3-way integral mortar bond and weep hole drainage as indicated.
- D. Interlock end joints of deformed metal flashings by over-lapping deformations not less than 1-1/2" and seal lap with elastic sealant.
- E. Install flashing to comply with manufacturer's instructions.
- F. Provide weep holes as specified.
 - 1. Install reglets and nailers for flashing and other related work where shown to be built into masonry work.

3.12 EXISTING BRICK REMOVAL AND REINSTALLATION

- A. Carefully remove existing brick veneer for reuse from areas indicated on the Drawings. Remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units. Toothing out existing brick veneer to be removed from existing brick veneer to remain.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.
- D. Remove in an undamaged condition as many whole bricks as possible.
 - 1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
 - 2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
 - 3. Store brick for reuse. Store off ground, on skids, and protected from weather.
- E. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick reinstallation.
- F. Install removed brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.

3.13 FIELD QUALITY CONTROL

- A. Inspectors: Construction Manager/Owner will engage a qualified, independent agency to perform field inspections and prepare inspection reports.
- B. Testing: Construction Manager/Owner will engage a qualified, independent agency to perform field tests indicated below and prepare test reports.
- C. Quality Assurance Level and Frequency:
 1. Testing Frequency for Non-Essential Facilities - Level B Quality Assurance:
 - a. Assurance level to be in accordance with Table 4 of the MSJC Specification for Masonry Structures.
 - b. Frequency level for Category I, II or III buildings to be in accordance with Table 1704.5.1 Level 1 Special Inspections of the Michigan Building Code.
 - c. Note: The MSJC and Michigan Building Codes require inspectors to observe all grouting operations continuously. Communication with inspector is the contractor's responsibility. Grouting shall not proceed until the inspector is onsite and has made the required pre-grouting observations.
 - d. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - e. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, locations and position of reinforcement.
- D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.
- E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- F. Mortar Test (Property Specification): For each mix provided, per ASTM C 780.
- G. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
- H. Testing agency will report results of tests and inspections promptly, in detail and in writing to Contractor, Architect and authorities having jurisdiction.
- I. Remove and replace work that does not comply with specified requirements.
- J. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
 - 7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Structural steel.
2. Grout.
3. Shop and Field Welding.
4. Shop installation of Shear Connectors.
5. Galvanizing.
6. Prime Painting.

- B. Related Sections include the following:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 05 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.
- B. Action Submittals: Mandatory submittals by the Sub-Contractor which require action on the part of the General Contractor, Construction Manager and Design Professional.
 1. General Contractor and Construction Manager: Review, Stamp and Forward to the Design Professional.
 2. Design Professional: Review, Stamp and Return to the General Contractor or Construction Manager.
- C. Informational Submittals: Mandatory submittals by the Sub-Contractor to the General Contractor, Construction Manager and Design Professional which are not returned but kept by each for their project record.

1.4 SYSTEM DESCRIPTION

- A. General: Unless otherwise specifically approved in writing, furnish exact sections, weights, and kinds of material specified, using details and dimensions shown.

1. Not all connections are detailed; similar details apply to similar conditions, unless otherwise indicated. Contact the architect promptly to verify design of members or connections in any situation where design requirements are unclear.
2. Substitution of other shapes of equivalent or greater strength and no greater dimension may be allowed by the architect, but only under normal substitution procedures.

1.5 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by the structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 1. Select and complete connections using schematic details indicated and AISC 360.
 2. Use ASD; data are given at service-load level.
 3. Design composite floor beams for 75% of the uniform load carrying capacity published in table in the AISC Code or the reaction indicated on the framing plans, whichever is greater. No connection shall have a capacity less than 6000 pounds.
 4. Design roof beams for 50% of the uniform load carrying capacity published in table in the AISC Code or the reaction indicated on the framing plans, whichever is greater. No connection shall have a capacity less than 6000 pounds.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: Combined system of braced frame and shear walls.

1.6 ACTION SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Shop Drawings: Show fabrication of structural-steel components.
 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.

1.7 INFORMATIONAL SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data: For each type of product indicated.
- C. Welding certificates.
- D. Qualification Data: For Installer and Fabricator.

- E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- F. Mill test reports for structural steel, including chemical and physical properties.
- G. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
 - 5. Shop primers.
 - 6. Non-shrink grout.
- H. Source quality-control test reports.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator who meets the intent of the AISC Quality Certification Program and submits a signed letter of intent indicating compliance with the provisions for an AISC-Certified Plant, Category STD.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Pre-installation Conference: Conduct conference at time and location specified by Construction Manager.
- F. Testing and Inspection Agency: The Owner will engage an independent testing and inspection agency to perform testing, inspect and evaluate connections, and prepare test reports.
 - 1. Only American Welding Society (AWS) Certified Welding Inspectors shall inspect and evaluate welds.
 - 2. Correct deficiencies in the structural steel work identified by the testing and inspection agency at no additional expense to the Owner. Subsequent tests to confirm the adequacy of the corrected work will be at the contractor's expense.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or

overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M or ASTM A 572/A 572M, Grade 50.
- B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50.
- C. Plate and Bar: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: Standard; Extra strong or Double-extra strong as indicated.
 - 2. Finish: Black, except where indicated to be galvanized.
- F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
 - a. Finish: Plain.

- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type.
 - a. Finish: Plain.
- C. Slip Critical Bolted Connections: Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex or round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Un-headed Anchor Rods: ASTM F 1554, Grade 36 or ASTM F 1554, Grade 55, weldable as indicated.
 - 1. Configuration: Hooked typically; Straight as indicated.
 - 2. Nuts: ASTM A 563 heavy hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel. Coordinate requirements with ANSI/AISC 360.J9 and AISC Manual of Steel Construction Table 14-2.
 - 4. Washers: ASTM F 436 hardened carbon steel.
 - 5. Finish: Plain.
- F. Headed Anchor Rods: ASTM F 1554, Grade 36 or ASTM F 1554, Grade 55, weldable, straight.
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel. Coordinate requirements with ANSI/AISC 360.J9 and AISC Manual of Steel Construction Table 14-2.
 - 3. Washers: ASTM F 436 hardened carbon steel.
 - 4. Finish: Plain or Hot-dip zinc coating, ASTM A 153/A 153M, Class C as indicated.
- G. Threaded Rods: ASTM A 36/A 36M typically or A 572/A 572M, Grade 50 as indicated.
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Washers: ASTM A 36/A 36M carbon steel.
 - 3. Finish: Plain.

2.3 PRIMER

- A. Primer: SSPC-Paint 25, Type II, iron oxide, zinc oxide, raw linseed oil, and alkyd.
- B. Primer: SSPC-Paint 23, latex primer.
- C. Galvanize miscellaneous framing and supports where exposed to the elements such as the Building Exterior as well as interior locations which are humid or corrosive.
- D. Galvanizing Repair Paint: MPI#18, MPI#19, SSPC-Paint 20 or ASTM A 780.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless noted Pre-tensioned or Slip critical on the Drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials.
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 1. SSPC-SP 3, "Power Tool Cleaning."
 - a. Typical except for "Architecturally Exposed Structural Steel."
 2. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - a. Required for "Architecturally Exposed Structural Steel."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels, and exposed plates, angles, tubes, shelf angles and rolled shapes attached to structural-steel frame and/or located in exterior walls.

2.9 SOURCE QUALITY CONTROL

- A. Construction Manager/Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at the Testing Agency's option:
 - 1. Inspect 100 percent of full penetration welds, using one of the following test methods:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
 - 2. Inspect 25 percent of fillet welds, using one of the following test methods:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- E. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate. Coordinate requirements with ANSI/AISC 360.J9 and AISC Manual of Steel Construction Table 14-2.
 - 3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless noted Pre-tensioned or Slip critical on the Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Construction Manager/Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at Testing Agency's option:
 - 2. Inspect 100 percent of full penetration welds, using one of the following test methods:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
 - 3. Inspect 25 percent of fillet welds, using one of the following test methods:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
- F. Test results and Inspection Reports shall be reported in writing to Architect, Contractor, and Authorities having jurisdiction within 48 hours of testing.

3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

COLD-FORMED DELEGATED

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes cold-formed steel wall, floor, and roof framing, and accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. Welding certificates.
- C. Product Test Reports: For each listed product, for tests performed
 - 1. Expansion anchors.
 - 2. Power-actuated anchors.
 - 3. Mechanical fasteners.

1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code – Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code – Sheet Steel."
- B. Comply with AISI S230 "Standard for Cold-Formed Steel Framing – Prescriptive Method for One and Two Family Dwellings."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads indicated on the drawings and within limits and under conditions indicated.
 - 1. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.
 - b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

2. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch.

B. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 COLD-FORMED STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges. G60.

C. Exterior Non-Load Bearing Studs

1. Minimum FY: 33,000psi
2. Minimum Base Metal Thickness: .0598 inches
3. Flange Width: 1-5/8 inches.

D. Interior Non-Load Bearing Studs

1. Minimum FY: 33,000psi
2. Minimum Base Metal Thickness: .0329 inches
3. Flange Width: 1-5/8 inches.

E. Soffits

1. Minimum FY: 33,000psi
2. Minimum Base Metal Thickness: .0329 inches
3. Flange Width: 1-5/8 inches.

F. Track

1. Minimum FY: 33,000psi
2. Minimum Base Metal Thickness: .00329 inches
3. Flange Width: 1-1/4 inches.

G. Vertical Deflection Clips – Head clip providing vertical movement, up or down.

H. Deflection Track- Head track clip providing vertical movement, up or down.

I. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight not less than that of connected member

2.3 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplemental framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

- B. Anchor Bolts: ASTM F 1554, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.5 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, 4ortland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, $\frac{1}{4}$ inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.6 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion..
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet.
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 07 "Building Insulation," in built-up exterior framing members as indicated on Drawings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- K. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends. Maximum anchor spacing: 24".
- L. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Maximum stud spacing: 16".
- M. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- N. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- O. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

- P. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- Q. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- R. Install horizontal bridging in stud system, spaced vertically 60 inches max and additionally as required by code or engineering. Fasten at each stud intersection.
- S. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- T. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

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- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

****END OF SECTION****

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.2 SUMMARY

- A. This section includes the following metal fabrications:
 - 1. Rough hardware.
 - 2. Loose bearing and leveling plates.
 - 3. Loose steel lintels.
 - 4. Miscellaneous framing and supports for the following:
 - a. Applications where framing and supports are not specified in other sections.
 - 5. Steel pipe railings.
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
 - 2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
 - 3. Section 051200 "Structural Steel Framing."

1.3 DEFINITIONS

- A. Definitions in ASTM E 985 for railing-related terms apply to this section.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Structural Performance of Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on testing performed in accordance with ASTM E 894 and E 935.
- B. Structural Performance: Design, engineer, fabricate, and install the following metal fabrications to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each metal fabrication.
 - 1. Handrail and Guardrail Assemblies: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbs. applied at any point nonconcurrently, vertically downward, or horizontally.

- b. Uniform load of 50 lbs. per linear ft. applied vertically and horizontally.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
2. Components of Handrail and Guardrail Assemblies: Capable of withstanding a horizontal concentrated load of 50 lbf applied to one sq. ft. at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.
- a. Above load need not be assumed to act concurrently with uniform horizontal loads on top rails of railing systems in determining stress on guard.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Paint products.
 - 2. Grout.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firms experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Installer Qualifications: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.
- C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel", and D1.2 "Structural Welding Code - Aluminum."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- D. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrications similar in material, design, and extent to that indicated for this Project.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

1.8 SEQUENCING AND SCHEDULING

A. Sequence and coordinate installation of wall handrails as follows:

1. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.
2. For handrail mounting conditions on gypsum wallboard assemblies, mount handrails only after assembly has been prepared with in-wall reinforcing to receive anchors, and where the location of concealed anchor plates has been clearly marked for benefit of Installer.

PART 2 - PRODUCTS

2.1 FERROUS METALS

- A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
- B. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Steel Bars for Gratings: ASTM A 569 or ASTM A 36.
- D. Steel Tubing: Product type (manufacturing method) and as follows:
1. Cold-Formed Steel Tubing: ASTM A 500, grade as indicated below:
 - a. Grade A, unless otherwise indicated or required for design loading.
 - b. Grade B, unless otherwise indicated or required for design loading.
 2. Hot-Formed Steel Tubing: ASTM A 501.
 - a. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A 53.
- E. Uncoated Structural Steel Sheet: Product type (manufacturing method), quality, and grade, as follows:
1. Cold-Rolled Structural Steel Sheet: ASTM A 611, grade as follows:
 - a. Grade A, unless otherwise indicated or required by design loading.
 2. Hot-Rolled Structural Steel Sheet: ASTM A 570, grade as follows:
 - a. Grade 30, unless otherwise indicated or required by design loading.
- F. Uncoated Steel Sheet: Commercial quality, product type (method of manufacture) as follows:

1. Cold-Rolled Steel Sheet: ASTM A 366.
 2. Hot-Rolled Steel Sheet: ASTM A 569.
- G. Galvanized Steel Sheet: Quality as follows:
1. Structural Quality: ASTM A 446; Grade A, unless another grade required for design loading, and G90 coating designation unless otherwise indicated.
 2. Commercial Quality: ASTM A 526, G90 coating designation unless otherwise indicated.
- H. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
1. Black finish, unless otherwise indicated.
 2. Galvanized finish for exterior installations and where indicated.
 3. Type F, standard weight (schedule 40), unless otherwise indicated, or another weight, type, and grade required by structural loads.
 4. Type S, Grade A, standard weight (schedule 40), unless otherwise indicated, or another grade or weight or both required by structural loads.
 5. Type S, Grade B, standard weight (schedule 40), unless otherwise indicated, or another weight required by structural loads.
 6. Schedule 80 Weight for railings and handrails, unless otherwise indicated or another weight is required by structural loads.
- I. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- J. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.
- K. Welding Rods and Bare Electrodes: Select in accordance with AWS
- 2.2 GROUT AND ANCHORING CEMENT
- A. Nonshrink Metallic Grout: Premixed, factory-packaged, ferrous aggregate grout complying with CE CRD-C 621, specifically recommended by manufacturer for heavy duty loading applications of type specified in this section.
 - B. Nonshrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C 621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.
 - C. Interior Anchoring Cement: Factory-prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.
 - D. Erosion-Resistant Anchoring Cement: Factory-prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating and is recommended for exterior use by manufacturer.

- E. Products: Subject to compliance with requirements, provide one of the following:
1. Nonshrink Nonmetallic Grouts:
 - a. "Bonsal Construction Grout," W.R. Bonsal Co.
 - b. "Diamond-Crete Grout," Concrete Service Materials Co.
 - c. "Euco N-S Grout," Euclid Chemical Co.
 - d. "Kemset," Chem-Masters Corp.
 - e. "Crystex," L & M Construction Chemicals, Inc.
 - f. "Masterflow 713," Master Builders.
 - g. "Sealtight 588 Grout," W.R. Meadows, Inc.
 - h. "SonogROUT," Sonneborn Building Products Div., Rexnord Chemical Products, Inc.
 - i. "Stoncrete NM1," Stonhard, Inc.
 - j. "Five Star Grout," U.S. Grout Corp.
 - k. "Vibropruf #11," Lambert Corp.
 2. Interior Anchoring Cement:
 - a. "Bonsal Anchor Cement," W.R. Bonsal Co.
 - b. "Por-Rok," Minwax Construction Products Division.
 3. Erosion-Resistant Anchoring Cement:
 - a. "Super Por-Rok"; Minwax Construction Products Division.

2.3 FASTENERS

- A. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.
- C. Lag Bolts: Square head type, FS FF-B-561.
- D. Machine Screws: Cadmium plated steel, FS FF-S-92.
- E. Wood Screws: Flat head carbon steel, FS FF-S-111.
- F. Plain Washers: Round, carbon steel, FS FF-W-92.
- G. Drilled-In Expansion Anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion, [nondrilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF-B-575, Grade 5.
- H. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class, and style as required.

- I. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

2.4 PAINT

- A. Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of FS TT-P-664D.
- B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint-20.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.
- D. Zinc Chromate Primer: FS TT-P-645.

2.5 CONCRETE FILL AND REINFORCING MATERIALS

- A. Concrete Materials and Properties: Comply with requirements of Division 3 section "Concrete Work" for normal weight, ready-mix concrete with minimum 28-day compressive strength of 2,500 psi, 440 lb. cement per cu. ft. minimum, and W/C ratio of 0.65 maximum, unless higher strengths indicated.
- B. Nonslip Aggregate Finish: Factory-graded, packaged material containing fused aluminum oxide grits or crushed emery as abrasive aggregate; rust-proof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
- C. Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.

2.6 FABRICATION, GENERAL

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 100 deg F (55.5 deg C).
- D. Shear and punch metals cleanly and accurately. Remove burrs.
- E. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- F. Remove sharp or rough areas on exposed traffic surfaces.

- G. Weld corners and seams continuously to comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- J. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- K. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.
- L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.7 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.
- B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required.

2.9 LOOSE STEEL LINTELS

- A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Weld adjoining members together to form a single unit unless otherwise indicated.

- C. Size loose lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing at each side of openings, unless otherwise indicated.
1. Loose lintels for 8" walls where indicated or required, and not included with structural steel, shall be as follows:
 - a. Openings up to 4'-0": Two angles 4" x 3-1/2" x 5/16" L.L.V.
 - b. Openings 4'-1" to 5'-4": Two angles 5" x 3-1/2" x 5/16" L.L.V.
 - c. Openings 5'-4" to 8'-0": One beam W8x18 plus 3/8" thick plate; 1/2" narrower than up to 12" thick wall.
 - d. Openings 8'-0" to 12'-4": One beam W8x28 plus 3/8" thick plate; 1/2" narrower than up to 12" thick wall.
 2. Loose lintels for 12" walls where indicated or required, and not included with structural steel, shall be as follows:
 - a. Openings up to 4'-0": Three angles 4" x 3-1/2" x 5/16" L.L.V.
 - b. Openings 4'-1" to 5'-4": Three angles 5" x 3-1/2" x 5/16" L.L.V.
 - c. Openings 5'-4" to 8'-0": One beam W8x18 plus 3/8" thick plate; 1/2" narrower than up to 12" thick wall.
 - d. Openings 8'-0" to 12'-4": One beam W8x28 plus 3/8" thick plate; 1/2" narrower than up to 12" thick wall.
- D. All double angle lintels shall be welded back to back with a minimum 2 inch stitch every 8 inches.
- E. Unless otherwise noted, provide angle 5" x 3"-1/2" x 5/16" L.L.V. lintel for each 4" of masonry for spans of up to 5'-0" max.
- F. Galvanize all loose steel lintels located in exterior walls.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.
1. Metal shapes, and assemblies indicated on the Architectural Drawings and not specified in other sections of the specifications or not indicated on the Structural Drawings, and framing supporting other components of the construction shall be provided in accordance with the provisions of this section and STRUCTURAL STEEL Section.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

2. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide x 1/4 inch x 8 inches long.

C. Frames fabricated from structural steel shapes:

1. Provide structural steel frames for door openings, exterior wall supports, ceiling hung toilet partition supports, frames around curbs, pits and other openings in floors and walls and at slab edges as indicated.
2. Construction frames to sizes indicated, of steel channels, bent plates, steel angles, steel plate or combinations of shapes as detailed. Frames shall be accurately squared, mitered, butted or coped as necessary and shall be full welded with all welds on exposed surfaces ground smooth. Concealed clip angles shall be welded or flush-riveted to the bottom of steel jamb members and provided with two (2) 1/2" diameter floor bolts for each clip angle. Provide sill members and slab edge angles where indicated.
3. Provide steel strap anchors of sizes and spacing indicated, welded to back of frames for anchoring into masonry, concrete or to steel as necessary. Where size and spacing of anchors are not shown, use 1/4" x 2" x 8" straps turned 2". Space anchors not more than 16" apart.
4. Provide spreaders between the bottom of steel jamb members and elsewhere as necessary. Remove spreaders after frames are properly set and securely anchored.

D. Roof Openings:

1. Where not otherwise shown, provide steel framing for roof openings.
2. Support steel framing by extending to primary framing or purlins as required for support at both ends as acceptable to Architect.
3. Size steel framing not less than the following for spans indicated:
 - a. Up to 5'-0", Channel C3 x 4.1.
 - b. Up to 7'-0", Channel C5 x 6.8.
 - c. Up to 10'-0", Channel C6 x 8.2.

E. Galvanize miscellaneous framing and supports in the following locations:

1. Exterior locations.
2. Interior locations where indicated.

2.11 STEEL PIPE RAILINGS AND HANDRAILS

- A. General: Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.
- B. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

1. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.
- C. Form changes in direction of railing members as follows:
1. By insertion of prefabricated elbow fittings.
 2. By radius bends of radius indicated.
 3. By mitering at elbow bends.
 4. By bending.
 5. By any method indicated above, applicable to change of direction involved.
- D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- E. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- F. Close exposed ends of pipe by welding 3/16-inch thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.
- G. Toe Boards: Where indicated, provide toe boards at railings around openings and at the edge of open-sided floors and platforms. Fabricate to dimensions and details indicated, or if not indicated, use 4 inches high x 1/8 inch steel plate welded to, and centered between, each railing post.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.
1. For railing posts set in concrete fabricate sleeves from steel pipe not less than 6 inches long and with an inside diameter not less than 1/2 inch greater than the outside diameter of post, with steel plate closure welded to bottom of sleeve.
 - a. Provide friction fit, removable covers designed to keep sleeves clean and hold top edge of sleeve 1/2 inch below finished surface of concrete.
 2. For removable railing posts, fabricate slip-fit sockets from steel pipe whose inside diameter is sized for a close fit with posts and to limit deflection of post without lateral load, measured at top, to not more than 1/12 of post height. Provide socket covers designed and fabricated to resist accidental dislodgement.
- I. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.
- J. For exterior steel railings and handrails formed from steel pipe with galvanized finish, galvanize fittings, brackets, fasteners, sleeves, and other ferrous components.

- K. For interior steel railings and handrails formed from steel pipe with galvanized finish, galvanize fittings, brackets, fasteners, sleeves, and other ferrous components.
- L. For interior steel railings formed from steel pipe with black finish, provide nongalvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.12 FINISHES, GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process compliance with the following requirements:
 - 1. ASTM A 153 for galvanizing iron and steel hardware.
 - 2. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.
 - 1. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include

threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint or zinc chromate primer.

3.3 SETTING LOOSE PLATES

- A. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
- B. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
 - 1. Use metallic nonshrink grout in concealed locations where not exposed to moisture; use nonmetallic nonshrink grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLATION OF STEEL PIPE RAILINGS AND HANDRAILS

- A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:

1. Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
 2. Anchor posts in concrete by core drilling holes not less than 5 inches deep and 3/4 inch greater than outside diameter of post. Clean holes of all loose material, insert posts and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
 - a. Nonshrink, nonmetallic grout.
 - b. Nonshrink, nonmetallic grout or anchoring cement.
 - c. Cover anchorage joint with a round steel flange attached to post as follows:
 - 1) Welded to post after placement of anchoring material.
 - 2) By set screws.
 - d. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch build-up, sloped away from post. For installations exposed on exterior, or to flow of water, seal anchoring material to comply with grout manufacturer's directions.
 3. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.
 4. Anchor rail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with lead expansion shields and bolts.
 5. Anchor rail ends to steel with steel oval or round flanges welded to rail ends and bolted to structural steel members, unless otherwise indicated.
 6. Install removable railing sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.
- B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated, or if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:
1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 2. Use type of bracket with pre-drilled hole for exposed bolt anchorage.
 3. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
 4. For hollow masonry anchorage, use toggle bolts having square heads.
 5. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with stud installations for accurate location of backing members.

6. For steel framed gypsum board assemblies, fasten brackets directly to steel framing or concealed anchors using self-tapping screws of size and type required to support structural loads.

C. Expansion Joints: Provide expansion joints at locations indicated, or if not indicated, at intervals not to exceed 40 feet. Provide slip joint with internal sleeve extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches of post.

3.5 ADJUSTING AND CLEANING

A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 Section "Painting" of these specifications.

C. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY:

- A. Types of work in this section include rough carpentry for the following:
 - 1. Wood grounds, nailers and blocking
 - 2. Fiber reinforced gypsum board sheathing
 - 3. Framing with dimension lumber.
 - 4. Framing with engineered wood products.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 06 Section "Interior Architectural Woodwork" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS:

- A. Rough carpentry includes carpentry work not specified in other sections and not exposed to view, except as otherwise indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Power-driven fasteners.

3. Powder-actuated fasteners.
4. Expansion anchors.
5. Metal framing anchors.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels, provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.
- B. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

1.7 PROJECT CONDITIONS:

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Wood Preservative-Treated materials:
 - a. Baxter: J.H. Baxter Co.
 - b. Chemical Specialties, Inc.
 - c. Continental Wood Preservers, Inc.
 - d. Hickson Corp.
 - e. Hoover Treated Wood Products, Inc.
 - f. Osmose Wood Preserving, Inc.
 2. Fiber Reinforced Gypsum Board Sheathing: Provide one of the following product types:
 - a. Glass-Fiber-Surfaced Gypsum Sheathing Board:
 - 1) Georgia-Pacific Corp., "Dens-Glass Gold"
 - 2) United States Gypsum Co., "USG Securock Brand UltraLight Glass-Mat Sheathing."
 - b. Glass-Fiber-Embedded Gypsum Sheathing Board:
 - 1) BPB America Inc., "GlasRoc Brand Sheathing"

2.2 LUMBER, GENERAL:

- A. Lumber Standards: Manufacture lumber to comply with DOC PS 20 "American Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection Agencies: Inspection agencies and the abbreviations to reference them, include the following:
 - 1. NELMA - Northeastern Lumber Manufacturers Association
 - 2. RIS - Redwood Inspection Service.
 - 3. SPIB - Southern Pine Inspection Bureau.
 - 4. WCLIB - West Coast Lumber Inspection Bureau.
 - 5. WWPA - Western Wood Products Association.
 - 6. APA - American Plywood Association.
- C. Grade Stamps: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
 - 1. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.
 - 2. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by the inspection agency.
- D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
- E. Plywood Standards: Comply with PS1 "U.S. Product standard for Construction and Industrial Plywood" for plywood construction panels and, for products not manufactured under PS1 provision, with APA PRP-108. Furnish panels factory marked with APA trademarks evidencing compliance with grade requirements.

2.3 MISCELLANEOUS LUMBER:

- A. Provide wood for support or attachment of other work including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown, or as required, and as follows:
- B. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- C. Grade: Standard Grade light framing size lumber of any species or board size lumber as required. No. 3 Common or Standard grade boards per WCLIB or WWPA rules or No. 3 boards per SPIB rules.

2.4 FIBER REINFORCED GYPSUM BOARD SHEATHING

A. Glass-Fiber-Surfaced Gypsum Sheathing Board: Gypsum sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material, surfaced on face and back with glass fiber mats with alkali-resistant coating, and with unsurfaced square edges; complying with ASTM C 1177 and requirements indicated below:

1. Type: Type X.
2. Thickness: 5/8 inch.
3. Size: 4 feet by 8 feet.

B. Glass-Fiber-Embedded Gypsum Sheathing Board: Paperless gypsum sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material and fully embedded glass fiber mats covered with an acrylic coating; unsurfaced square edges; complying with ASTM C 1177 and requirements indicated below:

1. Type: Type X.
2. Thickness: 5/8 inch.
3. Size: 4 feet by 8 feet.

C. Cellulose-Fiber-Embedded Gypsum Sheathing Board: Paperless gypsum sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material and fully embedded cellulose fiber; built-in water drainage channels embossed on the panel backs; unsurfaced square edges; complying with ASTM C 1177 and requirements indicated below:

1. Type: Type X.
2. Thickness: 5/8 inch.
3. Size: 4 feet by 8 feet.

2.5 MISCELLANEOUS MATERIALS:

A. Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

1. Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

2.6 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS:

A. General: Where lumber or plywood is indicated as preservative- treated wood or is specified herein to be treated, comply with applicable requirements of AWPAs Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.

1. Do not use chemicals containing chromium or arsenic.

- B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19% and 15%. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
- C. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.7 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
 - 1. Grade: Select Structural
 - 2. Grade: No.1
 - 3. Grade: No. 2
 - 4. Grade: Construction or No. 2
 - 5. Grade: Construction, Stud, or No.3
 - 6. Species:
 - a. Douglas fir-larch; WCLIB or WWPA
 - b. Hem-fir; WCLIB or WWPA
 - c. Southern Pine; SPIB
 - d. Douglas fir south; WWPA
 - e. Any species above

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL:

- A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.
- B. Set carpentry work to required levels and lines, with members plumb and true and accurately cut and fitted.
- C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.
- D. Countersink nail heads on exposed carpentry work and fill holes.
- E. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed

to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required.

- F. Apply field treatment complying with AWPA M4 to cut surfaces of preservative treated lumber and plywood.

3.2 FIBER REINFORCED GYPSUM BOARD SHEATHING

- A. Examine subframing; verify that surface of framing and furring members to receive sheathing does not vary more than 1/4" from the place of faces of adjacent members.
- B. Install sheathing in accordance with manufacturer's instructions and applicable instructions in GA-253 and ASTM C 1280.
 - 1. Use maximum lengths possible to minimize number of joints.
- C. Attach sheathing to metal framing with screws spaced 8" o.c. at perimeter where there are framing supports; and 8" o.c. along intermediate framing in field.
 - 1. Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.
 - 2. Locate fasteners minimum 3/8" from edges and ends of sheathing panels.

3.3 WOOD GROUNDS, NAILERS, BLOCKING AND SLEEPERS:

- A. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to form work before concrete placement.
- C. Provide permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

3.4 WOOD FURRING:

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

3.5 WOOD FRAMING, GENERAL:

- A. Provide framing members of sizes and on spacings shown, and frame openings as shown, or if not shown, comply with recommendations of "Manual for House Framing" of National Forest Products Association (N.F.P.A.). Do not splice structural members between supports.

END OF SECTION

BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

1.4 JOB CONDITIONS

- A. Substrate: Proceed with dampproofing work section only after substrate construction and penetrating work have been completed.
- B. Weather: Proceed with dampproofing work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer's recommendations.
- C. Ventilation: Provide adequate ventilation to prevent accumulation of hazardous fumes during application of solvent-based components in enclosed spaces, and maintain ventilation until coatings have thoroughly cured.

PART 2 - PRODUCTS

2.1 COLD APPLIED ASPHALT CUT-BACK DAMPPROOFING

- A. Asphalt Compound: Manufacturer's standard asphalt and solvent compound, recommended for dry below-grade exterior and for above-grade interior applications, compounded to penetrate substrate and build to moisture-resistant, vapor-resistant, firm, elastic coating.
- B. Provide heavy fibrated type mastic non-asbestos compound, complying with FS SS-C-153, Type 1, except containing nonasbestos, inorganic fibrous reinforcement materials.
 - 1. Provide non-fibrated type liquid, compound, complying with FS SS-A-694 or FS SS-A-701, depending upon viscosity required, except containing only non-asbestos, inorganic filler materials.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Celotex Corporation.
 - 2. Certainteed Corporation.

3. Flintkote/Genstar Building Products Company.
4. Koppers Company, Inc.
5. Manville Building Products Corp.
6. Sonneborne Bldg. Products/Rexnord Chemical Products Inc.
7. Tremco Company.

2.3 COLD-APPLIED ASPHALT EMULSION DAMPPROOFING

- A. Asphalt Emulsion: Manufacturer's standard asphalt and water emulsion, recommended for below-grade exterior and for above-grade interior applications to either damp (green) or dry substrates, compounded to penetrate substrate and build to moisture-resistant but breathing type of firm, elastic coating.
 1. Provide non-fibrated type liquid asbestos-free emulsion; ASTM D 1227 Type III or ASTM D 1187 Type B, depending upon application.

2.4 MISCELLANEOUS MATERIALS

- A. General: If specific manufacturers of miscellaneous damp-proofing materials are not indicated below, provide materials acceptable to manufacturer(s) of primary dampproofing materials (bitumens).
- B. Bituminous Grout: ASTM D 147.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Except as otherwise indicated, and whether or not shown on drawings, apply dampproofing to all exterior below-grade surfaces of exterior underground walls in contact with earthwork or other backfill, in any situation where space of any kind is enclosed on opposite side.
- B. Extend vertical dampproofing down walls 12" maximum or as indicated on drawing.
- C. Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.
- D. Mask or otherwise protect adjoining work to prevent spillage or migration of dampproofing materials onto other surfaces of work. Do not allow dampproofing materials to enter drains or conductors.
- E. Install 2 x 2 cant strip of bituminous grout at base of vertical dampproofing where it meets horizontal surface.
- F. Fill voids, seal joints, and apply bond breakers (if any) as recommended by prime materials manufacturer, with particular attention at construction joints.
- G. Install separate flashings and corner protection stripping as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and manufacturer's recommendations. Give particular attention to requirements at building expansion joints, if any.

- 3.2 APPLY DAMPPROOFING COMPOUND to comply with manufacturer's recommendations for minimum rate of application and minimum uniform dry film thickness.

END OF SECTION

BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings And General Provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of Insulation Work is shown on drawings and indicated by provisions of this section.
- B. Applications of Insulation Specified in this section include the following:
 - 1. Blanket-type building insulation.
- C. Related Sections: The following Sections contain requirements that relate to this section:
 - 1. Division 07 Section "EPDM Single-Ply Membrane Roofing" for roof insulation specified as part of roofing construction:
 - 2. Division 09 Section "Gypsum Wallboard Assemblies" for sound attenuation insulation installed as part of metal-framed wall and partition assemblies.

1.3 QUALITY ASSURANCE:

- A. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by r-values they represent the rate of heat flow through a homogeneous material exactly 1" thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.
- B. Fire Performance characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Surface Burning Characteristics: ASTM E 84.
 - 2. Fire Resistance Ratings: ASTM E 119.
- C. Maximum Allowable Asbestos Content Of Inorganic Insulations: Provide insulations composed of mineral fibers or mineral cores which contain less than 0.25% by weight of asbestos of any type or mixture of types occurring naturally as impurities as determined by polarized light microscopy test per Appendix A of 40 CFR 763.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

PART 2 – PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Guardian Building Products, Inc.
 - 3. Johns Manville.
 - 4. Knauf Insulation.
 - 5. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.2 AUXILIARY INSULATING MATERIALS:

- A. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer, and complying with requirements for fire performance characteristics.
- B. Mechanical Anchors: Type and size indicated or, if not indicated as recommended by insulation manufacturer for type of application and condition of substrate.
- C. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION IN CEILINGS FOR THERMAL INSULATION

- A. Where glass-fiber blankets are indicated for thermal insulation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 4 inches (102 mm) up either side of partitions.

3.4 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

POLYMER-BASED DIRECT APPLIED FINISH SYSTEM (DEFS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes the following:
1. Direct applied finish system (DEFS) applied over glass-fiber-surfaced gypsum board for exterior and interior applications.
 - a. Locations: Soffits and as indicated on Drawings.
 - b. Locations: Shower ceilings and as indicated on Drawings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 06 Section "Rough Carpentry" for glass-fiber-surfaced gypsum board sheathing substrates.

1.3 DEFINITIONS

- A. Interior/exterior finish system that consists of an integrally reinforced weather-resistant base coat and a weather-resistant textured protective finish coat applied to a substrate of either cement board or glass-fiber-surfaced gypsum board.

1.4 PERFORMANCE REQUIREMENTS

- A. DEFS Performance: Comply with the following:
1. Bond Integrity: Free from bond failure within DEFS components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
 2. Weathertightness: Resistant to water penetration from exterior into DEFS and assemblies behind it or through them into interior of building that results in deterioration or degradation of DEFS and assemblies behind it, including substrates, supporting wall construction, and interior finish.
- B. DEFS Physical Properties: Provide DEFS having physical properties and structural performance that comply with the following:
1. Accelerated Weathering Characteristics: Showing no cracking, checking, crazing, erosion, blistering, peeling, or delamination after testing for 2000 hours when viewed under five times magnification per the following:
 - a. Either ASTM G 23, Method 1 or ASTM G 53.

2. Freeze-Thaw: No surface changes, cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination, or indications of delamination between components when viewed under 5 times magnification after 10 cycles per ICC-ES AC219.
3. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch clean glass substrate, cured for 28 days, and showing no growth when tested per ASTM D 3273 and evaluated according to ASTM D 3274.
4. Adhesion: No failure in the DEFS, adhesive, base coat, or finish coat when tested per ASTM C 297.
5. Water Resistance: Showing no cracking, checking, crazing, erosion, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.
6. Impact Resistance: Sample consisting of 1-inch- thick DEFS when constructed, conditioned, and tested per EIMA 101.86; and meeting or exceeding the following:
 - a. High Impact Resistance: 90 to 150 inch-lb.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type and component of DEFS indicated.
- B. Samples for Initial Selection: For each type of finish-coat color and texture indicated.
 - a. Include similar Samples of joint sealants and exposed accessories involving color selection.
- C. Samples for Verification: 24-inch- (600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including a typical control joint filled with sealant of color selected.
 1. Include sealants and exposed accessory Samples to verify color selected.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator/erector, and testing agency.
- B. Manufacturer Certificates: Signed by manufacturers certifying that DEFS and joint sealants comply with requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each reinforcing mesh, joint sealant, and coating.
- D. Compatibility and Adhesion Test Reports: For joint sealants from sealant manufacturer indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For DEFS to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is certified in writing by DEFS manufacturer as qualified to install manufacturer's system using trained workers.
 - 1. Assign installation of polymer-based direct applied finish system (DEFS), polymer-based exterior insulation and finish system (EIFS, and water-drainage exterior insulation and finish system (EIFS) in Project to a single qualified installer.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain materials for system from one source and by a single manufacturer or by manufacturers approved by DEFS manufacturer as compatible with other system components.
- E. Fire-Test-Response Characteristics: Provide DEFS assemblies and components with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame Spread of Insulation Board and Finish Coats: 25 or less when tested individually per ASTM E 84.
 - 2. Smoke Developed of Insulation Board and Finish Coats: 450 or less when tested individually per ASTM E 84.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened packages with manufacturer's labels intact and clearly identifying products.
- B. Store materials inside and under cover; keep them dry and protected from the weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install system when ambient outdoor air and substrate temperatures are 40°F (4.4°C) and falling unless temporary protection and heat are provided to maintain ambient temperatures above 40°F (4.4°C) during installation of wet materials and until they have dried thoroughly and become weather resistant, but for at least 24 hours after installation.
- B. Field Measurements: Verify actual dimensions required for prefabricated panels by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating panels without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.11 COORDINATION AND SCHEDULING

- A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.
- B. Coordinate installation of Finish System with related Work specified in other Sections to ensure that wall assemblies, including sheathing, flashing, trim, joint sealers, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind Finish System.

1.12 WARRANTY

- A. General Warranty: Warranties specified in this article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Finish System shall be guaranteed against defects in materials and workmanship for a period of five (5) years from the date of substantial completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for DEFS finished gypsum board soffits is based on Sto Corp.; Sto Quik Gold Finish System for Soffits. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Dryvit Systems, Inc.
 - 2. Synergy

2.2 MATERIALS

- A. Compatibility: Provide substrates, reinforcing meshes, base- and finish-coat materials, sealants, and accessories that are compatible with one another and approved for use by DEFS manufacturer for Project.
- B. Colors, Textures, and Patterns of Finish Coat: Comply with the following requirements:
 - 1. Provide Architect's selections from system manufacturer's full range of colors, textures, and patterns for type of finish coat indicated.
- C. Primer-Sealer: DEFS manufacturer's standard substrate conditioner designed to seal substrates from moisture penetration and to improve the bond between substrate of type indicated and adhesive used for application of insulation.
- D. Reinforcing Mesh: Balanced, alkali-resistant, open-weave glass-fiber mesh treated for compatibility with other DEFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) per EIMA 105.01, complying with ASTM D 578 and the following requirements for minimum weight:
 - 1. Standard Reinforcing Mesh: Not less than 4.0 oz./sq. yd. (136 g/sq. m).
 - 2. Strip Reinforcing Mesh: Not less than 3.75 oz./sq. yd.

3. Detail Reinforcing Mesh: Not less than 4.0 oz./sq. yd.
 4. Corner Reinforcing Mesh: Not less than 6.25 oz./sq. yd.
- E. Base-Coat Materials: DEFS manufacturer's standard mixture complying with the following requirements for material composition and method of combining materials:
1. Job-mixed formulation of portland cement complying with ASTM C 150, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use indicated.
- F. Primer: DEFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.
- G. Finish-Coat Materials: DEFS manufacturer's standard mixture complying with the following requirements for material composition and method of combining materials:
1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
- H. Water: Potable.
- 2.3 Trim Accessories (Where Not Provided In Section 09 "Gypsum Wallboard Assemblies"): Type as designated or required to suit conditions indicated and to comply with DEFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D 1784, manufacturer's standard Cell Class for use intended, and ASTM C 1063.
1. Casing Bead: Prefabricated, one-piece type, of depth required to suit thickness of coating, with face leg perforated for bonding to coating and back leg.
 2. Expansion Joint: Prefabricated, one-piece V profile; designed to relieve stress of movement.
- 2.4 ELASTOMERIC SEALANTS
- A. Elastomeric Sealant Products: Provide DEFS manufacturer's listed and recommended chemically curing, elastomeric sealant that is compatible with joint fillers, joint substrates, and other related materials, and complies with requirements for products and testing indicated in ASTM C 1481 and with requirements in Division 07 Section "Joint Sealants" for products corresponding to description indicated below:
1. Single-component, nonsag, neutral-curing silicone sealant.
 2. Sealant with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
- B. Preformed Foam Sealant Products: Provide sealant compatible with adjacent materials and complying with requirements in Division 7 Section "Joint Sealants."
- C. Sealant Color: Comply with the following requirements:
1. Match finish-coat color of system.

2.5 MIXING

- A. General: Comply with DEFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by DEFS manufacturer. Mix materials in clean containers. Use materials within time period specified by DEFS manufacturer or discard.

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 DEFS.
- B. Examine soffit board application for compliance with the following:
 - 1. Glass-mat faced gypsum sheathing Georgia Pacific Publication #101514, or other requirements acceptable to DEFS manufacturer.
- C. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where DEFS will be installed.
- D. Repair weather damaged substrate and repair damaged or cracked surfaces, as required by DEFS Manufacturer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Begin coating application only after surfaces are dry.
 - 2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling caused by application of DEFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- B. Protect DEFS, substrates, and wall construction behind them from inclement weather during installation. Prevent infiltration of moisture behind DEFS and deterioration of substrates.
- C. Prepare and clean substrates to comply with DEFS manufacturers written requirements to obtain optimum bond between substrate and adhesive for insulation.
 - 1. Apply primer-sealer over substrates where required by system manufacturer for improving adhesion or for protecting substrates from degradation.

3.3 DEFS INSTALLATION, GENERAL

- A. Comply with DEFS manufacturer's written instructions for installation of DEFS as applicable to each type of substrate indicated.

3.4 SUBSTRATE PROTECTION APPLICATION

- A. Primer/Sealer: Apply over substrates to protect substrates from degradation and improving adhesion to substrate.

3.5 TRIM INSTALLATION (Where Not Provided In Section 09 "Gypsum Wallboard Assemblies")

- A. Trim: Apply trim accessories at perimeter of DEFS, at expansion joints, and elsewhere as indicated, according to DEFS manufacturer's written instructions.
1. Expansion Joint: Provide expansion joints in sheathing at minimum intervals of 30 feet up to a maximum area of 900 sq. ft., where the system abuts dissimilar construction or an existing joint occurs in construction.
 2. Casing Bead: Install appropriate casing bead accessories at system terminations. Maintain a minimum 1/4-inch gap between the accessory and the abutment to form a sealant joint, unless otherwise indicated.

3.6 BASE-COAT INSTALLATION

- A. Base Coat: Apply to exposed surfaces of soffit boards in minimum thickness recommended in writing by DEFS manufacturer, but not less than 1/16-inch dry-coat thickness.
- B. Reinforcing Mesh: Embed type indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 inches or otherwise treated at joints to comply with ASTM C 1397 and DEFS manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
1. Standard-impact reinforcing mesh.

3.7 FINISH-COAT INSTALLATION

- A. Primer: Apply over dry base coat according to DEFS manufacturer's written instructions.
- B. Finish Coat: Apply over dry primed base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by DEFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.
1. Texture: As selected by Architect from manufacturer's full range

3.8 INSTALLATION OF JOINT SEALANTS

- A. Prepare joints and apply sealants, of type and at locations indicated, to comply with applicable requirements in Division 07 Section "Joint Sealants" and in ASTM C 1481. Clean surfaces to receive sealants to comply with indicated requirements and system manufacturer's written instructions.
1. Apply joint sealants after base coat has cured but before applying finish coat.
 2. Clean surfaces to receive sealants to comply with indicated requirements and DEFS manufacturer's written instructions.
 3. Apply primer recommended in writing by sealant manufacturer for surfaces to be sealed.
 4. Install sealant backing to control depth and configuration of sealant joint and to prevent sealant from adhering to back of joint.

5. Apply masking tape to protect areas adjacent to sealant joints. Remove tape immediately after tooling joints, without disturbing joint seal.

3.9 CLEANING AND PROTECTING

- A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive system coatings.
- B. Provide final protection and maintain conditions, in a manner acceptable to Installer and system manufacturer that ensure system is without damage or deterioration at the time of Substantial Completion.

****END OF SECTION****

EPDM SINGLE-PLY MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of low-slope flexible sheet "LSFSR" roofing is indicated on drawings and is hereby defined to include non-traffic-bearing sheet membrane system intended for weather exposure as primary roofing. Similar membranes concealed by a wearing surface are excluded by definition.
- B. Types of roofing systems specified in this section utilizing flexible sheet roofing membranes include the following:
 - 1. Totally adhered systems.
- C. Flexible sheet roofing membranes include the following:
 - 1. Ethylene Propylene Diene Monomer (EPDM)
- D. Roof insulation related to flexible sheet roofing is specified in this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer: Obtain primary flexible sheet roofing from a single manufacturer. Provide secondary materials as recommended by manufacturer of primary materials.
- B. Installer: A firm with not less than 5 years of successful experience in installation of roofing systems similar to those required for this project and which is acceptable to or licensed by manufacturer of primary roofing materials.
- C. Pre-Roofing Conference: Prior to installation of roofing and associated work, conduct conference at time and location specified by General Contractor. Attendees shall include Installer, roofing manufacturer, installers of related work, and other entities concerned with roofing performance, including (where applicable) Owner's insurer, test agencies, governing authorities, Architect, and Owner. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours advance notice to participants prior to convening pre-roofing conference. Include periodic on site inspections by manufacturer to insure compliance with recommended installation procedures.
- D. UL Listing: Provide labeled materials which have been tested and listed by UL in "Building Materials Directory" for application indicated, with "Class A" rated materials/system for roof slopes shown.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
 - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Product Data: For the following products:
 - 1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. Roof insulation.
 - 3. Walkway pads or rolls.
 - 4. Termination bars.
 - 5. Battens.
 - 6. Insulation fasteners of each type, length, and finish.
 - 7. Roof cover fasteners of each type, length, and finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of complying with performance requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- D. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- E. Field quality-control reports.
- F. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For membrane roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at time and location specified by Construction Manager.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements for deck substrate conditions and finishes, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.

- G. Preinstallation Roofing Conference: Conduct conference at time and location specified by Construction Manager.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.

1.8 JOB CONDITIONS:

- A. Weather: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
1. Special warranty includes roofing membrane, base flashings, roofing accessories, roof insulation, fasteners, walkway products and other components of membrane roofing system.
 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Performance: Provide roofing materials recognized to be of generic type indicated and tested to show compliance with indicated performances, or provide other similar materials certified in writing by manufacturer to be equal or better than specified in every significant respect, and acceptable to Architect.
- B. Compatibility: Provide products which are recommended by manufacturers to be fully compatible with indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.

2.2 EPDM LSFSR MEMBRANE:

- A. Ethylene Propylene Diene Monomers formed into uniform, flexible sheets, complying with the following:
 1. Tensile Strength (ASTM D 412): 1400 psi.
 2. Ultimate Elongation (ASTM D 412): 300%.
 3. Brittleness Temperature (ASTM D 746): -75 deg.F (-59 deg.C).
 4. Tear Resistance (ASTM D 624): 125 lbs. per lin. inch.
 5. Resistance to Ozone Aging (ASTM D 1149): No cracks after 168 hours exposure of 50% elongated samples at 104 deg.F (40 deg.C) and 100 pphm ozone.
 6. Resistance to Heat Aging (ASTM D 573): Maximum reduction in elongation of 30% maximum loss of tensile strength of 15% (168 hours at 240 deg.F (116 deg.C).
 7. Thickness: 60 mils, nominal.
 8. Exposed Face Color: Manufacturer's standard color.
- B. Fully Adhered EPDM Membrane:
 1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products Co.
 - c. Johns Manville.
 - d. SIKA Sarnafil.

2.3 MISCELLANEOUS MATERIALS FOR LSF SR:

- A. Sheet Seaming System: Manufacturer's standard width, but minimum of 3", peal and stick seam tape for sealing lapped joints, including edge sealer to cover exposed spliced edges as recommended by manufacturer of LSF SR system.
- B. Membrane Field Seam Stripping: Pressure-sensitive seam flashing, Type recommended by seam manufacturer of LSF SR material against leakage.
- C. Cant Strips, Tapered Edge Strips and Flashing Accessories: Types recommended by manufacturer of LSF SR material, provided at locations indicated and at locations recommended by mfr., including adhesive tapes, flashing cements, and sealants.
- D. Slip Sheet: Type recommended by manufacturer of LSF SR material for protection of membrane from incompatible substrates.
- E. Membrane Adhesive: As recommended by LSF SR membrane manufacturer for particular substrate and project conditions, formulated to withstand min. 60 psf uplift force.
- F. Walkway: Rubber traffic pads as manufactured by Humane Equipment Co., Inc. or approved equal, for fully adhered roof area and "Lightweight Walkway Pavers" as manufactured by Hanover Architectural Products, Inc., or approved equal for ballasted roof areas (size 11-3/4" x 23-1/2" x 1-1/4"). Locate where indicated on drawings.

2.4 INSULATING MATERIALS:

- A. General: Provide insulating materials to comply with requirements indicated for materials and compliance with referenced standards; in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths and lengths.
- B. Polyisocyanurate Board Roof Insulation: Rigid, cellular thermal insulation with polyisocyanurate closed-cell foam core and manufacturer's standard facing laminated to both sides; complying with FS HH-I-1972/2, Class 1; aged R-values as designated at mean temperatures indicated, after conditioning per RIC/TIMA Bulletin #281-1; and as follows:
 - 1. Surface Burning Characteristics: Maximum flame spread of 25.
 - 2. Thermal Resistivity: R-value shall equal 20 for total roof system.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of **1/4 inch per 12 inches** unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 MISCELLANEOUS INSULATION MATERIALS:

- A. Insulation Adhesive: Cold fluid-applied, solvent-free, bituminous urethane adhesive formulated to adhere roof insulation to substrate.
 - 1. Fas-n-Free Adhesive by Tremco
 - a. Physical Properties:

- 1) Asbestos content: None EPA 600/R-93/116
 - 2) Viscosity @ 77 deg F: 70,000 cP (70Pa.s) ASTM D 2556-93a
 - 3) Density @ 77 deg F: 8.5 lb/gal (1016 g/L) ASTM D 1875-95
 - 4) Nonvolatile content: 98% ASTM D 1644-88
 - 5) Volatile organic content: <20 g/L ASTM D 3960-98
 - 6) Tensile strength @ 77 deg F: 200 psi (1379 kPa) ASTM D 412-92
 - 7) Elongation @ 77 deg F: 1200% ASTM D 412-98a
 - 8) Adhesion strength in shear @ 77 deg F: 80 psi (552 kPa) ASTM D 816-82(1993)
 - 9) Average T-Peel strength @ 77 deg F: 15 lbf. (66N) ASTM D 1876-95
 - 10) Low temperature flexibility: Pass at -60 deg F (-51 deg C) ASTM D 816-82 (1993)
- B. Low-VOC, water-based, adhesive substrate primer formulated for use with cold-applied insulation adhesive.
1. Tremprime WB by Tremco.
- C. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints and filling voids.
- D. Mechanical Anchors: As recommended by insulation manufacturer for deck type, and complying with fire and insurance rating requirements.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBSTRATE:

- A. General: Comply with manufacturers' instructions for preparation of substrate to receive LSFSR system.
- B. Clean substrate of dust, debris, and other substances detrimental to LSFSR system work. Remove sharp projections.
- C. Install cant strips, flashings, and accessory items as shown, and as recommended by manufacturer even though not shown.

3.2 INSTALLATION:

- A. General: Comply with manufacturer's instructions, except where more stringent requirements are indicated.
- B. Tie-in to existing roof as per drawing details and manufacturers recommendations.
- C. Apply the specified pressure-sensitive seam flashing as a stripping over all membrane field seams.

3.3 INSULATION INSTALLATION:

- A. Adhered Insulation: Install each layer of insulation in a cold fluid-applied adhesive to deck using adhesive specifically designed for adhering specified board-type roof insulation to deck type.

- B. General: Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches (50 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- C. Cutting and fitting tightly around obstructions. Use spray foam to close all gaps. Stagger joints of second layer of insulation. Form cant strips, crickets, saddles, and tapered areas with additional material as shown and as required for proper drainage of membrane.
- D. Do not install more insulation each day than can be covered with membrane before end of day and before start of inclement weather.

3.4 LSF SR MEMBRANE INSTALLATION:

A. ADHERED ROOFING MEMBRANE INSTALLATION

1. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
2. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.
3. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
4. Bonding Adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
5. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
6. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
7. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
8. Repair tears, voids, and lapped seams in roofing that does not meet requirements.
9. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
10. Install roofing membrane and auxiliary materials to tie in to existing roofing.
11. Adhesive Adhered LSF SR: Install membrane by unrolling over prepared substrate, lapping adjoining sheets as recommended by manufacturer. Apply adhesive to surfaces to be bonded and roll LSF SR into place when adhesive has properly cured. Treat seams with special cement and apply sealant to exposed sheet edges, tapering application as recommended by manufacturer. Install mechanical fasteners, flashings

and counterflashings, and accessories at locations and as recommended by manufacturer.

3.5 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated or as indicated below. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
 - 1. Locations: Install flexible walkways at top and bottom of ladders, around roof top equipment (RTU, exhaust fans, etc.), roof hatches and at one location at roof transitions greater than 30-inches.

3.6 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes sheet metal flashing and trim in the following categories:
1. Roof sheet metal flashings and fabrications.
 2. Miscellaneous sheet metal flashing.
 3. Exposed trim and miscellaneous sheet metal.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 04 Section "Unit Masonry Assemblies" for through-wall flashing, reglets, and other integral masonry flashings specified as part of masonry work.
 2. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
 3. Division 07 Roofing Sections for flashing and roofing accessories installed integral with roofing membrane as part of roofing-system work.
 4. Division 07 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the following wind zone:
1. Wind Zone 2: Wind pressures of 31 to 45 psf (1.48 to 2.15 kPa).
- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

- B. Shop Drawings: For sheet metal flashing and trim.

- 1. Include plans, elevations, sections, and attachment details.
- 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
- 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
- 4. Include details for forming, including profiles, shapes, seams, and dimensions.
- 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
- 6. Include details of termination points and assemblies.
- 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
- 8. Include details of roof-penetration flashing.
- 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
- 10. Include details of special conditions.
- 11. Include details of connections to adjoining work.
- 12. Detail formed flashing and trim at scale of not less than **3 inches per 12 inches (1:5)**.

- C. Samples for Verification: For each type of exposed finish.

- 1. Sheet Metal Flashing: **12 inches (300 mm)** long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
- 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: **12 inches (300 mm)** long and in required profile. Include fasteners and other exposed accessories.
- 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
- 4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

- B. Product Certificates: For each type of coping and roof edge flashing that is FM Approvals approved.

- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.9 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:
 - 1. Aluminum Sheet: ASTM B 209 (ASTM B 209M), 3003-H14, with a minimum thickness of 0.040 inch (1.0 mm), unless otherwise indicated.

2. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063-T52, with a minimum thickness of 0.080 inch (2.0 mm) for primary legs of extrusions unless otherwise indicated.
3. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Fluoropolymer 3-Coat System: Manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil (0.038 mm); complying with AAMA 2605.
 - 1) Color: Custom color to match Architect's samples
- B. Stainless-Steel Sheet: ASTM A 167, Type 304, soft annealed, with No. 2D finish, except where harder temper is required for forming or performance; minimum 0.0187 inch (0.5 mm) thick, unless otherwise indicated.

2.2 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
- B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

2.3 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

- E. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop-fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

2.5 GENERAL ROOF SHEET METAL FABRICATIONS

- A. Base Flashing: Fabricate from the following material:
1. Aluminum: 0.040 inch (1.0 mm) thick.
 2. Stainless Steel: 0.0187 inch (0.5 mm) thick.
- B. Counterflashing: Fabricate from the following material:
1. Aluminum: 0.040 inch (1.0 mm) thick.
 2. Stainless Steel: 0.0187 inch (0.5 mm) thick.
- C. Flashing Receivers: Fabricate from the following material:
1. Aluminum: 0.0320 inch (0.8 mm) thick.
 2. Stainless Steel: 0.0156 inch (0.4 mm) thick.
- D. Roof-Penetration Flashing: Fabricate from the following material:
1. Stainless Steel: 0.0187 inch (0.5 mm) thick.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Splash Pans: Fabricate from the following material:
1. Aluminum: 0.040 inch (1.0 mm) thick.
 2. Stainless Steel: 0.0187 inch (0.5 mm) thick.

2.7 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet: Minimum **30 mils (0.76 mm)** thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
 - g. Polyguard Products, Inc.; Deck Guard HT.
 - h. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
 - i. SDP Advanced Polymer Products Inc; Palisade SA-HT.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
 1. Coat side of uncoated aluminum, stainless-steel, and lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.

3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
 1. Aluminum: Use aluminum or stainless-steel fasteners.
 2. Stainless Steel: Use stainless-steel fasteners.
- H. Seal joints with elastomeric sealant as required for watertight construction.
 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pretinned surface would show in finished Work.
 1. Do not solder aluminum sheet.
 2. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
 3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.
- J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Splash Pans: Install where downspouts discharge on low-sloped roofs. Set in asphalt roofing cement, elastomeric sealant, or mastic sealant compatible with roofing membrane.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for butyl sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant.
 - 1. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant as required.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
 - 1. Seal with butyl sealant and clamp flashing to pipes penetrating roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)** on slope and location lines indicated on Drawings and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes firestopping for the following:
 - 1. Penetrations through fire-resistance-rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - 2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - 3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
 - 4. Sealant joints in fire-resistance-rated construction.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 3 Section "Cast-In-Place Concrete" for construction of openings in concrete slabs.
 - 2. Division 4 Section "Unit Masonry" for joint fillers for non-fire-resistive-rated masonry construction.
 - 3. Division 7 Section "Building Insulation" for safing insulation and accessories.
 - 4. Division 7 Section "Joint Sealants" for non-fire-resistive-rated joint sealants.
 - 5. Division 15 Sections specifying ducts and piping penetrations.
 - 6. Division 16 Sections specifying cable and conduit penetrations.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.
- B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
- C. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated and where systems protect penetrating items exposed to contact with adjacent

materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist:

1. Where firestop systems protect penetrations located outside of wall cavities.
 2. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
 3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.
 4. Where firestop systems protect penetrating items larger than a 4-inch-diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
- D. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.
- E. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- F. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E 84.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:
1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by Warnock Hersey, or by another qualified testing and inspecting agency.
 3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119 under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide systems complying with the following requirements:
 - a. Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.
 - b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.
- B. Installer Qualifications: Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- C. Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.
- D. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."
- E. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
- G. Owner will employ and pay a qualified inspection agency to check installed firestopping systems for compliance with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A/D Fire Protection Systems, Inc.
 - 2. DAP, Inc.
 - 3. Firestop Systems, Inc.
 - 4. Hilti Construction Chemicals, Inc.
 - 5. 3M Fire Protection Products
 - 6. Tremco
 - 7. USG, Co.
 - 8. International Protective Coatings Corporation

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Semirefractory fiber (mineral wool) insulation.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated formboard.
 - e. Joint fillers for joint sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.
- C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

2.3 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Ceramic-Fiber and Mastic Coating: Ceramic fibers in bulk form formulated for use with mastic coating, and ceramic fiber manufacturer's mastic coating.
- B. Ceramic-Fiber Sealant: Single-component formulation of ceramic fibers and inorganic binders.
- C. Endothermic, Latex Compound Sealant: Single-component, endothermic, latex formulation.
- D. Intumescent, Latex Sealant: Single-component, intumescent, latex formulation.
- E. Intumescent Putty: Nonhardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum foil on one side.
- G. Job-Mixed Vinyl Compound: Prepackaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing ASTM E 136, with flame-spread and smoke-developed ratings of zero per ASTM E 84.

- H. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.
- I. Pillows/Bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
- J. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping/ gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) grade for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag grade for openings in vertical and other surfaces.
- L. Solvent-Release-Curing Intumescent Sealant: Solvent-release-curing, single-component, synthetic-polymer-based sealant of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping/ gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) grade for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag grade for openings in vertical and other surfaces.

2.4 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.
- B. Sealant Colors: Provide color of exposed joint sealants to comply with the following:
 - 1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.
- C. Single-Component, Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, G, A, and (as applicable to joint substrates indicated) O.
 - 1. Additional Movement Capability: Provide sealant with the capability to withstand the following percentage changes in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, and

remain in compliance with other requirements of ASTM C 920 for uses indicated:

- a. 50 percent movement in both extension and compression for a total of 100 percent movement.
 - b. 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.
- D. Multicomponent, Nonsag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.
1. Additional Movement Capability: Provide sealant with the capability to withstand the following percentage change in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, and remain in compliance with other requirements of ASTM C 920 for uses indicated:
 - a. 40 percent movement in extension and 25 percent in compression for a total of 65 percent movement.
 - b. 50 percent movement in both extension and compression for a total of 100 percent movement.
- E. Single-Component, Nonsag, Urethane Sealant: Type S; Grade NS; Class 25; and Uses NT, M, A, and (as applicable to joint substrates indicated) O.

2.5 MIXING

- A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form release agents from concrete.

- B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 INSTALLING THROUGH-PENETRATION FIRESTOPS

- A. General: Comply with the "System Performance Requirements" article in Part 1 and the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - 1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

- A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.
- C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.
- D. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.5 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches (150 mm)** of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.6 FIELD QUALITY CONTROL

- A. Inspecting agency employed and paid by Owner will examine completed firestopping to determine, in general, if it is being installed in compliance with requirements.
- B. Inspecting agency will report observations promptly and in writing to Contractor and Architect.
- C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.
- D. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.7 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.
- B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

****END OF SECTION****

FIRESTOP JOINT SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes firestop joint systems for the following:
 - 1. Head-of-wall joints.
 - 2. Joints in or between fire-resistance-rated constructions.

1.3 DEFINITIONS

- A. Firestopping: The use of a material or combination of materials in a fire-rated wall or floor where it has been breached, so as to restore the integrity of the fire rated assembly.
- B. System: The use of a specific firestop material or combination of materials in conjunction with a specific wall or floor construction assembly and a specific gap condition, constitutes a system.

1.4 PERFORMANCE REQUIREMENTS

- A. General: For joints in the following constructions, provide firestop joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gasses, and maintain original fire-resistance rating of assembly in which firestop joint systems are installed:
 - 1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire protection-rated openings.
- B. Fire Resistance of Joint Systems: Assembly ratings indicated, but with assembly ratings not less than that equaling or exceeding fire-resistance rating of constructions in which joints are located, as determined by UL 2079.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- C. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
 - 1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
- D. Preinstallation Conference: Conduct conference at time and location specified by Construction Manager.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver Firestop joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials for Firestop joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install firestop joint systems when ambient or substrate temperatures are outside limits permitted by firestop joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate firestop joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced air circulation.

1.10 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
 - 1. Basis-of-Design Products: The design for each firestop joint system is based on products named in Part 2 articles. Subject to compliance with requirements, provide either the named products or comparable products by one of the following.
 - a. Firestop joint system
 - 1) A/D Fire Protection Systems Inc.
 - 2) Hilti Construction Chemicals, Inc.
 - 3) Metacaulk
 - 4) Specified Technologies Inc.
 - 5) Tremco

2.2 FIRESTOP JOINT SYSTEMS, GENERAL

- A. Compatibility: Provide firestop joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by firestop joint system manufacturer based on testing and field experience.
- B. Accessories: Provide components of firestop joint systems, including forming materials that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by firestop joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Firestop Joint System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- B. Intumescent Spray Coatings: Latex-based non-halogen intumescent coating.
- C. Unfaced, Slag-Wool-/Rock-Wool-Fiber Board Insulation (for Curtain Wall Insulation): Thermal insulation combining slag-wool or rock-wool fibers with thermosetting resin binders to comply with ASTM C 612 for type and other requirements indicated below:

1. Nominal density of 8 lb/cu. ft. (128 kg/cu. M), Type III, thermal resistivity of 4.35 deg F x h x sq. ft./Btu x in. at 75°F (30 K x m/Wat 24°C).
2. Fiber Color: Darkened.
3. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 15 and 5, respectively.

2.4 MIXING

- A. For those products requiring mixing before application, comply with firestop joint system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Destructive Sampling (By AHS).
 1. Staged inspection (between mineral wool and firestop).

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing firestop joint systems to comply with firestop joint system manufacturer's written instructions and the following requirements.
 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by firestop joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install firestop joint systems to comply with Part 1 "Performance Requirements" Article and firestop joint system manufacturer's written installation instructions for products and applications indicated.
- B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for firestop joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
4. Bond Breaker tape is necessary to avoid three-sided adhesion (Refer to C1193)

3.4 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by firestop joint system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure firestop joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated firestop joint systems immediately and install new materials to produce firestop joint systems complying with specified requirements.

3.5 FIRESTOP JOINT SYSTEMS

- A. Where UL-classified firestop joint systems are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.
- B. Head-of-Wall, Firestop Joint Systems:
 1. Rated gypsum wall construction intersection with steel floor deck above.
 - a. Basis-of-design: No. HW-D-0043
 - b. Assembly Rating: 1 hour or 2 hours to match wall construction.
 - c. Nominal Joint Width: As indicated, or required by tested assembly.
 - d. Movement Capabilities: Class II – 18.75%
 2. Rated gypsum wall construction intersection with concrete floor deck above.
 - a. Basis-of-Design: No. HW-D-0044
 - b. Assembly Rating: 1 hour or 2 hours to match wall construction.
 - c. Nominal Joint Width: As indicated, or required by tested assembly.
 - d. Movement Capabilities: Class II – 18.75% compression or extension
 3. Rated concrete masonry wall construction intersection with steel floor deck above:
 - a. Basis-of-Design: No. HW-D-0086
 - b. Assembly Rating: 1 hour or 2 hours to match wall construction.
 - c. Nominal Joint Width: As indicated, or required by tested assembly.
 - d. Movement Capabilities: Class II – 18.75% compression or extension
 4. Rated concrete masonry wall construction intersection with concrete floor deck above:
 - a. Basis-of-Design: No. HW-D-1006
 - b. Assembly Rating: 1 hour or 2 hours to match wall construction.
 - c. Nominal Joint Width: As indicated, or required by tested assembly.
 - d. Movement Capabilities: Class II – 15 compression or extension

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- C. Where another type of construction is encountered, or if field conditions vary from those described in the U.L. System listed (i.e. annular space is greater/smaller, insulation type varies, etc.), provide firestopping systems that are appropriate, and U.L. tested, for that condition.

****END OF SECTION****

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes joint sealants for the following locations:
1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:
 - a. Control and expansion joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors and windows.
 - e. Control and expansion joints in ceiling and overhead surfaces.
 - f. Other joints as indicated.
 2. Exterior joints in horizontal traffic surfaces as indicated below:
 - a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
 - b. Tile control and expansion joints.
 - c. Joints between different materials listed above.
 - d. Other joints as indicated.
 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - f. Perimeter joints of toilet fixtures.
 - g. Other joints as indicated.
 4. Interior joints in horizontal traffic surfaces as indicated below:
 - a. Control and expansion joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.
- B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.
- C. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 - 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in ~~1/2-inch-~~ (13-mm-) wide joints formed between two ~~6-inch-~~ (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- G. Field-Adhesion Test Reports: For each sealant application tested.
- H. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
 2. When joint substrates are wet.

- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.9 SEQUENCING AND SCHEDULING

- A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

1.10 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors: Provide color of exposed joint sealants to comply with the following:
 - 1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this Section, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.
- B. Products: Subject to compliance with requirements, provide one of the products specified in each Elastomeric Joint Sealant Data Sheet.
- C. GLAZING SEALANT shall be Dow Corning silicone sealant No. 795 or Tremco "Spectrem 2" or General Electric "Silglaze", in a standard color designated by the Architect.
- D. CONSTRUCTION SEALANT shall be Tremco "Spectrem 3" silicone Type S, Grade-NS, Class 50 or approved equal from Dow Corning or General Electric, in standard color designated by architect.
- E. ACRYLIC LATEX SEALANT shall be one-part conforming to ASTM C-834-76 as manufactured by TREMCO "Tremflex 834", PECORA or PTI. Color shall be selected by the Architect from standard colors. This material shall be used at interior areas around windows, doors, frames, precast concrete slabs, and interior masonry walls.
- F. ACOUSTICAL SEALANT shall conform to ASTM-D-217 and be a synthetic rubber base, as manufactured by TREMCO. This material shall be used wherever interior partitions butt up against exterior walls or drywall ceilings.
- G. ON-GRADE JOINT SEALANT shall be one or two-part, self-leveling pouring grade polyurethane as manufactured by Tremco THC 900/901", Pecora "NR-200", Sonaborn SL-2 or Master Mechanics "Vulkem #245".

2.3 JOINT SEALANT BACKINGS

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Open-cell polyurethane foam.
 - 2. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
 - 3. Proprietary, reticulated, closed-cell polymeric foam, nonoutgassing, with a density of 2.5 pcf and tensile strength of 35 psi per ASTM D 1623, and with water absorption less than 0.02 gms/cc per ASTM C 1083.
 - 4. Any material indicated above.
- C. PRIMER: Provide type as recommended by the sealant manufacturer for the varied joint surfaces.

2.4 COMPRESSION SEALS

- A. Preformed Foam Sealant: Manufacturer's standard preformed, precompressed, impregnated open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water repellent agent; factory-produced in precompressed sizes and in roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to degree specified by manufacturer. Provide products which are permanently elastic, mildew-resistant, non-migratory, nonstaining, compatible with joint substrates and other joint sealers, and comply with the following requirements:
1. Impregnating Agent: Neoprene rubber suspended in chlorinated.
 2. Density: 9-10 lb./cu. ft.
 3. Backing: Pressure sensitive adhesive, factory applied to one side, with protective wrapping.
 4. Color: Manufacturers standard gray at building expansion joint, black at all other locations.
 5. Acceptable Manufacturers/Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. [Dayton Superior Specialty Chemicals](#); Polytite Standard.
 - b. [EMSEAL Joint Systems, Ltd.](#); Emseal 25V.
 - c. [Sandell Manufacturing Co., Inc.](#); Polyseal.
 - d. [Schul International, Inc.](#); Sealtite
 - e. [Willseal USA, LLC](#); Willseal 150

2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - APPLICATION

3.1 SEALANT TYPE DETERMINATION

- A. USE EXTERIOR CONSTRUCTION SEALANT at above-grade exterior joints. Use same sealant at interior side of joint if exterior material is the same through the wall, such as a metal frame or single-wythe block wall.
- B. USE INTERIOR ACRYLIC LATEX SEALANT at all other above-grade interior joints, such as at interior hollow metal frames, wood, stone, brick or drywall, in any combination.

- C. USE PAVING SEALANT at all sealed joints on traffic bearing surfaces and at grade.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form release agents from concrete.
 - 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Solvent-Release-Curing Sealant Installation Standard: Comply with requirements of ASTM C 804 for use of solvent-release-curing sealants.
- D. Latex Sealant Installation Standard: Comply with requirements of ASTM C 90 for use of latex sealants.
- E. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 19 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- F. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint fillers.
 - b. Do not stretch, twist, puncture, or tear joint fillers.
 - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
 2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- G. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- H. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
1. Provide concave joint configuration per Figure 5A in ASTM C 62, unless otherwise indicated.
 2. Provide flush joint configuration, per Figure 5B in ASTM C 962, where indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.
 3. Provide recessed joint configuration, per Figure 5C in ASTM C 962, of recess depth and at locations indicated.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

END OF SECTION

STANDARD STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following products manufactured in accordance with SDI Recommended Standards:
1. Doors: Seamless, hollow or composite construction standard steel doors for interior and exterior locations. (Indicated as Hollow Metal "HM" on the Door Schedules.)
 2. Frames: Pressed steel frames for doors, transoms, sidelights, borrowed lights, mullions, interior glazed panels, and other interior and exterior openings of following type: (Indicated as Hollow Metal "HM" on the Door Schedules.):
 - a. Welded unit type.
 3. Assemblies: Provide standard steel door and frame assemblies as required for the following:
 - a. Labeled and fire rated.
 4. Provide factory primed doors and frames to be field painted.
- B. The following sections contain requirements that relate to this Section:
1. Division 04 Section "Unit Masonry" for building in of anchors and grouting of frames in masonry construction.
 2. Division 08 Section "Flush Wood Doors" for wood doors.
 3. Division 08 Section "Door Hardware" for door hardware.
 4. Division 08 Section "Glazing" for glass and glazing.
 5. Division 09 Section "Painting" for painting primed doors and frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
1. Elevations of each door type.
 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- E. Fire-Rated Door Sidelight and Transom Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
1. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-protection-rated door assemblies except for size.
 3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.
- F. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

- G. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inches high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inches spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide standard steel doors and frames by one of the following:
 - 1. Standard Steel Doors and Frames:
 - a. Ceco Corp.
 - b. Curries Company.
 - c. Republic Builders Products.
 - d. Pioneer Industries.
 - e. Steelcraft

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.
- B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.
- C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, or drawing quality, ASTM A 642, hot dipped galvanized in accordance with ASTM A 525, with A60 or G60 coating designation, mill phosphatized.
 - 1. Stainless Steel: ASTM Type 2, AISI Type 302, other 300 series to suit specified requirements.
- D. Supports and Anchors: Fabricate of not less than 18-gage sheet steel; galvanized where used with galvanized frames.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize in compliance with ASTM A 153, Class C or D as applicable.
- F. Shop Applied Paint: Apply after fabrication.

1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

2.3 DOORS

- A. Provide metal doors of SDI grades and models specified below or as indicated on drawings or schedules:
 1. Interior Doors: ANSI/SDI-100, Grade II, heavy-duty, Level 3 or 4, minimum 18-gage cold-rolled sheet steel faces.
 2. Exterior Doors: ANSI/SDI-100, Grade III, extra heavy-duty, Level 4, minimum 16-gage hot dipped A60 galvanized steel faces, also galvanized hardware reinforcement.
 3. Doors shall have beveled (1/8" in 2") hinge and lock edge with edge seam welded and ground smooth.

2.4 FRAMES

- A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 16-gage cold-rolled steel.
 1. Fabricate frames with mitered, coped, or welded corners.
 2. Form exterior frames from 14-gage hot dipped A60 galvanized steel.
- B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.
- C. Plaster Guards: Provide minimum 26-gage steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.5 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. Comply with ANSI/SDI-100 requirements.
 1. Internal Construction: Manufacturer's standard honeycomb, polyurethane, unitized steel grid, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
 2. Clearances: Not more than 1/8 inch at jambs and heads except between non-fire-rated pairs of doors not more than 1/4 inch. Not more than 3/4 inch at bottom.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.
- C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."

- D. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.
- E. Fabricate exterior doors, panels, and frames from galvanized sheet steel in accordance with SDI-112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gage inverted steel channels.
- F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- G. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236 or ASTM C 976 on fully operable door assemblies.
 - 1. Unless otherwise indicated, provide thermal-rated assemblies with U factor of .13 Btu/(hr x sq ft x deg F.) or better.
- H. Finish Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Series Specifications for door and frame preparation for hardware.
 - 1. For concealed hardware, provide space, cutouts, reinforcing and provisions for fastening in doors and frames, as applicable.
- I. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware to be done at project site.
- J. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.
- K. Shop Painting: Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
 - 1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
 - 2. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.
- L. Glazing Stops: Minimum 20 gage steel or .040-inch-thick aluminum.
 - 1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
 - 2. Provide screw applied removable glazing beads on inside of glass, louvers, and other panels in doors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

- B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames," unless otherwise indicated.
1. Except for frames located at existing concrete, masonry or drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 2. In masonry construction, locate 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry Tee anchors. Provide four (4) wall anchors per jamb for frame over 7'-2" high.
 3. At existing concrete or masonry construction, provide 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb, set frames and secure to adjacent construction with bolts and masonry anchorage devices.
 - a. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 4. Install fire-rated frames in accordance with NFPA Standard No. 80.
 5. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In closed steel stud partitions, attach wall anchors to studs with screws.
 6. At existing in-place drywall partitions install knock down slip-on drywall frames.
- C. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI-100.
1. Install fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.2 ADJUST AND CLEAN

- A. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.
- C. Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to of this section.

1.2 SUMMARY

- A. This section includes:

1. Extent and location of each type of flush wood door is indicated on drawings and in schedules.
2. Types of doors required include the following:
 - a. Solid core flush wood doors with wood veneer faces.
3. Factory-finishing of flush wood doors is included in this section.
4. Factory-prefitting to frames and factory-premachining for hardware for wood doors is included in this section.

- B. The following sections contain requirements that relate to this Section:

1. Division 08 Section "Standard Steel Doors and Frames" for steel doors and frames.
2. Division 08 Section "Door Hardware" for door hardware.
3. Division 08 Section "Glazing" for glass and glazing.
4. Division 09 Section "Painting" for painting light frames.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Substitutions for products as specified MUST be submitted in accordance with Division 01. Substitute products not submitted in accordance with Division 1 Section "Product Requirements" will NOT be considered.

- B. Product Data: Door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings and louvers, and factory-finishing specifications.

- C. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other pertinent data.

1. For factory-premachined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light openings.

- D. Samples: Submit samples, 1'-0" square or as indicated, for the following:

1. Doors for Transparent Finish: Door faces with solid wood edging representing typical range of color and grain for each species of veneer and solid lumber required.
2. Factory-Finished Doors: Each type of factory finish required.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Obtain doors from a single manufacturer.
- B. Quality Standards: Comply with the following standards:
 1. NWWDA Quality Standard: I.S.1 "Industry Standard for Wood Flush Doors," of National Wood Window and Door Association (NWWDA).
 2. AWI Quality Standards: "Architectural Woodwork Quality Standards," including Section 1300 "Architectural Flush Doors", of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of NWWDS quality standard.
- C. NWWDA Quality Marking: Mark each wood door with NWWDA Wood Flush Door Certification Hallmark certifying compliance with applicable requirements of NWWDA I.S. 1 Series.
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 1. Test Pressure: After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
 2. Oversize, Fire-Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.
 3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors," as well as with manufacturer's instructions.
- B. Identify each door with individual opening numbers which correlate with designation system used on shop drawings for door, frames and hardware, using temporary, removable or concealed markings.

1.6 PROJECT CONDITIONS

- A. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project's geographical location:
 1. Referenced AWI quality standard including Section 100-S-3 "Moisture Content."

1.7 WARRANTY

- A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.
- B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.
 - 1. Warranty shall also include reinstallation which may be required due to repair or replacement of defective doors where defect was not apparent to hanging.
 - 2. Warranty shall be in effect during following period of time after date of Substantial Completion.
 - 3. Solid Core Interior Doors: Life of Installation.
- C. Contractor's Responsibilities: Replace or refinish doors where Contractor's work contributed to rejection or to voiding of manufacturer's warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following.
 - 1. Solid Core Doors with Wood Veneer Faces:
 - a. Algoma Hardwoods, Inc.
 - b. Baillargeon Doors, Inc.
 - c. Doors, Incorporated.
 - d. Eggers Industries, Architectural Door Division.
 - e. Mohawk Flush Doors, Inc.
 - f. Oshkosh Architectural Door Company.

2.2 INTERIOR FLUSH WOOD DOORS

- A. Solid Core Doors for Transparent Finish: Comply with the following requirements:
 - 1. Faces: Select White Maple, plain sliced.
 - 2. AWI Grade: Premium, Grade AA
 - 3. Construction: PC-5 (Particleboard core, 5-ply).
 - 4. Blocking: Provide wood blocking in particleboard core as needed to eliminate through-bolting hardware and as follows:
 - a. 5-inch (125 mm) top-rail blocking, in doors indicated to have closers.
 - b. 5-inch (125 mm) bottom-rail blocking, in doors indicated to have kick, mop or armor plates.
 - c. 5-inch (125 mm) mid-rail blocking, in doors indicated to have exit devices.
 - 5. Edge Veneer: Match Door Face, Typical at all doors.

2.3 FIRE-RATED SOLID CORE DOORS

- A. Faces and AWI Grade: Provide faces and grade to match non-rated doors in same area of building, unless otherwise indicated.
- B. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
 - 1. Provide intumescent strip built inside the door by being embedded beneath the outer stile and has no impact on door appearance or function.
- C. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors as needed to eliminate through-bolting hardware.
 - 1. 5-inch (125-mm) top-rail blocking.
 - 2. 4-1/2-by-10-inch (114-by-250-mm) lock blocks or 5-inch (125-mm) mid-rail blocking, in doors indicated to have exit devices.
- D. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile matching face veneer, and laminated backing at hinge stiles for improved screw-holding capability and split resistance.

2.4 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors and Fire Doors: Manufacturer's standard wood beads matching veneer species of door faces.
 - 1. Provide manufacturer's standard fire-rated wood beads at fire-rated doors.
- B. Metal Frames for Light Openings in Wood Doors and Fire Doors: Manufacturer's standard frame formed of 0.0478-inch- (1.2-mm-) thick, cold-rolled steel sheet; factory primed and approved for use in doors of fire rating indicated.
 - 1. Refer to Division 09 Section "Painting" for field painted finish.
 - a. Color: Match door frames.
- C. Fusible Link Louver in Wood Doors and Fire Doors: Manufacturer's standard fusible-link louver assembly; factory primed and approved for use in doors of fire rating indicated.
 - 1. Refer to Division 09 Section "Painting" for field painted finish.
 - a. Color: Match door frames.

2.5 FABRICATION

- A. Fabricate flush wood doors to produce doors complying with following requirements:
 - 1. Factory-prefit and pre-machine doors to fit frame opening sizes indicated with the following uniform clearances and bevels:
 - a. Comply with tolerance requirements of AWI for pre-fitting. Comply with final hardware schedules and door frame shop drawings and with hardware templates.

- B. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of doors required.

- 1. Light Openings: Trim openings with manufacturer's standard wood moldings.

2.6 FACTORY FINISHING

- A. General: Comply with referenced AWI quality standard including Section 1500 "Factory Finishing".

- B. Prefinished wood doors at factory.

- C. Transparent Finish: Comply with requirements indicated for grade, finish system, staining effect and sheen.

- 1. AWI Grade: Premium.
 - 2. Finish: Manufacturer's standard finish with performance requirements comparable to either AWI System TR-4 conversion varnish or AWI System TR-6 catalyzed polyurethane.
 - 3. Staining: Match approved sample for color.
 - 4. Effect: Open grain finish.
 - 5. Sheen: Satin-medium rubbed effect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine installed door frames prior to hanging door:

- 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
 - 2. Reject doors with defects.

- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation see Division 8 Section "Finish Hardware" section of these specifications.

- B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and referenced AWI standard and as indicated.

- 1. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA No. 80.

- C. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Fitting Clearances for Non-Rated Doors: Provide 1/8" at jambs and heads; 1/16" per leaf at meeting stiles for pairs of doors; and 1/8" from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4" clearance from bottom of door to top of threshold.
 2. Fitting Clearances for Fire-Rated Doors: Comply with NFPA 80.
 3. Bevel non-rated doors 1/8" in 2" at lock and hinge edges.
 4. Bevel fire-rated doors 1/8" in 2" in lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Prefit Doors: Fit to frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation, if fitting or machining is required at the job site.

3.3 ADJUSTING AND PROTECTION

- A. Operation: Re-hang or replace doors which do not swing or operate freely.
- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to assure that wood doors will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

FRP DOORS AND ALUMINUM FRAMES FOR FRP DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS/DESCRIPTION

- A. Drawings and General provision of Contract, including General and Supplementary Conditions and Division 1 Specification sections, are a part of this Section for the Base Bid and applicable alternates.
- B. This Section includes:
 - 1. FRP doors - provide FRP doors as specified, shown or scheduled, with components and accessories for a complete and proper installation.
 - 2. Factory glazing of FRP door lites.
 - 3. Factory installation of finish hardware.
 - 4. Aluminum frames for FRP doors.
- C. The following sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Joint Sealants" for sealants and gaskets.
 - 2. Division 8 Section "Glazing" for glass and glazing.
 - 3. Division 8 Section "Door Hardware" for door hardware.
- D. System Performance:
 - 1. Provide exterior and interior doors assemblies that have been designed and fabricated to comply with requirements for system performance characteristics listed below as demonstrated by testing manufacturer's corresponding stock systems according to test methods designated.
 - a. Thermal Transmittance (exterior doors): U-value of not more than 0.09 Btu/(hr x sf x Degrees F.) per AAMA 1503.1.

1.2 QUALITY ASSURANCE

- A. Comply with fire-resistance, flammability, regulations as interpreted by governing authorities and as follows:
 - 1. Face Sheets tested in accordance with ASTM E84-79A shall have the following ratings; Standard Face sheets:
 - a. Smoke Developed: not greater than 345.
 - b. Flame Spread: not greater than 145.
 - 2. Class A Face Sheets (Required on interior face of all exterior doors):
 - a. Smoke Developed not greater than 340.

- b. Flame Spread: not greater than 15.
- B. Manufacturer Qualifications: Shall have produced fiberglass reinforced doors for at least five years.
- C. Field Measurement:
 - 1. Take field measurements prior to fabrication of doors and frames to insure proper fitting of assemblies. Successful bidders are expected to field verify all dimensions, sizes, quantities and the material required to complete this project. Failure to do so will not relieve the successful contractor from the necessity of furnishing any and all materials that may be required, without any additional cost to the Owner.

1.3 COORDINATION

- A. Door manufacturer shall be responsible for coordinating all necessary information from hardware supplier in order that doors shall be properly prepared to receive hardware and fit frames properly. Contractor shall provide manufacturer with copies of approved schedules necessary to complete manufacturing of doors. This information shall be in the possession of the door manufacturer 60 days prior to desired delivery date of doors.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Substitutions for products as specified MUST be submitted in accordance with Division 1. Substitute products not submitted in accordance with Division 1 Section "Product Requirements" will NOT be considered.
- B. Product Data: Submit manufacturer's specifications, standard details, and installation recommendations for components of FRP (fiberglass reinforced polyester) doors required for project, including test reports certifying that products have been tested and comply with performance requirements.
- C. Shop Drawings: Submit shop drawings for fabrication and installation of FRP (fiberglass reinforced polyester) doors, including elevations, detail sections of typical composite members, hardware mounting heights, anchorages, reinforcement, expansion provisions, and glazing.
- D. Samples: Submit 6" samples of each type and color of FRP (fiber reinforced polyester) finish, and 12" long sections of extrusions or formed shapes. Where normal color and texture variations are to be expected, include 2 or more units in each set of samples showing limits of such variations.

1.5 PRODUCT DELIVERY, HANDLING, AND STORAGE

- A. All materials supplied shall be delivered to the jobsite in their original, unopened packages with labels intact. Materials shall be inspected for damage, and the manufacturer informed of any discrepancies. Unsatisfactory materials shall not be used.
- B. All materials supplied shall be packaged in individual corrugated cartons. Doors shall "floated" within cartons, with no portion of door in contact with outer shell.

- C. All doors to be marked with individual opening numbers to correlate with the designation system used on the shop drawings for doors, frames and hardware. Markings shall be temporary, removable, or concealed.

1.6 WARRANTY

- A. Provide written warranty signed by Manufacturer, Installer, and Contractor, agreeing to replace FRP (fiberglass reinforced polyester) doors which fail in materials or workmanship within time period indicated below of acceptance. Failure of materials or workmanship includes excessive deflections, faulty operation of entrances, and deterioration of finish or construction in excess of normal weathering.
 - 1. Time Period: Five years from date of substantial completion.
- B. Provide written warranty signed by Manufacturer guaranteeing hardware attachment of factory installed finish hardware.
 - 1. Time Period: Five years from date of substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide SL17 FRP Flush Doors as manufactured by Special-Lite, Inc., and Aluminum Frames for FRP Doors as specified herein.

2.2 MATERIALS AND ACCESSORIES

- A. Aluminum Members: Alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish; ASTM B 221 for extrusions, ASTM B 209 for sheet/plate, minimum wall thickness of 1/8".
- B. Fasteners: Aluminum, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum components.
 - 1. For exposed fasteners, provide Phillips head flat head screws with finish matching item to be fastened.
- C. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible; otherwise provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 386.
 - 1. Provide manufacturer's standard reinforcement for each type of hardware required, not less than .125" thick.
 - 2. Provide manufacturer's recommended fastener reinforcement.
- D. Door Face Material: Fiberglass reinforced polyester, SpecLite3, 0.120" minimum thickness, with pebble-like embossed finish.
 - 1. Acceptable Product: Subject to compliance with the following requirements:

- a. Impact Strength of Face Sheets: ASTM D256, Izod Impact Strength, 13.5 footpounds per inch of notch.
 - b. Abrasion Resistance of Face Sheets: ASTM D1242, 1000 cycles of Model 503 Taber Abraser with a 1000 gram load, not to exceed 0.23% weight loss.
 - c. Hardness of Face Sheets: ASTM D2583, Barcol Meter Hardness Test, not more than 50.
 - d. Humidity Resistance of Face Sheets: ASTM D570, water absorption not greater than 0.40% after 24 hour immersion.
 - e. Ultra-Violet Degradation: Only slight color change, and negligible change in surface gloss and other physical properties after exposure to 500,000 Langleys.
- E. Weatherstripping: Provide manufacturer's standard replaceable weathering pile.
- F. Sealants and Gaskets: Provide sealants and gaskets in the fabrication, assembly and installation of the work, which are recommended by the manufacturer to remain permanently elastic, non-shrinking, non-migrating, and weatherproof.

2.3 FIBERGLASS REINFORCED POLYESTER (FRP) DOORS

- A. FRP Doors are to be constructed as follows:
1. Doors shall be 1 3/4" thick.
 2. Constructed of aluminum alloy rails and stiles, joined with steel tie rods, and have an inner core consisting of foamed-in-place Urethane.
 3. Stiles shall be tubular shape to accept hardware as specified.
 4. Top and bottom rails shall be extruded with internal legs for interlocking rigid weather bar.
 5. Face Sheets shall be secured with extruded interlocking edges. (No snap-on trim will be accepted).
 6. Joinery shall be 3/8" tie rods, top and bottom, bolted through an extruded spline and 3/16" riveted reinforcing angles, and secured with hex nuts.
 7. Core to be of Urethane foam of 3 pounds per cubic ft. density. All doors are shall be properly reinforced for hardware prior to Urethane core foaming in door.
 8. Face Sheets:
 - a. Fiberglass Reinforced Plastic Sheets shall be polyester SpecLite3, 0.120" thick, with pebble-like finish.
 9. Pairs of Doors: Meeting stiles shall be beveled.
 10. All doors shall be machined for finish hardware at the factory in accordance with the templates from the hardware supplier and the Approved Hardware Schedule. For surface applied hardware, doors shall have necessary reinforcement, including the attachment of RIVNUT blind bolt fasteners. With the exception of door holders, which require field application, doors are to be shipped with surface hardware factory applied.

11. Door Lites: Provide door lites factory glazed as indicated, with manufacturer's standard aluminum moldings and stops, with removable stops on inside only. Glass shall be 1" insulated safety glass.

2.4 FLUSH INSULATED PANELS

- A. Flush insulated panels shall be constructed as follows:
 1. Panels shall be 1" thick.
 2. Panel stiles shall be formed of hardwood.
 3. Core shall be Urethane of 3 pounds per cubic foot density.
 4. Face Skins to be as follows:
 - a. Fiberglass Reinforced polyester panel faces shall be SpecLite3, 0.120" thick, with pebble-like embossed finish.

2.5 ALUMINUM DOOR FRAMING FOR FRP DOORS (Required for all immediate door frames with FRP doors).

- A. Frame Members: Frame members shall be one piece tubular extrusions of 6063 T5 aluminum alloy with minimum wall thickness of 1/8".
- B. Reinforcement: Frames shall be internally reinforced and factory prepared for specified finish hardware. As required, members shall be steel reinforced to meet wind load and/or dead load requirements.
- C. Stops: Provide applied door stops at single acting doors. Stops shall be caulked and weathertight by installer in field.
- D. Fabrication: Fabricate tubular frame assemblies as shown. Vertical frame members shall be the full height of the entrance opening. Joints shall be reinforced with internal anchors so that vertical and horizontal frame members are physically interlocked.
- E. Glazing: Provide glazing system for doors and frames to receive lites. Design system for replacement of glass/panel, but for non-removal of glass/panel from the exterior. Ship frame members to jobsite with glazing bead installed and caulked on secure side of frame.

2.6 ALUMINUM CAPPING SYSTEM

- A. Where indicated, provide a Frame capping system fabricated of .062" Aluminum, as manufactured by Special-Lite, Inc. Finish capping to match finish as supplied on other framing sections.

2.7 INSERT FRAMING

- A. Where indicated, provide insert frames fabricated of extruded 6063T5 Aluminum alloy fitted with .34 inch high by .36 inch wide wool-poly-propylene blend pile. Corner joints shall be mitered and secured with prefabricated aluminum clips. Framing as manufactured by Special-Lite, Inc., and finished to match other framing sections.

2.8 FINISH HARDWARE

- A. Supplier: Refer to Section 087100 of these specifications for the Finish Hardware requirements for this project. Refer to approved Finish Hardware Schedule for items to be supplied to the door and frame manufacturer to install.
- B. Receive Hardware supplied in accordance with Section 087100, and Hardware Schedule, and coordinate with the Hardware requirements of this section. Report discrepancies in writing to the Architect immediately.
- C. Ship hardware, to be installed by manufacturer, to manufacturer with cartons marked with door numbers correlating with designation system used on shop drawings.
- D. Install all Hardware, except door holders at the fabrication plant. Remove only Hardware as required for final finishing or delivery to jobsite. Package and identify such Hardware and ship with doors and frames for installation at the project site.

2.9 FINISHES AND COLORS

- A. Fiberglass Reinforced Polyester Colors: As selected by Architect from manufacturer's complete range.
- B. Aluminum Stiles and Rails: Comply with the following:
 - 1. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
 - 2. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
 - 3. Class I Clear Anodized Finish: AA-M12C22A41 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural, clear film thicker than 0.7 mil) complying with AAMA 607.1.\
- C. Aluminum Framing:
 - 1. High-Performance Organic Coating: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instruction.
 - 2. Fluorocarbon 3-Coat Coating System: Manufacturer's standard 3-coat thermo-cured system, composed of specially formulated inhibitive primer and fluorocarbon color coat, and clear fluorocarbon topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; comply with AAMA 605.2.
 - 3. Color and Gloss: Custom color to match Architect's sample.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's recommendations and specifications for the installation of the doors and frames.
- B. Set units plumb, level and true to line, without warp or rack of doors, frames or panels. Anchor securely in place. Separate aluminum, and other corrodible metal surfaces, from sources of corrosion or electrolytic action at points of contact with other materials, with bituminous coatings, or other means as approved by Architect.
- C. Set saddles in a bed of compound.
- D. Clean Aluminum surfaces promptly after installation of doors and frames, exercising care to avoid damage to the protective coating (if any). Remove excess glazing and sealant compounds, dirt and other substances.
- E. Provide protective treatment and other precautions required through the remainder of the construction period, to ensure that the doors and frames will be without damage or deterioration (other than normal weathering) at the time of acceptance.
- F. Adjusting: Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight seal.
- G. Caulking: Refer to Section 079200 "Joint Sealants."

END OF SECTION

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes:

1. Extent of aluminum entrances and storefronts is indicated on drawings and schedules.
2. Aluminum entrances and storefront types required for the project include:
 - a. Exterior and interior storefront framing.
 - b. Storefront framing for window walls.
 - c. Exterior and interior manual-swing entrance doors and door-frame units.

- B. The following sections contain requirements that relate to this Section:

1. Division 8 Section "FRP Doors and Aluminum Frames for FRP Doors" for FRP doors.
2. Division 8 Section "Door Hardware" for door hardware.
3. Division 8 Section "Glazing" for glazing requirements for aluminum entrances and storefronts.
4. Division 08 Section "Glazed Aluminum Curtain Walls" for curtain-wall systems that mechanically retain glazing on four sides.
5. Division 08 Section "Louvers And Vents" for units installed with aluminum-framed systems.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.

- c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
 - h. Failure of operating units to function properly.
- B. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. Provide sealant that fails cohesively before sealant releases from substrate when tested for adhesive compatibility with each substrate and joint condition required.
- 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
- C. Structural-Sealant Joints: Designed to produce tensile or shear stress in structural-sealant joints of less than 20 psi (138 kPa).
- D. Structural Loads:
- 1. Show design loads determined by Project's structural engineer on Drawings or insert loads in two subparagraphs below. Verify requirements of authorities having jurisdiction. See Evaluations.
 - 2. Thermal Movement: Provide systems capable of withstanding thermal movements resulting from an ambient temperature range of 120°F (67°C), that could cause a metal surface temperature range of 180°F (100°C) within the framing system.
 - 3. Wind Loading: Provide assemblies capable of withstanding a uniform test pressure of 25 psf inward and 25 psf outward when tested in accordance with ASTM E 330.
- E. Deflection of Framing Members:
- 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is the smaller amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below to less than 1/8 inch (3.2 mm) and clearance between members and operable units directly below to less than 1/16 inch (1.5 mm).

- F. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity but not less than 10 seconds.
- G. Aluminum Entrance Transmission Characteristics: Provide entrance doors with jamb and head frames that comply with requirements indicated for transmission characteristics.
1. Air Infiltration: Provide doors with an air infiltration rate of not more than 0.50 CFM for single doors and 1.0 for pairs of doors when tested in accordance with ASTM E 283 at an inward test pressure differential of 1.567 psf.
 2. Condensation Resistance: Provide entrance door units tested for thermal performance in accordance with AAMA 1502 showing a condensation resistance factor (CRF) of not less than 48.
- H. Operable Sashes: Performance Characteristics: Provide aluminum operable framing system that complies with requirements indicated for performance characteristics.
1. Air Infiltration: Provide framing system with an air infiltration rate of not more than 0.09 CFM per sq. Ft. of sash perimeter (when closed and locked) with tested in accordance with ASTM E 283 at a static pressure differential of 6.24 PSF.
 2. Water Penetration: Provide framing system with no water penetration (when closed and locked) as defined in the test method when tested in accordance with ASTM E 331 at a static pressure differential of 12 PSF.
 3. Condensation Resistance: When tested to AAMA 1503.1 the condensation resistance factor (CRF) shall not be less than Frame 57, Glass 50.
 4. Thermal Resistance: Provide framing system that has an overall U-Value of not more than 0.62 BTU/HR/SF/°F when tested in accordance with AAMA 1503.1.
 5. Structural Performance: When tested in accordance with ASTM E330 window units shall comply with the following requirements:
 - a. Uniform Load Structural Performance: There shall be no glass breakage, no permanent damage to fasteners, hardware parts, support arms, or actuating mechanism, and no damage that would cause the unit to be inoperable when tested in accordance with ASTM E330 at a static air pressure difference of 75 lbs per sq. ft. with the pressure applied first on one side of the unit then the other.
 - 1) Permanent deformation of any frame, or sash member shall not exceed 0.2 percent of its span.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Substitutions for products as specified MUST be submitted in accordance with Division 1. Substitute products not submitted in accordance with Division 1 Section "Product Requirements" will NOT be considered.
- B. Product Data: Submit manufacturer's product specifications, technical product data, standard details, and installation recommendations for each type of entrance and storefront product required. Include the following information:
 - 1. Fabrication methods.
 - 2. Finishing.
 - 3. Accessories.
- C. Shop Drawings: Submit shop drawings for fabrication and installation of entrances and storefronts, including the following:
 - 1. Elevations.
 - 2. Detail sections of typical composite members.
 - 3. Hardware, mounting heights.
 - 4. Anchorages and reinforcements.
 - 5. Glazing details.
- D. Samples: Submit pairs of samples of each type and color of aluminum finish, on 12" long sections of extrusions or formed shapes and on 6" square sheets. Where color or texture variations are anticipated, include 2 or more units in each set of samples indicating extreme limits of variations.
- E. Certification: Provide certified test results showing that entrance and storefront systems have been tested by a recognized testing laboratory or agency and comply with specified performance characteristics.

1.5 QUALITY ASSURANCE

- A. Installer's Qualifications: Entrances and storefront shall be installed by a firm that has not less than 5-years successful experience in the installation of systems similar to those required.
- B. Design Criteria: Drawings are based on one manufacturer's entrance and storefront system. Another manufacturer's system of a similar and equivalent nature will be acceptable when, in the Architect's sole judgement, differences do not materially detract from the design concept or intended performance.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work. Where necessary, proceed

with fabrication without field measurement, and coordinate fabrication tolerances to ensure proper fit.

1.7 WARRANTY

- A. Special Product Warranty: Submit a written warranty, executed by the Contractor, Installer and Manufacturer, agreeing to repair or replace units (including reglazing) which fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to structural failures including excessive deflection, excessive leakage or air infiltration, faulty operation, and deterioration of metals, metal finishes and other materials beyond normal weathering. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
1. Warranty period for aluminum entrances and storefront is 3 years after the date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide the following products (refer to drawings for locations of each framing system):
1. Basis-of-Design 2" x 4/12" Thermal Storefront Framing: Kawneer Company, Trifab VG 451T System.
 2. Basis-of-Design 1-3/4" x 6" Thermal Storefront Framing: Kawneer Company, EnCORE System.
- B. Equivalent Manufacturers: Subject to compliance with requirements provide equivalent products of one of the following manufacturers: (Variations in specified and detailed Basisof-Design framing dimensions are not acceptable.)
1. Tubelite Division of Indal, Inc.
 2. EFCO Corporation
 3. Vistawall Architectural Products.
 4. YKK AP America, Inc.
 5. Reliable Architectural Metals Company (RAMCO).

2.2 MATERIALS

- A. Aluminum Members: Provide alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for extrusions and ASTM B 209 for sheet or plate.
- B. Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, or other materials warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components.
1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125" thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts.

- C. Concealed Flashing: Provide 26 gage minimum dead-soft stainless steel, or 0.026" minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.
- D. Brackets and Reinforcements: Where feasible, provide high-strength aluminum brackets and reinforcements; otherwise provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 386.
- E. Concrete/Masonry Inserts: Provide concrete and masonry inserts fabricated from cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 386.
- F. Compression Weatherstripping: Provide the manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.
- G. Sliding Weatherstripping: Provide the manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.
- H. Glass and Glazing Materials: Glass and glazing materials shall comply with requirements of "Glass and Glazing" section of these specifications.

2.3 COMPONENTS

- A. Storefront Framing System: Provide inside-outside matched resilient flush-glazed storefront framing system with provisions for glass replacement. Shop-fabricate and preassemble frame components where possible.
 - 1. Thermal-Break Construction: Fabricate storefront framing system with integrally concealed, low conductance thermal barrier, located between exterior materials and exposed interior members to eliminate direct metal-to-metal contact. Use manufacturer's standard construction that has been in use for similar projects for period of not less than 3 years.
- B. Aluminum Perimeter Door Framing:
 - 1. Fabricate tubular frame assemblies from the size and type shown. .125" minimum wall thickness and type 6063-T5 aluminum alloy. .625" x 1.25" applied door stops with screws and weatherstripping.
 - 2. Where wide strikes or electric strikes are used, a .625" x 1.75" stop with screws and weatherstripping shall be applied.
 - 3. Where surface applied hardware (exit device strikes, closer shoes, overhead stops, etc.) is to be mounted to the frame stop, provide solid bar stock reinforcement under the stop.
 - 4. Frame members are to be box type with four (4) enclosed sides. Open back framing will not be accepted. Frames must be anchored by removing the door stop, drilling a .5" pilot hole on the door side of the frame, and anchoring the frame from the wall side of the frame.

2.4 OPERABLE SASHES

- A. General: Provide operable sashes that comply with performance requirements indicated including component structural tests for ventilator torsion, balance arm load, horizontal and

vertical concentrated loads on the ventilator latch rail, and vertical concentrated load on intermediate frame rails.

- B. Hardware: Provide the following operating equipment and hardware:
1. Hinges: Concealed four-bar friction hinges with adjustable slide shoe (2 per ventilator).
 - a. Comply with AAMA 904, 1.
 - b. Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.
 2. Sash lock: Cam action sweep lock handle with surface-mounted strike.
 3. Limit Device: Stay bar with an adjustable hold-open device.
 - a. Provide the manufacturer's standard concealed, friction-adjuster or support arm with adjustable stay bar limit device designed to restrict the ventilator opening.
 4. Insect Screens: Provide insect screens for each operable exterior sash or ventilator. Locate screens on the inside or outside of the window sash or ventilator, depending upon window type. Design windows and hardware to accommodate screens in a tight-fitting removable arrangement, with a minimum of exposed fasteners and latches.
 - a. Wickets: Provide sliding or hinged-type wickets, framed and trimmed for a tight fit and durability during handling.
 - b. Screen Frames: Fabricate frames of tubular-shaped extruded or formed aluminum members of 0.040-inch minimum wall thickness, with mitered or coped joints and concealed mechanical fasteners. Finish frames to match window units.
 - c. Wire Fabric Insect Screen: Provide 18 by 18, 18 by 16, or 18 by 14 mesh of 0.013-inch diameter coated aluminum wire, complying with FS RR-W-365, Type VII.

2.5 HARDWARE

- A. General: Refer to hardware section in Division 8 for requirements for hardware items other than those indicated to be provided by the aluminum entrance manufacturer.
- B. Operable Sashes: Provide the manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended.

2.6 FABRICATION

- A. General: Sizes of door and frame units, and profile requirements, are indicated on drawings. Variable dimensions are indicated, with maximum and minimum dimensions required to achieve design requirements and coordination with other work.
- B. Prefabrication: Before shipment to the project site, complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible. Disassemble components only as necessary for shipment and installation.
1. Preglaze door and frame units to greatest extent possible.
 2. Do not drill and tap for surface-mounted hardware items until time of installation of project site.

3. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.
- C. Welding: Comply with AWS recommendations; grind exposed welds smooth and restore mechanical finish.
- D. Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements, sag resistance and rigidity.
1. Attachments of all hardware shall be made using machine screws which are supplied by the manufacturer.
 2. All holes shall be drilled and tapped using the recommended drill size for the tap required.
 3. Frame stops shall be: applied stop min. 5/8" high x min. 1 1/4" wide.
 4. Frame tubes sections should be closed back, minimum of 1/8" wall thickness.
 5. Door skins should be minimum of 1/8" wall thickness.
 6. Where hardware is to be attached to frame stop (ex., exit device strike, door closer shoe) a piece of solid bar stock aluminum sized to fill the frame stop void x 18" long shall be securely attached to the frame tube.
 7. Where it is not practical to have solid bar stock reinforcement at attachment points, use Riv-Nuts for attachment.
- E. Dissimilar Metals: Separate dissimilar metals with zinc chromate primer, bituminous paint, or other separator that will prevent corrosion.
- F. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.
1. Uniformity of Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.
- G. Fasteners: Conceal fasteners wherever possible.
- H. Weatherstripping: For exterior doors, provide compression weatherstripping against fixed stops; at other edges, provide sliding weatherstripping retained in adjustable strip mortised into door edge.
1. Provide EPDM or vinyl blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.
 2. At interior doors and other locations without weatherstripping, provide neoprene silencers on stops to prevent metal-to-metal contact.
 3. Provide finger guards of collapsible neoprene or PVC gasketing securely anchored into frame at hinge-jamb of center-pivoted doors.

2.7 FINISHES

- A. High-Performance Organic Coating: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instruction.
 - 1. Fluorocarbon 3-Coat Coating System: Manufacturer's standard 3-coat thermo-cured system, composed of specially formulated inhibitive primer and fluorocarbon color coat, and clear fluorocarbon topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; comply with AAMA 605.2.
 - 2. Color and Gloss: Architect shall select from manufacturer's full line of standard colors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation.
- B. Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Provide proper support and anchor securely in place.
 - 1. Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Comply with requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA 101-85.
- C. Drill and tap frames and doors and apply surface-mounted hardware items. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.
- D. Set sill members and other members in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Comply with requirements of Division 7 for sealant, fillers, and gaskets.
- E. Refer to "Glass and Glazing" section of Division 8 for installation of glass and other panels indicated to be glazed into doors and framing, and not preglazed by manufacturer.

3.2 ADJUSTING

- A. Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight closure.

3.3 CLEANING

- A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.
- B. Clean glass surfaces after installation, complying with requirements contained in the "Glass and Glazing" section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

3.4 PROTECTION

- A. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

****END OF SECTION****

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes items of finish hardware that are required for swing, sliding, and folding doors, except hardware specified in the same sections as the doors and door frames on which it is installed.
- B. Related Sections include the following:
 - 1. Division 08 Section "Flush Wood Doors".
 - 2. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility:
 - 1. Obtain each category of hardware (hinges, latch and locksets, exit devices, closers, etc.) from a single manufacturer.
- B. Supplier Qualifications:
 - 1. An established finish hardware supplier who is a factory authorized distributor for all products required, and has display samples, inventory, and qualified personnel trained and experienced in preparing Hardware Schedules, issuing templates, and ordering, furnishing, and servicing finish hardware for architecturally designed projects.
 - 2. Supplier or supplier's representative shall meet with Owner to determine keying requirements.
- C. Fire-Rated Openings:
 - 1. Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80. Provide only items of door hardware that are listed by Factory Mutual, Underwriters' Laboratories, or Warnock Hersey for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and frame labels.
- D. Preinstallation Seminar:
 - 1. Before the installation of finish hardware begins, the Contractor/Construction Manager shall request that a hardware installation seminar for the installation of LCN closers and Von Duprin exit devices be conducted by the manufacturer's representative of these products. Seminar to be held at job site and attended by all installers of hardware. Examples: Aluminum doors and carpentry installers. Seminar will address proper coordination and installation of exit devices, door closers, and weatherstripping, as detailed in the finish hardware schedule for this project, with the use of installation

manuals, hardware schedule, templates, physical product samples, and exit device installation videos.

1.4 SUBMITTALS

A. Hardware Schedules:

1. Submit proper number of Hardware Schedules to allow the Architect to retain two copies for his use, plus the number of copies required by the Contractor/Construction Manager for his distribution and use; but, do not submit more than six copies. Include the following:

- a. Door index, listing all doors by Architect's number, with Schedule page number where Hardware is itemized.
- b. Complete preface sheet, in the same order as the Specification, listing product categories only and manufacturers' names of items being furnished, as follows:

<u>CATEGORY</u>	<u>SPECIFIED</u>	<u>SCHEDULED</u>
Hinges	Manufacturer A	Manufacturer B
Locksets	Manufacturer X	Manufacturer X
Kick Plates	Open	Manufacturer Z

- c. Hardware locations: Refer to paragraph 3.1.B, Templates and Hardware Locations.
- d. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, material, frame material, and UL Listed.
- e. Hardware Description: Quantity, category, product number, and finish.
- f. Headings that refer to the specified Hardware Set Numbers.
- g. To facilitate checking, follow scheduling sequence specified in Hardware Sets and as outlined in Sequence and Format for the Hardware Schedule published by DHI.
- h. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
- i. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved".
- j. Typed copy.
- k. Double spacing of lines containing product details.
- l. 8-1/2 x 11 inch sheets.
- m. Consecutively numbered pages.
- n. U.S. Standard finish symbols or BHMA finish symbols.

2. Do NOT submit hardware catalog cuts.

1.5 Existing Conditions:

A. Where existing doors, frames and/or hardware are to remain, conditions, preparations and functions shall be field verified to confirm compatibility with specified hardware. Where any incompatibility is discovered, notify the contractor or construction manager immediately and provide a suggested solution based on industry standard business practices.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the Contractor/Construction Manager.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Requirements for function, size, and other distinctive qualities for finish hardware are specified in the "Hardware Sets" at the end of this Section.

B. Hinges:

1. Furnish class 5BB1 and size 4-1/2 x 4-1/2 inches, unless specified otherwise. Numbers specified are Ives.
- a. Equal products from any B.H.M.A. member will also be acceptable.

C. Locksets and Latchsets:

1. Mortise Locksets and Latchsets with Lever Trim.
- a. Function numbers are Schlage L9000 series with 17A lever trim. (No substitutions)

D. Exit Devices:

1. Panic exit and Fire exit Devices.
- a. Function numbers are Von Duprin 99 series. (No substitutions)

E. Push and Pull Hardware:

1. Push Plates: Plain design, wrought, 4 x 16 x 0.050 inches, square corners, beveled edges.
2. Pull Plates: Plain design with wrought plate 4 x 16 x 0.050 inches, square corners, beveled edges: 1 inch round rod, straight grip with 10 inch centers.
3. Furnish Push and Pull Hardware from any member of BHMA, except for products specified by particular manufacturers.

F. Closers & Low Energy Operators:

1. Review the door frame and plan details to determine the proper length of arm and the degree of swing. State the degree of door swing in the Hardware Schedule. Provide accessories such as drop and adapter plates, panel adapters, thick-hub shoes, blade stop spacers, and shoe supports as required to install door closers correctly.
- a. LCN 4000 series. (No substitutions)

G. Kick Plates:

1. Furnish 10 x 0.050 inches x door width less 2 inches at single doors, and less one inch at pairs.
 - a. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less two inches.
 - b. When specified to be installed above surface mounted automatic door bottoms, deduct height of door bottoms.
 - c. Drill and countersink screw holes for oval head undercut screws. Pan head screws are not acceptable.

H. Wall Stops:

1. Furnish with pictorial installation instructions illustrating downward slope of diagonal side.
 - a. Door Controls 3252
 - b. Ives WS33
 - c. Trimco 1298

I. Cylinders and Keying: All hardware components capable of being locked shall be provided with a cylinder as listed below. Cylinders shall be mortise or rim type as required by function of locking device. Provide cams or tail pieces as required.

1. Furnish cylinders factory master and grand master keyed to existing Best system, according to Owner's instructions. Furnish two change keys for each cylinder and master and grand master keys as required by Owner.
2. Supply cylinders with interchangeable construction cores for use during the construction period. Best Representative shall ship final cores to Owner who shall replace construction cores with final cores and return construction cores to Best Representative.
3. Furnish construction master keys as required by Contractor/Construction Manager.

J. Miscellaneous:

1. Furnish items not categorized in the above descriptions but specified by manufacturers' names in the Hardware Sets.

K. Fasteners:

1. Furnish fasteners of the proper type, size, quantity, and finish.
 - a. Use machine screws and lead anchors for attaching hardware to concrete or masonry.
 - b. Use wall grip inserts at hollow wall construction.
 - c. Install exit devices with fasteners supplied by the exit device manufacturer.
 - d. Attach closers with wood or machine screws.

L. Finishes:

1. Generally, Satin Chrome, US26D. Furnish finish for each item as indicated in sets.

M. Quantities

1. Furnish one hinge for each 30 inches of door height or fraction thereof.
2. Furnish one additional intermediate pivot for doors over 90 inches.
3. Furnish hinges, continuous hinges, electric hinges, pivot sets, electric pivots, roller latches, exit devices, push and pull hardware, closers, overhead holders and stops, kick plates, armor plates, door edgings, bumpers, stops, seals, automatic bottoms, bottom sweeps, stop strips, weatherstripping, and thresholds for both leaves of pairs and batteries unless specified otherwise.

PART 3 – EXECUTION

2.2 INSTALLATION

A. General:

1. Install hardware according to manufacturers' printed instructions and to template dimensions.
2. Refer to Cylinders and Keying in Part 2 of this Section regarding replacement of construction cores with final cores.

B. Templates and Hardware Locations:

1. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
2. Dimensions are from finish floor to centerline of items.
3. Include this list in Hardware Schedule.

CATEGORY

DIMENSION

Hinges	Door Manufacturer's Standard
Wall Stops	At Head
Roller Bumpers	At Head

C. Inspecting, Adjusting, and Demonstrating:

1. Provide the services of a hardware supplier's or manufacturer's representative to inspect and adjust each item of hardware to ensure proper installation and operation of every unit.
2. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
3. Instruct the Owner's personnel in adjustment and maintenance of the hardware.

2.3 HARDWARE SETS:

** NOT ALL FINISH HARDWARE SETS ARE USED **

HARDWARE SET NO. 01

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	SET	WEATHER SEAL	RE-USE EXISTING		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 02

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 03

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17A L583-363	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 04

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	DBL CYL STORE W/DB	L9466BDC 17A	626	SCH
1	EA	WALL STOP	WS33	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 05

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	DBL CYL STORE W/DB	L9466BDC 17A	626	SCH
1	EA	OH STOP	450S J	652	GLY

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 06

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8302 8" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 07

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17A L583-363	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 08

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 17A	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 09

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17A L583-363	626	SCH
1	EA	WALL STOP	WS33	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 10

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	WALL STOP	WS33	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 11

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	OH STOP	450S J	652	GLY

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 12

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	OFFSET PULL	908.09.899 X 909.39.099	WHT	HAF
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4021	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 12.1

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	OFFSET PULL	908.09.899 X 909.39.099	WHT	HAF
1	EA	OH STOP	90SE	630	GLY
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
1	EA	ESCUTCHEON	8310-874	689	LCN

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 13

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	OFFSET PULL	908.09.899 X 909.39.099	WHT	HAF
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4021	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 14

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	WALL STOP	WS33	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 15

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4111 CUSH ST-3220	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 15.1

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 16

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 17

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 18

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4111 CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

COORDINATE STOP REQUIREMENT WITH ADJACENT CONDITIONS.
THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 19

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	KEYED REMOVABLE MULLION	KR4954	689	VON
1	EA	PANIC HARDWARE	99-DT	626	VON
1	EA	PANIC HARDWARE	99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	SURFACE CLOSER	4111 EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 20

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB52	630	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4111 EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 21

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 22

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 23

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 24

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	WALL STOP/HOLDER	WS40	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 25

EACH TO HAVE:

8	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CONST LATCHING BOLT	FB51T	630	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
2	EA	WALL STOP/HOLDER	WS40	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 26

EACH TO HAVE:

3	EA	HINGE	5BB1 5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8302 8" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 27

EACH TO HAVE:

1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		
			BALANCE OF EXISTING HDWE TO REMAIN		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE
ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 27.1

EACH TO HAVE:

2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE
ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 28

EACH TO HAVE:

2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4111 CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FIRE/LIFE HOLDER	4040SEH	689	LCN
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE
ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 28.1

EACH TO HAVE:

2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 29

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	OFFSET PULL	908.09.899 X 909.39.099	WHT	HAF
1	EA	OH STOP	100SE	630	GLY
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PUSH BUTTON	BY SECURITY CONTRACTOR		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 30

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	DUMMY PUSH BAR	330	626	VON
1	EA	OFFSET PULL	908.09.899 X 909.39.099	WHT	HAF
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 31

EACH TO HAVE:

1	EA	CONT. HINGE	224HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4111 SCUSH ST-1586	689	LCN
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

FIELD VERIFY THE EXISTING FRAME PREPARATIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 32

EACH TO HAVE:

1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR BALANCE OF EXISTING HDWE TO REMAIN		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 33

EACH TO HAVE:

1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
			BALANCE OF EXISTING HDWE TO		
			REMAIN		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 34

EACH TO HAVE:

1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
			BALANCE OF EXISTING HDWE TO		
			REMAIN		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 35

EACH TO HAVE:

2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 36

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17A L583-363	626	SCH
1	EA	WALL STOP	WS33	626	IVE

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 37

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 38

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	STOREROOM LOCK	L9080BDC LLL 17A L283-150	626	SCH
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 39

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

HARDWARE SET NO. 40

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	WALL STOP	WS33	626	IVE

HARDWARE SET NO. 41

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	OH STOP	450S J	652	GLY

HARDWARE SET NO. 42

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	OH STOP	410S	630	GLY
1	EA	GASKETING	870AA	AA	ZER
1	EA	DOOR BOTTOM	369AA6	AA	ZER

HARDWARE SET NO. 43

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB52	630	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4111 EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

HARDWARE SET NO. 44

EACH TO HAVE:

ALL HDWE BY DOOR MFR

HARDWARE SET NO. 45

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB52	630	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4111 CUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

HARDWARE SET NO. 46

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	DBL CYL STORE W/DB	L9466BDC 17A	626	SCH
1	EA	OH STOP	450S J	652	GLY

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 47

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB52	630	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	OH STOP	90S	630	GLY
2	EA	SURFACE CLOSER	4011	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

HARDWARE SET NO. 48

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

HARDWARE SET NO. 49

EACH TO HAVE:

2	EA	CONT. HINGE	224HD	CPC	IVE
1	EA	KEYED FIRE RATED REMOVABLE MULLION	KR9954-STAB	689	VON
1	EA	FIRE EXIT HARDWARE	99-EO-F	626	VON
1	EA	FIRE EXIT HARDWARE	99-NL-OP-F-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE CLOSER	4111 SCUSH ST-1586	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	429A	A	ZER
1	EA	GASKETING	139N	A	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 50

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-17	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

HARDWARE SET NO. 51

EACH TO HAVE:

1	EA	CONT. HINGE	224HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4111 SCUSH ST-1586	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 52

EACH TO HAVE:

1	EA	STOREROOM LOCK	L9080BDC 17A BALANCE OF HDWE BY DOOR MFR	626	SCH
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HARDWARE SET NO. 53

EACH TO HAVE:

1	EA	CONT. HINGE	224HD	CPC	IVE
1	EA	DBL CYL STORE W/DB	L9466BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 SHCUSH SRI ST-1586	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 54 - NOT USED

HARDWARE SET NO. 55

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	OFFSET PULL	908.09.899 X 909.39.099	WHT	HAF
1	EA	OH STOP	100SE	630	GLY
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PUSH BUTTON	BY SECURITY CONTRACTOR		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 56

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	OFFSET PULL	908.09.899 X 909.39.099	WHT	HAF
1	EA	OH STOP	100SE	630	GLY
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PUSH BUTTON	BY SECURITY CONTRACTOR		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 57

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 58

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8302 8" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE

HARDWARE SET NO. 59

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

HARDWARE SET NO. 60

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 17A L583-363	626	SCH
1	EA	WALL STOP	WS33	626	IVE

HARDWARE SET NO. 61

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	WALL STOP	WS33	626	IVE
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 62

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 63

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	WALL STOP	WS33	626	IVE
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 64

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	OH STOP	100SE	630	GLY
1	EA	LOW-ENERGY OPERATOR	RE-USE EXISTING		
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER
1	EA	PROXIMITY READER	RE-USE EXISTING		
1	EA	POWER SUPPLY	RE-USE EXISTING		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 65

EACH TO HAVE:

2	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	KEYED REMOVABLE MULLION	KR4854-B	689	VON
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
2	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4021	689	LCN
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
2	EA	WALL STOP	WS33	626	IVE
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	GASKETING	139N	A	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER
1	EA	ELECTRONIC KEYPAD	BY SECURITY CONTRACTOR		
1	EA	PROXIMITY READER	RE-USE EXISTING		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 66

EACH TO HAVE:

2	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	KEYED REMOVABLE MULLION	KR4854-B	689	VON
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
2	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4021	689	LCN
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
2	EA	WALL STOP	WS33	626	IVE
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 67

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17A L583-363	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

HARDWARE SET NO. 68

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 69

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 17A L583-363	626	SCH
1	EA	OH STOP	450S	652	GLY

HARDWARE SET NO. 70

EACH TO HAVE:

1	EA	CONT. HINGE	224HD	CPC	IVE
1	EA	STOREROOM LOCK	L9080BDC LLL 17A L283-150	626	SCH
1	EA	DOOR PULL	VR900	630	IVE
1	EA	SURFACE CLOSER	4111 SCUSH ST-1586	689	LCN
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 71

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

HARDWARE SET NO. 72

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-DT	626	VON
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

HARDWARE SET NO. 73

EACH TO HAVE:

2	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	REMOVABLE MULLION	5654	628	VON
2	EA	PANIC HARDWARE	99-EO	628	VON
2	EA	SURFACE CLOSER	4111 SCUSH SRI	689	LCN
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

HARDWARE SET NO. 74

EACH TO HAVE:

1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR BALANCE OF EXISTING HDWE TO REMAIN		

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 75

EACH TO HAVE:

EXISTING HDWE TO REMAIN

HARDWARE SET NO. 76

EACH TO HAVE:

1	EA	ELECTRIC STRIKE	6211 FSE	630	VON
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR BALANCE OF EXISTING HDWE TO REMAIN		

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 77

EACH TO HAVE:

1	EA	ELECTRIC STRIKE	6211 FSE	630	VON
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	PROXIMITY READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR BALANCE OF EXISTING HDWE TO REMAIN		

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 78

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	OH STOP	90S	630	GLY

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 79

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	GASKETING	488S-BK	S-BK	ZER

HARDWARE SET NO. 80

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 17A L583-363	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE

HARDWARE SET NO. 81

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	ELECTRIC STRIKE	6211WF FSE	630	VON
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 82 (REVISED 12-04-17)

OPENING NO.

W-D124A

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4021	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN
1	EA	WALL STOP	WS33X	626	IVE
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 83

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW4	652	IVE
1	EA	EU MORTISE LOCK	L9095BDCEU 17A	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1	EA	PANIC BUTTON	BY SECURITY CONTRACTOR		

THE LEVERS ARE SECURE WHEN THERE IS NO POWER APPLIED.
THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODES.
COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 84 (REVISED 12-04-17)

OPENING NO.

W-D124B

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4021	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN
1	EA	WALL STOP	WS33X	626	IVE
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 85 (ADDED 12-04-17)

OPENING NO.

W-D112A W-D112B

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-17-SNB	626	VON
1	EA	SFIC RIM HOUSING	80-129	626	SCH
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	SURFACE CLOSER	4111 EDA	689	LCN

SECTION 087100
DOOR HARDWARE

1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33	626	IVE

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 86 (ADDED 12-04-17)

OPENING NO.

W-D134A

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	SURFACE CLOSER	4021	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN
1	EA	WALL STOP	WS33	626	IVE
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

HARDWARE SET NO. 87 (ADDED 12-04-17)

OPENING NO.

W-D134B

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	CPC	IVE
1	EA	PANIC HARDWARE	99-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	CONCEALED PULL	SL-82 BY DOOR MFR		
1	EA	OH STOP	100SE	630	GLY
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
1	SET	WEATHER SEAL	BY DOOR & FRAME MFR		
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	655A-MSLA-10	A	ZER
1	EA	ELECTRONIC KEYPAD	BY SECURITY CONTRACTOR		
1	EA	PROXIMITY READER	RE-USE EXISTING		

1 EA POWER SUPPLY BY SECURITY CONTRACTOR

FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

****END OF SECTION****

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Refer to specifications section 012300 "Alternates" for information regarding alternate pricing required

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Storefront framing.
 - 3. Glazed entrances.
 - 4. Interior borrowed lites.
- B. Safety Glass Where Required: Meet or exceed applicable current requirements of ANSI Z97.1 "Safety Glazing" and CPSC 16 CFR, Category II.

1.3 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: Not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."
 - b. Specified Design Snow Loads: Not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."
 - c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.
 - 1) For monolithic-glass lites heat treated to resist wind loads.
 - 2) For insulating glass.
 - 3) For laminated-glass lites.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 1/4 inch thick.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units with lites 1/4 inch thick and a nominal 1/2-inch- (12.7-mm-) wide interspace.
 4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).

- b. Solar Heat Gain Coefficient: NFRC 200.
- c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
 - 1. Samples:
 - 2. Each type and thickness of glass: three (3) samples, 12 inches square.
 - 3. Gaskets and Tapes: Three (3) samples, 6 inches long; each type and shape; molded corners for each type of gasket.
- B. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- D. Qualification Data: For installers.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain glass through one source from a single manufacturer for each glass type.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
- E. Safety Glazing Products including wired glass: Comply with testing requirements in CPSC 16 CFR 1201, Category II and ANSI Z97.1.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
 - 2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. (0.84 sq. m) in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. (0.84 sq. m) or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
 2. AAMA Publications: AAMA GD5G-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
1. Insulating Glass Certification Council.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Primary Glass Manufacturers:
 - a. AFG Industries, Inc.
 - b. Guardian Industries, Inc.
 - c. Pilkington Building Products North America
 - d. PPG Industries, Inc.
 - e. Viracon
 - f. Visteon Corp.

2.2 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 2. Heat Strengthened: Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 3. Tempered: Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
- C. Tinted Glass:
1. Product: Subject to compliance with requirements, provide Solarban 60 Gray as manufactured by PPG Industries, Inc. or equal by one of the above listed primary glass manufacturers
 2. Color: Gray
 3. Comply with the following properties for one-inch insulating glass with Low-E Coating:
 - a. Visible Light Transmittance: 49%
 - b. Summer U-Value: 0.28
 - c. Winter U-Value: 0.29
 - d. Solar Heat Gain Coefficient: 0.30
 - e. Shading Coefficient: 0.34
- D. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:
1. Interlayer: Polyvinyl butyral of 0.060 inch thickness unless indicated otherwise with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
 - a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.
 2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.
- E. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 4. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Polyisobutylene and polysulfide or silicone.

- 1) Silicone seal is required for all four sided or two sided structural glazing.
5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
- a. Spacer Material:
 - 1) Aluminum with mill or clear anodic finish for non-structurally glazed applications
 - 2) Aluminum with black, color anodic finish for structurally glazed applications.
 - b. Desiccant: Molecular sieve, silica gel, or blend of both.
 - c. Corner Construction: Manufacturer's standard corner construction.
- F. Low Emissivity-Coated Insulating Glass Units (Low-E): Manufacturer's standard unit with one pane coated with pyrolytic or sputtered, neutral colored, Low-E coating, on third surface of tinted insulating unit or second surface of clear insulating unit. See glass schedule for types and thicknesses.
1. Pyrolytic-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture, and complying with other requirements specified.
 2. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.

2.3 FIRE-RATED GLAZING PRODUCTS

- A. Film-Faced Ceramic Glazing Material: Proprietary Category II safety glazing product in the form of a 3/16-inch- (5-mm-) thick, ceramic glazing material polished on both surfaces, faced on one surface with a clear glazing film, and as follows:
1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Product: "FireLite NT" by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products.or SuperlitCSP
- B. Specially Tempered Monolithic Glass: Proprietary Category II safety glazing product in the form of a specially tempered 1/4-inch- (6.4-mm-) thick monolithic lite, and as follows:
1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Product: Subject to compliance with requirements, "SuperLite 1" by SAFTI; a Division of O'Keeffe's Inc.
- C. Gel-Filled, Dual-Glazed Units: Proprietary Category II safety glazing product in the form of two lites of Condition A (uncoated surfaces), Type I (transparent flat glass), Class 1 (clear), Kind FT (fully tempered) float glass; with a perimeter metal spacer separating lites and dual-edge seal enclosing a cavity completely filled with clear, fully transparent, heat-absorbing gel.

1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Product: Subject to compliance with requirements, "SuperLite II XL" by SAFTI; a Division of O'Keeffe's Inc.

2.4 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 Glazing Tape: Tremco #440; Shore A hardness of 10 at installation and not exceeding 20 upon aging.

2.5 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, black, and of profile and hardness required to maintain watertight seal:
 1. Silicone, ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
 1. Silicone.

2.6 GLAZING SEALANTS

- A. Sealant for Glazing: Meet requirements for materials and workmanship specified under Division 7 Section "Joint Sealants."
 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Neoprene or EPDM 70 to 90 Shore A Hardness as recommended by manufacturer; certified non-staining and compatible with sealant. Use EPDM for units set with silicone glazing sealant.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges and corners.
- C. Glazing Contractor, Glass Fabricator and Glass Manufacturer shall determine which areas require heat strengthening. The glazing contractor shall include in his bid and shall install heat strengthened glass where it is required by manufacturer and/or fabricator.

2.9 GLASS SCHEDULE

- A. Schedule of Glass Types:

GL-1 Annealed Insulating Glass:
 Exterior Lite: 1/4"
 Tint: Gray
 Airspace: 1/2"
 Interior Lite: 1/4"
 Tint: Clear
 Low-E Coating: #3 Surface.

GL-2 Tempered Insulating Tinted Glass:
 Exterior Lite: 1/4"
 Tint: Gray
 Interspace: 1/2"
 Interior Lite: 1/4"
 Tint: Clear
 Low-E Coating: #2 Surface.

- GL-3 90 minute fire rated door glass
For use in 60 & 90 minute door applications. Must comply with CPSC Category II. Nominal 1/4" thick polished ceramic glazing with impact film applied to one side. Basis of design is Superlite CSP as manufactured by SAFTI First, a division of O'Keeffe's Inc. (888)653-3333/(415)822-5222 fax. Or approved equal.
- GL-4 Tempered Monolithic Glass:
Tint: Clear
Thickness: 1/4"

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep system.
 3. Minimum required face or edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
1. Install glass in accordance with recommendations outlined in "Glazing Manual" and "Glazing Sealing Systems Manual" prepared by Flat Glass Marketing Association.
- B. Interior glazing shall be dryset with black glazing tape.
- C. Exterior glazing at entrance doors, sidelights, transoms, window wall frames, and similar members shall be installed with dryset gasket glazing.
- D. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- E. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- F. Apply primers to joint surfaces where required for adhesion of sealants.

- G. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- H. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- I. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- J. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- K. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

****END OF SECTION****

GYPSUM WALLBOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes the following:
1. Interior gypsum wallboard.
 2. Non-load-bearing steel framing.
 3. Fire rated gypsum wallboard assemblies.
 4. Sound Attenuation Blankets (acoustical Insulation) for non-load-bearing steel framed construction.
 5. Acoustical Sealant for gypsum wallboard assemblies.
- B. Related Sections include the following:
1. Division 06 Section "Rough Carpentry" for wood framing and furring, exterior gypsum sheathing, and air infiltration barriers.
 2. Division 07 Section "Polymer-Based Direct Applied Finish System (DEFS)" for polymer-based direct applied finish system.
 3. Division 07 Sections "Firestopping" and "Firestop Joint Systems" for fire-rated sealing systems for penetrations, head-of-wall joints, and joints with other construction in gypsum wallboard assemblies.
 4. Division 07 Section "Joint Sealants" for construction sealant and interior latex sealant other than Acoustical Sealant.
 5. Division 09 Section "Painting" for painting.

1.3 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SYSTEM DESCRIPTION

- A. In order to be acceptable, the appearance of all exposed wallboard surfaces in finished locations, after painting, shall be equivalent, in the judgment of the Architect, to the appearance of painted putty coat plaster surfaces and as follows:
1. The finish shall be equal to a Level 4 Finish as described in the current edition of the "Gypsum Construction Handbook" of the United States Gypsum Company.

B. Structural performance of fire rated shaft-wall assemblies:

1. Provide gypsum board shaft-wall assemblies capable of withstanding the full air-pressure loads indicated for maximum heights of partitions without failing and while maintaining an airtight and smoke-tight seal. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end-reaction shear causing track (runners) to bend or to shear and studs to become crippled.
2. Provide gypsum board shaft-wall assemblies for horizontal duct enclosures capable of spanning distances indicated within deflection limits indicated.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Lay-out drawings indicating proposed location of all control joints in metal-framed gypsum board partitions, walls, ceilings, bulkheads, fasciae and soffits. Coordination drawings for this purpose may be annotated copies of Construction Documents architectural floor plans, reflected ceiling plans and interior elevations. Submit prior to commencement of framing installation.

1.6 QUALITY ASSURANCE

- A. Comply with the provisions and recommendations of the United States Gypsum Company - "Gypsum Construction Handbook" (current edition) except where otherwise specified.
- B. Single-Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.
- C. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings and fire rated shaft-wall assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory," GA-600, "Fire Resistance Design Manual," or of other testing agency acceptable to authorities having jurisdiction.
- D. Sound Transmission Characteristics: For gypsum board assemblies and fire rated shaft-wall assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.
- C. Handle gypsum boards to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Minimum Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40°F (4°C). For adhesive attachment and finishing of gypsum board maintain not less than 50°F (10°C) for 48 hours prior to application and continuously thereafter until drying is complete.
- C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

1.9 SCAFFOLDING

- A. Provide necessary scaffolding and staging required for proper execution of wallboard work.
- B. Allow access and use of scaffolding by other trades whose work must be coordinated with wallboard work at no additional cost or back-charge and during regular working hours.

1.10 COORDINATION

- A. Make detailed inspection of all areas and surfaces to be covered.
- B. Verify dimensions, details, partition schedule and relationship to other work.
- C. Observe benchmarks and thickness of materials. Where diffusers or other accessories are mis-located notify installing trade with copy to the Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 STEEL PARTITION AND SOFFIT FRAMING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Framing and Furring:
 - a. Clark Steel Framing Systems.
 - b. Dale Industries, Inc. - Dale/Incor.
 - c. Dietrich Industries, Inc.
 - d. National Gypsum Company.
 - e. Unimast, Inc.
 - f. Western Metal Lath & Steel Framing Systems.
- B. Components, General: As follows:
 - 1. Comply with ASTM C 754 for conditions indicated.

2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating. **“EQ coatings” and “galvannealed” products are not acceptable.**
- C. Steel Studs and Runners: ASTM C 645.
1. Minimum Base Metal Thickness: 0.030 inch (0.762 mm). **Equivalent thickness (“EQ”) steel stud material is not acceptable.**
 2. Depth: As indicated.
- D. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm), unless otherwise indicated on drawings.
- F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
 - a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
 2. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.
 - b. Basis-of-Design Product: ClarkDietrich Building Systems “Resilient Channel RC Deluxe (RCSD) or equal.
- G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
- H. Channel Bridging and Bracing: Steel, 0.0538-inch (1.37mm) minimum base-metal thickness, with minimum 1/2-inch (13-mm) wide flanges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Systems Spazzer 9200 Bridging and Spacing Bar, or equivalent.
- I. Slotted Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and width to accommodate depth of studs:
1. Basis-of-Design Product: ClarkDietrich Building Systems “Blazeframe DSL”, or approved equal.
- J. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: Gypsum core wall panel surfaced with a natural-finish face paper on front and a liner paper on back. Comply with ASTM C36 and the following:
 - 1. Type X:
 - a. Thickness: 5/8 inch (15.9 mm).
 - b. Long Edges: Tapered.
 - c. Location: As indicated and where required for fire-resistance-rated assembly.
 - 2. Products: Subject to compliance with requirements, provide one of the following, or approved equivalent products:
 - a. BPB America Inc., ProRoc products.
 - b. Georgia-Pacific Corp., ToughRock Gypsum Board products.
 - c. National Gypsum Company, Gold Bond Brand products.
 - d. United States Gypsum Co., Sheetrock Brand Gypsum products.
- C. High Impact, Abuse-Resistant Gypsum Wallboard: ASTM C 36, manufactured to produce greater resistance to surface indentation and through-penetration than standard gypsum panels.
 - 1. Gypsum core wall panel surfaced with heavy abrasion-resistant paper on front and a heavy liner paper on back. In addition a fiberglass mesh is embedded in the core towards to back side of the panel.
 - a. Type: X
 - b. Thickness: 5/8 inch (15.9 mm).
 - c. Long Edges: Tapered.
 - d. Location: As indicated.
 - e. Products: Subject to compliance with requirements, provide one of the following or an equivalent approved product:
 - 1) United States Gypsum Co., Mold Tough VHI Firecode X Panels.
 - 2) National Gypsum Company, Hi-Impact XP Brand Wallboard.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Corner bead: Use at outside corners.
 - 1) Product: U.S. ClarkDietrich 103 Deluxe Corner Bead, or equal.
 - b. LC-Bead (Casing Bead): J-shaped; exposed long flange receives joint compound; use at exposed panel edges and where indicated.
 - 1) Product: ClarkDietrich M20A U-Trim, Spakle J., or equal.

- c. L-Bead (Casing Bead): L-shaped; exposed long leg receives joint compound; use where indicated.
 - 1) Product: ClarkDietrich M20B Metal I-Trim, or equal.
 - d. Control Joint: Use at control joint locations in walls, ceilings, bulkheads, fasciae and soffits:
 - 1) Basis-of-Design Product: ClarkDietrich 093 Zinc Control Joint, or equal.
 - 2) Back to back casing beads may be used in lieu of prefabricated control joint trim. Provide backer and sealant to finish opening between beads with materials appropriate to conditions of installation.
 - e. Curved-Edge Cornerbead: With notched or flexible flanges for use at curved openings.
 - 1) Product: U.S. Gypsum Sheetrock Flexible Metal Corner Tape or equal.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFS Specialty Metal Products
 - b. Fry Reglet Corp.
 - c. MM Systems Corporation.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), alloy 6063-T5.
 - 3. Finish: Refer to Drawings.
 - a. Corrosion-resistant primer compatible with joint compound and finish materials specified.
 - b. Factory-finished in color selected by Architect from manufacturer's full line.
 - 1) Class II anodic.
 - 2) Baked-enamel finish.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound or drying-type, all-purpose compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish (where indicated) use setting-type, sandable topping compound or drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat Water-Resistant Backing Board: As recommended by manufacturer.

2.6 SOUND ATTENUATION BLANKETS (ACOUSTICAL INSULATION) AND ACOUSTICAL SEALANT

A. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Density: 2.5 pounds per cubic foot.
3. Thickness: 3 inches unless indicated otherwise on the drawings
4. Products: Subject to compliance with requirements, provide the following:
 - a. Thermafiber Sound Attenuation Fire Blankets as manufactured by United States Gypsum Co.

B. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

C. Products: Subject to compliance with requirements, provide the following:

1. Acoustical Sealant for Concealed Joints:
 - a. Tremco, Inc.; Tremco Acoustical Sealant.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate and for adhering second layer of wallboard to first layer.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to cold formed metal framing and steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
 - D. Isolation Strip at Exterior Walls:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.
 - E. Thermal Insulation: As specified in Division 07 Section "Building Insulation."
 - F. Polyethylene Vapor Retarder: As specified in Division 07 Section "Building Insulation."
- 2.8 FIRE RATED ASSEMBLIES
- A. General: Comply with requirements of Fire Rated Shaft-wall Assemblies indicated.
 - 1. Products: Subject to compliance with requirements, provide assemblies by one of the following:
 - a. Georgia-Pacific Corp.
 - b. National Gypsum Company
 - c. United States Gypsum Co.
 - 2. Sustained Air-Pressure Loads: 7.5 lbf/sq. ft. (0.36 kPa).
 - 3. Deflection Limit: L/240.
 - B. Gypsum Wallboard: ASTM C 36, core type as required by fire-resistance-rated assembly indicated.
 - C. Studs: Manufacturer's standard profile for repetitive members and corner and end members and for fire-resistance-rated assembly indicated.
 - 1. Depth: As indicated.
 - 2. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.
 - D. Track (Runner): Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (51 mm), in depth matching studs.
 - 1. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.
 - E. Room-Side Finish: Gypsum board.
 - F. Cavity Insulation: Sound attenuation blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Control Joint Layout: Prior to commencement of framing installation submit coordination drawings indicating proposed control joint locations in metal-framed gypsum board partitions, walls, ceilings, bulkheads, fasciae and soffits, for review and acceptance of Architect.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 - 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use deep-leg deflection track where indicated.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.
- E. General requirements and locations of control joints in metal-framed gypsum board construction:
 - 1. General: Comply with requirements of ASTM C840, and as noted below:
 - 2. Control joints shall be constructed with manufactured control joint trim, or field fabricated from materials as specified.
 - 3. Control joints will be installed where a partition, wall, or ceiling traverses and construction joint (expansion, or building control element) in the base building structure.
 - 4. Control joints will be installed where a wall or partition extends in an uninterrupted straight plane exceeding 30 linear feet. Door and/or window frames that extend full height of partitions will be considered equivalent to control joint construction.
 - 5. Control joints in interior ceilings, bulkheads, fasciae and soffits will be installed so that linear dimensions between control joints do not exceed 30 linear feet and total area

between control joints does not exceed 900 square feet. Control joints will be installed to isolate wings of "L", "U" and "T" shaped ceiling and soffit areas.

6. A control joint will be installed where ceiling, bulkhead, fascia and soffit framing members change direction.
 7. Provide appropriate backing material, fire-safing insulation, and sealant for control joints installed in acoustical or fire-rated construction, as required to maintain fire-rating and/or acoustical separation.
- F. All mechanical heating and cooling system components shall be independently supported; not supported by gypsum board framing system.
- G. Provide gypsum panel bulkheads and closures where ducts penetrate fire separations.

3.4 INSTALLING STEEL PARTITION FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
1. Where studs are installed directly against exterior walls, install foam-gasket isolation strip between studs and wall.
 2. Anchor tracks 24 inches o.c. with not less than two fasteners per section.
 - a. Review electrical conduit layout in slab, avoid penetration of conduits running directly below walls.
 3. Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.
 4. Allow for differential movement between floors and at roofs by use of nested runners unless otherwise noted.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
1. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
 2. Metal studs which cannot extend full height to structure above, due to interference with ductwork and the like, shall be tied to cross stiffening, or diagonal bracing to structure above.
 3. Terminate partition framing at suspended ceilings where indicated.
 4. Interrupt metal framing (including top and bottom tracks) with a 1/2-inch gap at all control joint locations. Provide back to back studs and or framing for each control joint flange. Provide appropriate backing material, fire-safing insulation, and sealant for

control joints installed in acoustical or fire-rated construction, as required to maintain fire-rating and/or acoustical separation.

- D. Install supplementary framing, blocking, backing plates and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work.
- E. Install steel studs and furring at the following spacings:
 - 1. Single-Layer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
 - 2. Multilayer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
- F. Install horizontal stiffeners in stud system, spaced (vertical distance) not more than 4'-6" o.c. Install stiffeners in accordance with manufacturer's instructions using recommended fasteners.
- G. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- H. Acoustical Partition:
 - 1. Typical Partition: Steel channel studs with one or two layers of wallboard each side, with or without blanket insulation between the studs.
 - 2. Lay all runners in mastic or caulk between wallboard and floor.
 - 3. Caulk all top and bottom joints between the wallboard and structure.
 - 4. Tape other joints and spackle partition thoroughly airtight.
- I. Sound Insulation (where indicated): Install in accordance with manufacturer's recommendations.
- J. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Install two studs at each jamb, unless otherwise indicated.
 - 2. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- K. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- L. Z-"CONT. CC Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.

3.5 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- K. Hold gypsum panels free from all surfaces subject to condensation or moisture.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.6 PANEL APPLICATION METHODS

A. General:

1. Plenum wall, ceiling drops, skirts or baffles that are beyond reach of user or occupant are to be constructed to meet L/120 deflection criteria.
2. Partitions, ceiling drops, baffles or other assemblies within user or occupant contact or with painted or vinyl finishes or that some vibration or movement is not detrimental to perceived structural integrity shall be constructed to meet L/240 deflection criteria.
3. Do not proceed with work until temperature and humidity of building meet requirements of manufacturer's standard specifications.
4. Fastening system shall be power driven drywall screws. Where hand driven fasteners are used, double nailing will be required.
5. Set all nails and screws to slightly dimple, but not break surface of board. Space nails 6 to 8 inches, 3/8 inch from edges, staggered at joints; double spacing for screws.
6. Repair areas scarified or otherwise damaged by cutting out damaged areas, back blocking set with adhesive, and patching with patching plaster.
7. Grout anchors for door frames. Jamb board into door frame to provide rigidity. Full grout frames at label doors, shaftwall, and elsewhere as indicated.
8. Metal studs with finish one side are to receive stiffener channels at no more than 4'-6" maximum spacing.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

C. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

1. Z-Furring Members: Apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with

vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

- D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- E. Multilayer Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners unless otherwise indicated or required by fire-resistance-rated assembly.
- F. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.7 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations specified and per reviewed Coordination Drawings, subject to Architect's approval. Install control joint trim in accordance with manufacturer's recommendations.
- C. All aluminum in contact with joint compound shall have contact faces treated with zinc chromate primer.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 - 1. Apply perforated tape and compound at all joints, at inside corner and as required to conceal all fasteners and finish off all trim. Protect outside corners with corner beads.
 - 2. Finished appearance shall be perfectly smooth so that, after painting, there shall be no evidence of taping or patching. Areas where the location of joints or fasteners may be determined by visual inspection due to bulges, irregularities in surface of variations in texture, will be considered defective.
 - 3. If dry-out or over-sanding of finish coat of compound leaves surface requiring special treatment or sealing, provide such sealer or treatment and leave entire surface acceptable to the finishing trades as specified under Division 9 Section "Painting."
 - 4. Repair all nail pops, wrinkles, buckles and other defects occurring during the Guarantee period and make good all damage to other work resulting from such repairs.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Only for surfaces not exposed to view or indicated to receive finish painting or other finish materials (e.g. above level of finish ceilings, plenums, etc.)
2. Level 4: All surfaces exposed to view where other finish levels are not specified.

3.9 FIRE RATED ASSEMBLIES

- A. General: Install gypsum board assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Fire ratings are as indicated and as required by Code.

3.10 ACOUSTICAL BULKHEADS IN PLENUM SPACE

- A. Provide acoustical separation by bulkhead in ceiling plenum space where indicated.
- B. Bulkhead: Tight assembly of screw studs and wallboard with all cracks sealed or gasketed. Bulkheads between adjacent rooms require wallboard on one side only (where so indicated.).
- C. Coordinate with acoustical ceiling work.

3.11 PATCHING AND REPAIRS

- A. Prior to start of painting or installation of wall covering, neatly and accurately patch and repair all damaged wallboard to match finish of adjoining work. Cut out cracks, damaged areas, blemished, defective portions and re-work to match adjacent area.
- B. Apply chemical treatment where required to remedy defects.
- C. After sizing and seal coats have been applied, as specified under Division 9 Section "Painting," patch and repair any hair cracks or fine cracks which become visible, as necessary to render finish painting free from visible cracks.

3.12 CLEAN UP

- A. Upon completion of the work, in each area, brush all surfaces clean including floors, ledges and other areas carrying droppings or debris resulting from the work.
- B. Upon completion of work in any area or as often as directed, remove from the premises and legally dispose of all surplus materials, and construction debris.
- C. Do not bury lime or gypsum materials on the site.

END OF SECTION

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of acoustical ceilings.
 - 1. Acoustical panel ceilings installed with exposed suspension systems.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 15 for grilles, registers, and diffusers and sprinkler heads in acoustical ceilings.
 - 2. Division 16 for lighting fixtures in acoustical ceilings.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual acoustical units or sections of units showing full range of colors, textures, and patterns available for each type of unit indicated.
- D. Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.
 - 1. 6-inch-square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.
- E. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
- F. Product test reports from qualified independent testing laboratory that are based on its testing of current products for compliance of acoustical ceiling systems and components with requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.
- B. Fire-Performance Characteristics: Provide acoustical ceilings that are identical to those tested for the following fire-performance characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 - 2. Fire-Resistance Ratings: As indicated by reference to design designations in UL "Fire Resistance Directory," for types of assemblies in which acoustical ceilings function as a fire-protective membrane and tested per ASTM E 119.
 - a. Protect lighting fixtures and air ducts to comply with requirements indicated for rated assembly.
- C. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- E. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition system (if any).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.7 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with appropriate labels.
1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
 2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS

- A. Manufacturer: Subject to compliance with requirements provide products as follows:
1. ACT1 USG Interiors
Radar ClimaPlus
Item No.: 2210
Size: 24" x 24" x 5/8"
Edge: SQ
Color: White
Or Equal By: Armstrong, CertainTeed
 2. ACT2 USG Interiors
Radar ClimaPlus
Item No.: 2215 (firecode panel)
Size: 24" x 24" x 5/8"
Edge: SQ
Color: White
Or Equal By: Armstrong, CertainTeed

2.2 METAL SUSPENSION SYSTEMS

- A. Suspension systems shall conform to ASTM C-635 for "intermediate duty" classification, except that where quantity or weight of ceiling fixtures would create deflection of greater than 1/360 of the span length, "heavy duty" system shall be used or ceiling grid shall be reinforced in a manner to maintain deflection of less than 1/360 of the span length. The General and Supplementary Conditions shall take precedence over Section 6 (Inspection) of ASTM C-635. All recessed light fixtures shall be supported by main runners on not less than two opposite sides.
1. Exposed portions shall receive a factory applied matte white baked enamel finish.
- B. Manufacturer: Subject to compliance with requirements provide products as follows:
1. Grid at ACT1:
 - a. USG Interiors
Donn DX Suspension System with 15/16" Exposed Face
Color: White
Or Equal By: Armstrong, CertainTeed

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer's instructions and CISCA "Ceiling Systems Handbook."
 - 1. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C 636.
- B. Arrange acoustical units and orient directionally patterned units (if any) in a manner shown by reflected ceiling plans.
- C. Suspend ceiling hangers from building structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 5. Do not support ceilings directly from permanent metal forms; furnish cast-in-place hanger inserts that extend through forms.
 - 6. Do not attach hangers to steel deck tabs.

7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 8. Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.
- D. Install edge moldings of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.
1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.
 2. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.
- E. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.
1. Install hold-down clips in areas indicated and in areas where required by governing regulations or for fire-resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

****END OF SECTION****

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes, labor, materials and equipment for Painting and Finishing.
- B. The following sections contain requirements that relate to this Section:
 - 1. Division 06 Section "Interior Architectural Woodwork" for factory finished millwork.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 - 1. Submit 8-1/2 x 11 color downs on heavy paper to match Architect's color chips for each color and type of paint specified for Architect's approval.
 - a. Architect will furnish a schedule after beginning of construction. The schedule will include color chips for matching.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Material Certificates: For scrub resistance and washability, signed by manufacturers.

1.4 QUALITY ASSURANCE

- A. Architect has the option of requesting test patches in place for Architect's approval of final color and finish.
 - 1. Notify Architect 48 hours in advance of the time the test patches will be ready for inspection.
- B. Manufacturer shall certify that tests have been performed on semi-gloss wall finish and others as selected by the Architect. Acceptance of materials is conditional upon demonstration of washability and abrasion resistance of test patches. Testing shall include the following:
 - 1. Scrub resistance per ASTM D2486-79: Value as specified in approved finish schedule but not less than 1200.
 - 2. Washability per ASTM D3450-80: Value as specified in approved finish schedule but not less than 80% for sponge and 90% for brush.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.
 - a. Do not store oil or paint soaked rags inside the building.
 - 3. Do not store materials in any room containing a direct-fired heating unit.
- B. Mix and thin paints in strict accordance with recommendations of the manufacturer.
 - 1. Mix paints only in areas designated, and provided proper protection for walls and floors.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply interior paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce manufacturer and product lists, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.3 COLORS

- A. The Architect has the option of accenting certain building elements different colors; (i.e.: doors, frames, columns, ceilings, walls) to be defined in a Schedule.
- B. The Architect reserves the right to select colors from manufacturer's standard or premium price groups, including deep tone colors for both interior and exterior products.

- C. Furnish an equal product by the same manufacturer only in those instances where a deep tone color specified by the Architect is not available in the specified product. This is subject to Architect's approval.
- D. Tinted primer shall be used whenever deep tone colors are specified.

2.4 EXTERIOR FINISHES

- A. Ferrous Metals (i.e. doors, railings, fences, lintels, etc.):
 - 1. First Coat: (If flash rusting occurs, use two coats)
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
 - 2. Second and Third Coats:
 - a. Sherwin Williams: DTM Acrylic Gloss Coating (Water Reducible), B66-100
- B. Concrete, Masonry, Concrete Block, and Stucco - Sealer:
 - 1. First and Second Coats: Apply per manufacturer's recommendations.
 - a. United Coatings Inc; Canyon Tone Stain. Custom colored.
 - b. No substitutions shall be accepted.
- C. Cementitious Materials:
 - 1. Preparation: Add a prime coat if recommended by manufacturer (for a total of 3 coats).
 - 2. Two Coats:
 - a. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series
- D. Composition Board, Hardboard, Fiberboard:
 - 1. First Coat:
 - a. Sherwin Williams: Exterior Latex Wood Primer B42W8041
 - 2. Second and Third Coats:
 - a. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series
- E. Wood:
 - 1. First Coat:
 - a. Sherwin Williams: Exterior Latex Wood Primer B42W8041
 - 2. Second and Third Coats:
 - a. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series
- F. Previously Painted Cement Plaster (new cement plaster shall remain unpainted):
 - 1. First Coat:
 - a. Sherwin Williams: Exterior Latex Wood Primer B42W8041

2. Second and Third Coats:
 - a. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series

G. Exterior Structural Steel exposed to view.

1. For warranty purposes, the Contractor shall insure that the specified primer in Division 5 "Structural Steel" and the intermediate and finish coats specified below are from the same manufacturer.
 - a. No coatings shall be applied until approved by the Architect and Owner's Representative.
2. Prime Coat: Refer to Division 5, "Structural Steel."
3. Intermediate Coat:
 - a. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.
4. Finish Coat:
 - a. Sherwin Williams: One (1) coat Acrolon 218 HS @ 3-6 mils DFT.

2.5 INTERIOR FINISHES

A. Plaster and Gypsum Board Ceilings and Ceiling Drops

1. First Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
2. Second Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Latex Flat B30 Series
3. Third Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Latex Flat B30 Series

B. Plaster and Gypsum Board Walls and Columns – Non-epoxy:

1. First Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
2. Second and Third Coats:
 - a. Sherwin Williams: ProMar 200 Zero VOC Latex Eg-Shel B20 Series

C. Dry-Erase Coating (PT2)

1. Preparation:
 - a. Gypsum board surface: Recess nails and screws. Repair irregular tape joints, sand and remove dust.

- b. Painted surface: Remove loose paint or scale. Sand surface of enamel or gloss paint and remove dust with tack cloth or denatured alcohol.
- c. Ensure gypsum wallboard surfaces scheduled to receive dry-erase coatings are properly primed with Manufacturer recommended primer.
2. Apply paint in strict accordance with Manufacturer's instructions.
3. Subject to compliance with requirements, provide the following product:
 - a. Latex Coat:
 - 1) Apply latex paint to substrate in accordance with "Plaster and Gypsum Board Walls and Columns – Non-epoxy" as indicated above.
 - 2) Allow latex top coat to dry for at least 24 hours prior to applying FUZE CREATE WHITE.
 - b. Dry-Erase Coat:
 - 1) Distributor: MDC Wallcoverings:
 - 2) White Fuze High Performance Dry Erase Paint providing a surface suitable for use of dry erase markers
 - 3) Mix components in strict accordance with manufacturer's instructions. Pot life is 4 hour maximum.
 - 4) Coating shall cure for a minimum of 5 days after application before use.
 - c. Accessories:
 - 1) Roller covers: Manufacturer Provided Only
 - 2) Aluminum Tray Silver ME-2001 as indicated on drawings. Install in strict accordance with Manufacturer's instructions.
 - d. Manufacturer's Representative: Rebecca Knorek (419) 450-7875.
- D. Plaster and Gypsum Board Walls and Columns - Epoxy:
 1. First Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
 2. Second and Third Coats:
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- E. Existing Painted Plaster and Gypsum Board Walls and Columns - Epoxy:
 1. Sample Patch: Prepare a 36" x 36" minimum test area to see if a reaction occurs between existing and new finishes prior to proceeding with the specified work. If a reaction occurs, alert Architect and propose solution(s).
 2. First Coat: Barrier Coat Primer
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600 (bare spots and patches)

3. Second and Third Coats:
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- F. Concrete Block - Sealer:
1. First and Second Coats: Apply per manufacturer's recommendations.
 - a. United Coatings Inc; Canyon Tone Stain. Custom colored.
 - b. No substitutions shall be accepted.
- G. Masonry Block:
1. First Coat: Masonry block filler at rate not to exceed 100 sq. ft. per gal.
 - a. Sherwin Williams: Pro Mar Interior/Exterior Block Filler B25W25
 2. Second and Third Coats – Non-epoxy.
 - a. Semi-Gloss Latex Enamel Finish: Two (2) Coats over filled surface with total dry film thickness not less than 3.5 mils, excluding filler coat.
 - 1) Sherwin Williams: ProMar 200 Zero VOC Latex Semi-Gloss B31 Series
 3. Second and Third Coats - Epoxy.
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- H. Existing Painted Masonry Block – Epoxy:
1. Sample Patch: Prepare a 36" x 36" minimum test area to see if a reaction occurs between existing and new finishes prior to proceeding with the specified work. If a reaction occurs, alert Architect and propose solution(s).
 2. First Coat: Barrier Coat Primer
 - a. Sherwin Williams: Loxon Masonry Primer A24W8300 (patches and bare spots)
 3. Second and Third Coats.
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- I. Poured Concrete Walls and Ceilings:
1. Preparation: Clean all concrete with 5% solution of muriatic acid and rinse thoroughly and allow to dry.
 2. First Coat:
 - a. Sherwin Williams: Loxon Masonry Primer A24W8300
 3. Second and Third Coats:
 - a. Sherwin Williams: ProMar 200 Zero VOC Latex Flat B30 Series.
- J. Concrete Floors - Epoxy:

1. Preparation:
 - a. Surfaces shall be clean and dry.
 - b. Mechanically abrade surface to achieve a texture of medium grade sandpaper.
 - c. Sweep or vacuum all residues.
 2. First Coat:
 - a. Sherwin Williams: Armorseal 33 Epoxy Primer Sealer
 - 1) Apply one coat of Armorseal 33 Epoxy Primer Sealer and spread at 200 sq. ft. per gallon.
 - 2) Allow 6 hours between coats.
 3. Second Coat:
 - a. Sherwin Williams: 650 SL/RC Self Leveling Recoatable 100% Solids Epoxy
 - 1) Apply one coat of 650 SL/RC and spread to 50-160 sq.ft. per gallon.
 - 2) Allow 24 hours for foot traffic – 7 days for full cure.
- K. Existing Structural Glazed Facing Tile Walls and Existing Ceramic Tile Walls
1. Preparation:
 - a. Clean well with heavy duty degreaser.
 - b. Mechanically abrade to thoroughly remove gloss as recommended by the manufacturer of the epoxy wall paint.
 2. Primer, if recommended by the manufacturer:
 - a. Sherwin Williams: Adhesion Primer B51W8050
 3. First and Second Coats:
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- L. Acoustical Wood Fiber Panels and Cementitious Wood Fiber Deck - Non-bridging paint:
1. First and Second Coats: Apply per manufacturer's recommendations.
 - a. ProCoat Products, Inc.; ProCoustic Acoustical Tile and Ceiling Coating, custom color. Phone: 781-767-2270.
- M. Exposed Ceiling Construction - Dry Fall Paint.
1. Preparation: Spot prime any welds, etc.
 2. First Coat:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
 3. Second and Third Coats: (if deep tone colors are specified, the products below shall be factory mixed)
 - a. Sherwin Williams: Low VOC Waterborne Acrylic Dryfall Flat B42W81

N. Ferrous, Galvanized Metals, Aluminum

1. Preparation:
 - a. See Divisions 5 and 8 for requirements for priming of ferrous metals.
 - b. Do all touch up and priming of unprimed metals in accordance with requirements of Divisions 5 and 8.
2. Apply paint in accordance with Steel Structure Painting Council Paint Application Specifications SSPC-PA1 to a dry film thickness as specified by the manufacturer.
3. First Coat - Primer:
 - a. Ferrous metal (to be used even at shop primed items except as noted in Division 5):
 - 1) Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
 - b. Galvanized metal after thorough cleaning per SSPC-SP1 with water soluble degreaser. No hydrocarbons.
 - 1) Sherwin Williams: ProCryl Universal Metal Primer B660310 Series
 - c. Aluminum:
 - 1) Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
4. Second and Third Coats:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.

O. Structural Steel, Interior Wet or Severe - Exposed:

1. For warranty purposes, the Contractor shall insure that the specified primer in Division 5 "Structural Steel" and the intermediate and finish coats specified below are from the same manufacturer.
 - a. No coatings shall be applied until approved by the Architect and Owner's Representative.
2. Prime Coat: Refer to Division 5, "Structural Steel."
3. Intermediate Coat:
 - a. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.
4. Finish Coat:
 - a. Sherwin Williams: One (1) coat Acrolon 218 HS @ 3-6 mils DFT.

P. Galvanized Steel including galvanized decking and all steel in pool environments:

1. For warranty purposes, the Contractor shall insure that the specified primer in Division 5 "Steel Deck" and the intermediate and finish coats specified below are from the same manufacturer.

- a. No coatings shall be applied until approved by the Architect and Owner's Representative.
 2. Prime Coat: Refer to Division 5, "Steel Deck."
 3. Intermediate Coat:
 - a. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.
 4. Finish Coat:
 - a. Sherwin Williams: One (1) coat Acrolon 218 HS @ 3-6 mils DFT.
- Q. Painted Woodwork including any interior window sash and trim:
1. Coordinate with "Interior Architectural Woodwork" Section to verify Scope of Work to be finished by Millwork Contractor.
 - a. First Coat:
 - 1) Sherwin Williams: Premium Wall & Wood Primer B28W8111
 - b. Second Coat:
 - 1) Sherwin Williams: ProMar 200 Interior Waterbased Acrylic-Alkyd B33W8251
- R. Natural Finished Woodwork:
1. Coordinate with "Interior Architectural Woodwork" section to verify Scope of Work to be finished by Millwork Contractor.
 - a. First Step:
 - 1) Wood Filler, applied as per manufacturer's instructions
(Do not apply filler to open grained wood)
 - a) Benjamin Moore: Benwood Paste Wood Filler 238
 - b. Second Step: Stain, as needed to achieve color as per Architect; applied as per manufacturer's instructions. The following products or equal as approved by Architect:
 - 1) Sherwin Williams: Wood Classic 250 VOC Stain.
 - c. Third Step: Sanding Sealer, if recommended by the manufacturer.
 - d. Fourth Step: Two (2) Finish Coats
 - 1) Sherwin Williams: Wood Classic Waterborne Polyurethane Varnish, A68 Series.

2.6 MECHANICAL

- A. Apparatus, Equipment, and Equipment Supports

1. First Coat:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
 2. Second Coat:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.
- B. Exposed Bare Piping, Valves, Fittings, and Hangers:
1. First Coat:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 2. Second Coat:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.
- C. Exposed Insulation Piping, Valves, Fittings, and Hangers when canvas wrapped:
1. First Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
 2. Second Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Flat B30 Series.
- D. Insulated Ductwork and Piping with Canvas Covering Inc. Hangers for any kind of ductwork.
1. One Brush Coat:
 - a. Pittsburgh Paints: 42-7, Speedhide Interior Fire Retardant Flat Latex.
- E. Grilles, Registers, and Diffusers
1. First Coat:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 2. Second and Third Coats:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.
- F. Exterior Ductwork Exposed to Weather
1. First Coat (Heavy coat of one of the following):
 - a. Sherwin Williams: Macropoxy 646 Fast Cure, B58-600/B58V600.
 2. Second and Third Coats (allow 24 hours drying time after first coat):
 - a. Sherwin Williams: Hi-Solids Polyurethane B65-300.

2.7 ELECTRICAL

- A. Exterior Exposed Electrical Conduit Fittings, Boxes, and other miscellaneous exterior electrical items.
 - 1. First Coat - Galvanized:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 - 2. First Coat - Ferrous Metal:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 - 3. Second and Third Coats:
 - a. Sherwin Williams: DTM Acrylic Gloss Coating (Water Reducible), B66 Series
- B. Interior Exposed Electrical Items in areas where walls and/or ceilings are painted including electrical panels, cabinets, exposed conduit, etc.
 - 1. First Coat - Galvanized:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 - 2. First Coat - Ferrous Metal:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 - 3. Second and Third Coats:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION OF NEW SUBSTRATES

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Clay Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceed that permitted in manufacturer's written instructions.
- F. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- G. Ferrous Metals, Galvanized Metal, Aluminum: Clean surfaces according to the Steel Structure Painting Council Surface Preparation Specifications: SSPC-SP1 Solvent Cleaning, SSPC-SP2 Hand Tool Cleaning, or SSPC-SP3 Power Tool Cleaning, as appropriate.
 1. Steel Substrates: Remove any rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 2. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 - a. Thoroughly clean galvanized metal per SSPC-SP1 with water soluble degreaser. No hydrocarbons.
 3. Aluminum Substrates: Remove surface oxidation.
- H. Wood Substrates:
 1. Refer to Division 6 Section "Finish Carpentry and Millwork" for preparation specified under other trades.

2. Countersink all nails and finish with putty or plastic wood filler. Sand smooth when dried.
 3. Sand surfaces that will be exposed to view, and dust off.
 4. Prime edges, ends, faces, undersides, and backsides of wood.
 5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- J. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.
- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 PREPARATION OF EXISTING SUBSTRATES

- A. Preparation of Previously Painted Surfaces: Comply with requirements as specified for preparation of new substrates as well as the following:
1. Scrub clean existing surfaces with a stiff brush and a solution of clean water and mild detergent.
 2. Scuff sand surface to allow new finish to hold.
 3. De-gloss painted surfaces in a manner appropriate to the substrate.
 4. Fill cracks, holes, voids and defects, and leave a smooth surface ready for application of primer.
 5. Remove loose paint and feather edges or patch as required to provide a smooth, seamless finish.
 6. Prepare a 36" x 36" minimum test area to see if a reaction occurs between existing and new finishes prior to proceeding with the specified work. If a reaction occurs, alert Architect and propose solution(s).

3.4 PRIMING AND BACKPRIMING OF WOOD

- A. All wood, factory finished or otherwise, must be back-primed immediately upon delivery with interior trim primer specified for wood which is to be painted, or finish manufacturer's recommended protective pre-treatment for wood which is to have natural finish.
- B. Apply first coat to all wood scheduled to receive natural finish before material is handled at the site by other trades.
- C. Furnish sealer to other trades for touching up any bare wood caused by mortising or butting of surfaces, or any kind of assembly or installation.
- D. Avoid painting over or otherwise staining edges of wood where natural finish is scheduled.

3.5 APPLICATION

- A. General: Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
 - a. Except where specifically authorized by the Architect to do otherwise: Apply flat or eggshell wall paint by brush or roller; apply gloss or semi-gloss with brush only.
 2. Sanding: In addition to preparatory sanding, fine sand between succeeding coats of all varnish enamel or flat enamel, using sandpaper appropriate to the finish. Use fine production paper between coats.
 3. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 5. Doors: Finish all edges, including tops and bottoms, of wood and metal doors same as faces. Fill edges of exposed plywood doors, panels, similar materials.
 6. Finish interior of all closets and cabinets same as adjoining rooms, unless otherwise scheduled.
 7. Apply one coat of sanding sealer and one coat of semi-gloss varnish to insides of all drawers unless otherwise specified.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. The number of coats scheduled are minimums.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
1. Holidays and restrikes in painted surfaces shall be considered sufficient cause to require recoating of entire surface.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.6 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance of paint materials with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.7 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION

VISUAL DISPLAY BOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of visual display boards:
 - 1. Porcelain enamel markerboards.
 - 2. Fabric-faced cork tackboards.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 06 Section "Rough Carpentry" for wood blocking and grounds.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings: Provide shop drawings for each type of markerboard, and tackboard required. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
- C. Samples: Provide the following samples of each product for initial selection of colors, patterns, and textures, as required, and for verification of compliance with requirements indicated.
 - 1. Samples for initial selection of color, pattern, and texture:
 - a. Porcelain Enamel Markerboard: Manufacturer's color charts consisting of actual sections of porcelain enamel finish showing the full range of colors available for each type of markerboard required.
 - b. Fabric-faced Cork Tackboards: Manufacturer's color charts consisting of actual sections of fabric, showing the full range of colors, textures, and patterns available for each type of fabric-faced tackboard indicated.
 - c. Aluminum Trim and Accessories: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.
- D. Certificates: In lieu of laboratory test reports, when permitted by the Architect, submit the manufacturer's certification that vinyl-fabric-faced cork tackboard materials furnished comply with requirements specified for flame spread ratings.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who is an authorized representative of the visual display board manufacturer for both installation and maintenance.
1. Maintenance Proximity: Not more than 4 hours' normal travel time from the Installer's place of business to the Project site.
- B. Fire Performance Characteristics: Provide fabric-faced tackboards with surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.
1. Flame Spread: 25 or less.
 2. Smoke Developed: 10 or less.
- C. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of visual display boards and are based on the specific type and model indicated. Other visual display boards having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the Architect. The burden of proof of equality is on the proposer.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.
1. Allow for trimming and fitting wherever taking field measurements before fabrication might delay the Work.

1.6 WARRANTY

- A. Porcelain Enamel Markerboard Warranty: Furnish the manufacturer's written warranty, agreeing to replace porcelain enamel markerboards that do not retain their original writing and erasing qualities, exhibit crazing, cracking, or flaking, provided the manufacturer's instructions with regard to handling, installation, protection, and maintenance have been followed.
1. Warranty Period: Lifetime of the building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
1. Aarco Products Inc.
 2. Best-Rite Chalkboard Co.
 3. Claridge Products and Equipment, Inc.
 4. Marsh Industries, Inc.

5. Newline Corp.
6. PolyVision Corp.

2.2 MATERIALS

- A. Porcelain Enamel Markerboards: Provide balanced, high-pressure-laminated porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.
1. Face Sheet: Provide face sheet of 24-gage enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat the exposed face and exposed edges with a 3-coat process consisting of primer, ground coat, and color cover coat, and the concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at the manufacturer's standard firing temperatures, but not less than 1200 deg F (649 deg C).
 - a. Markerboard Cover Coat: Provide the manufacturer's standard light-colored special writing surface with gloss finish intended for use with liquid felt-tipped markers. Color shall be chosen by Architect from manufacturer's standard colors.
 2. Core: Provide the manufacturer's standard 3/8-inch-thick particleboard core material complying with the requirements of ANSI A208.1, Grade 1-M-1.
 3. Backing Sheet: Provide the manufacturer's standard 0.015-inch-thick aluminum sheet backing.
 4. Laminating Adhesive: Provide the manufacturer's standard moisture-resistant thermoplastic-type adhesive.
- B. Fabric-Faced Cork Tackboards: 1/4-inch- (6-mm-) thick, fabric-faced cork sheet factory laminated to 1/4-inch- (6-mm-) thick hardboard backing.
1. Fiberboard: ANSI A208.2, Grade MD.
 2. Cork Sheet: MS MIL-C-15116-C, Type II.
 3. Vinyl Fabric: FS CCC-W-408, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with flame-spread index of 25 or less when tested according to ASTM E 84.
 - a. Fabric: Carnegie, Xorel, Meteor 6427, Colors: Architect shall select two (2) colors per building from manufacturer's standard line.
 4. Hardware: Manufacturer's standard extruded-aluminum overhead track and channel-shaped bottom guides; with two nylon ball-bearing carriers and two nylon rollers for each sliding panel.

2.3 ACCESSORIES

- A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick aluminum of size and shape as indicated and to suit type of installation. Provide straight, single-length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.
1. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
 2. Where the size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports or modify the trim as indicated or as selected by the Architect from the manufacturer's standard structural support accessories to suit the condition indicated.
 3. Marker/Chalk Tray: Furnish manufacturer's standard continuous box-type aluminum marker/chalk tray with slanted front and cast aluminum end closures for each markerboard and chalkboard.
 4. Marker/Chalk Tray: Furnish the manufacturer's standard continuous, solid extrusion-type aluminum marker/chalk tray with ribbed section and smoothly curved exposed ends, for each markerboard and chalkboard.
 5. Map Rail: Furnish map rail at the top of each unit, complete with the following accessories:
 - a. Display Rail: Provide continuous cork display rail approximately 1 or 2 inches wide, as indicated, integral with the map rail.
 - b. End Stops: Provide one end stop at each end of the map rail.
 - c. Map Hooks: Provide two (2) map hooks for each 4 feet of map rail or fraction thereof.
 - d. Map Hooks: Provide two (2) map hooks with flexible metal clips for each 4 feet of map rail or fraction thereof.
 6. Accessory Tray: Provide "Sketch" magnetic accessory tray as manufactured by Allsteel as part of their "Gather" Conferencing line.
 - a. Provide one tray at each MB-2 markerboard not otherwise equipped with an integral marker tray.
 - b. PR 6 Silver finish.
 - c. 11" wide x 3" deep.

2.4 MARKERBOARD AND TACKBOARD SCHEDULE

MB: Markerboard with marker tray and map rail, with aluminum trim. Mount with long dimension horizontally.

TB: Fabric-wrapped tackboard.

2.5 FABRICATION

- A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.
- B. Assembly: Provide factory-assembled markerboard and tackboard units, except where field-assembled units are required.
 - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Architect.
 - 2. Provide the manufacturer's standard vertical joint system between abutting sections of markerboard.
 - 3. Provide manufacturer's standard mullion trim at joints between markerboard and tackboard.

2.6 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II Clear Anodized Finish: AA-M12C22A31 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Deliver factory-built markerboard and tackboard units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.
- B. Install units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for a complete installation.
- C. Coordinate job-site assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.2 ADJUST AND CLEAN

- A. Verify that accessories required for each unit have been properly installed and that operating units function properly.
- B. Clean units in accordance with the manufacturer's instructions.

END OF SECTION

INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Refer to Drawings for sign types, sign copy listing, and sign locations.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior die-raised signage.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
- B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
 - 1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.
- C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.
- D. Samples for Verification: For each type of sign, include the following Samples to verify color selected:
 - 1. Dimensional Characters: Full-size Samples of each type of dimensional character (letter and number) required. Show character style, material, finish, and method of attachment.
 - 2. Casting: Show representative texture, character style, spacing, finish, and method of attachment.
 - 3. Approved samples will not be returned for installation into Project.
- E. Qualification Data: For Installer.
- F. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.
- G. Replacement Instructions: Provide in writing, instructions to Owner on how to replace name inserts, turn around time required, etc.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of signage and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.
 - 1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Basis-of-Design Product: The design for each sign is based on the product named.

2.2 INTERIOR DIE-RAISED SIGNAGE

- A. Manufacturer:
 - 1. Subject to compliance with requirements, provide signs as manufactured by 2/90 Sign Systems.
- B. Sign Construction:
 - 1. As indicated on Sign Type Drawings.
- C. Colors:
 - 1. Plate background and Braille: Custom color to match Architect's sample.
 - 2. Raised characters and graphics: Standard color as selected by Architect.
 - 3. Aluminum and acrylic backshields: Color to match sign background.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Locate sign units and accessories where indicated on Sign Location Drawings, using mounting methods of the type described in Sign Type Drawings, and in compliance with the manufacturers' instructions.
1. Examine areas to receive signage; notify Building Contractor/Architect in writing of unacceptable substrate. Beginning work indicates acceptance of substrate.
 2. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
 3. Mount directly on glass with double face foam tape, reinforce with clear silicone adhesive. Install back shield on opposite side of glass.
 4. Mount wall signs by mechanically fastening backshield to wall: Mount sign to backshield with double face foam tape and reinforce with clear silicone adhesive.

3.2 CLEANING AND PROTECTION

- A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Framed mirrors.
- 2. Clothes hook - single.
- 3. Clothes hook - double.
- 4. Grab bars.

- B. Related Sections include the following:

- 1. Division 6 Section "Finish Carpentry and Millwork" for countertops.
- 2. Division 8 Section "Mirrors" for frameless mirrors.
- 3. Division 10 Section "Toilet Compartments" for compartments and screens.
- 4. Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Samples: For each accessory item to verify design, operation, and finish requirements.
- C. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.
- E. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

- B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
 2. Other manufacturers' products with equal characteristics may be considered. See Division 1 for product substitutions.
 3. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Comply with applicable provisions of the following specification and documents:
1. ICC/ANSI A11.1-2003 American National Standard – Accessible and Useable Buildings and Facilities.
 2. Michigan Building Code.
 3. ADA, Accessibility Guidelines for Buildings and Facilities, Federal Register Volume 56, Number 144, Rules and Regulations.
 4. Michigan Barrier Free.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Furnish a one (1) year guarantee against defects in material and workmanship on all accessories from date of substantial completion.
- C. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:
1. Toilet and Bath Accessories:
 - a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
- C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
- E. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.
- F. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- G. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.
- H. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
- I. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- J. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

- A. General: One, maximum 1-1/2-inch- (38-mm-) diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

- D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
 - 1. Provide galvanized steel backing sheet, not less than 0.034 inch (0.85 mm) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation:
- F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

- A. Framed Mirror: Provide mirror unit complying with the following:
 - 1. Products: Bobrick Washroom Equipment, Inc. Series B-165.
 - 2. Stainless-Steel, Channel-Framed Mirror: Fabricate frame from stainless-steel channels in manufacturer's standard satin or bright finish with square corners mitered to hairline joints and mechanically interlocked.
 - 3. Mounting: Concealed brackets and wall hangers.
 - 4. Refer to Drawings for size(s).
- B. Clothes Hook, Single: Provide clothes hook complying with the following:
 - 1. Products: Bobrick Washroom Equipment, Inc., Series B-76717.

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2. Single-Prong Unit: Stainless-steel satin finished, single-prong clothes hook with rectangular wall bracket and backplate for concealed mounting.
- C. Clothes Hook, Double: Provide clothes hook complying with the following:
1. Products: Bobrick Washroom Equipment, Inc., Series B-76727.
 2. Double-Prong Unit: Stainless-steel satin finished, double-prong clothes hook with rectangular wall bracket and backplate for concealed mounting.
- D. Grab Bars: Provide stainless-steel grab bar with satin finish complying with the following:
1. Products: Bobrick Washroom Equipment, Inc., Series B-5806.99
 2. Stainless-Steel Nominal Thickness: Minimum 0.05 inch (1.3 mm).
 3. Mounting: Concealed with manufacturer's standard flanges and anchors.
 4. Gripping Surfaces: Manufacturer's standard slip-resistant texture.
 5. Outside Diameter: 1-1/4 inches (32 mm) for medium-duty applications.

****END OF SECTION****

FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
 - 3. Mounting brackets for fire extinguishers.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
 - 3. Division 1 Section "LEED Requirements" for additional LEED requirements.
- B. Samples for Initial Selection: For fire-protection cabinets with factory-applied color finishes.
- C. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on Samples of size indicated below.
 - 1. Size: 6 by 6 inches (150 by 150 mm) square.
- D. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.
- D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.
- 1.5 COORDINATION
- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
 - B. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- 1.6 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Basis-of-Design Product: The design for each product is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 1. Sheet: **ASTM B 209** (ASTM B 209M).
 2. Extruded Shapes: **ASTM B 221** (ASTM B 221M).
- C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 PORTABLE FIRE EXTINGUISHERS

- A. Basis-of-Design Product: Cosmic 6E fire extinguisher as manufactured by JL Industries, Inc. or a comparable product by one of the following:

1. Ansul Incorporated.
 2. Badger Fire Protection.
 3. Fire End & Croker Corporation.
 4. Kidde Fyrnetics.
 5. Larsen's Manufacturing Company
 6. Potter Roemer; Div. of Smith Industries, Inc.
- B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
1. Valves: Manufacturer's standard.
 2. Handles and Levers: Manufacturer's standard.
 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- C. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.4 FIRE-PROTECTION CABINET

- A. Basis-of-Design Product: Academy Series Model 1025V17 (provide Fire-FX Option where installed in fire rated walls) as manufactured by JL Industries, Inc. or a comparable product by one of the following:
1. Ansul Incorporated.
 2. Badger Fire Protection.
 3. Fire End & Croker Corporation.
 4. Kidde Fyrnetics.
 5. Larsen's Manufacturing Company
 6. Potter Roemer; Div. of Smith Industries, Inc.
- B. Cabinet Type: Suitable for fire extinguisher.
- C. Cabinet Construction: Nonrated and fire rated as indicated on Drawings.
- D. Cabinet Material: Aluminum sheet.
1. Shelf: Same metal and finish as cabinet.
- E. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface 1-3/4" with exposed trim face.

- F. Cabinet Trim Material: Aluminum sheet.
- G. Door Material: Aluminum sheet.
- H. Door Style: Vertical duo panel with frame.
- I. Door Glazing: Tempered float glass (clear).
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide concealed hinge permitting door to open 180 degrees.
- K. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
- L. Finishes:
 - 1. Aluminum: Clear anodic.

2.5 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 1. Color: Black.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

2.6 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material.
 - a. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- D. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. All-welded, corridor metal lockers.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for furring, blocking, and shims required for installing metal lockers and concealed within other construction before metal locker installation.
- C. Uncoated Steel Sheet Thicknesses: Indicated as the minimum thicknesses.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of metal locker.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker[**and bench**].
- B. Shop Drawings: For metal lockers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Show locker trim and accessories.
 - 3. Include locker identification system and numbering sequence.
- C. Samples: For each color specified, in manufacturer's standard size.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.
- E. Samples for Verification: For the following products, in manufacturer's standard size:
 - 1. Lockers and equipment.
 - 2. Locker benches.
- F. Product Schedule: For lockers. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal lockers and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Provide not less than 1 shelf located no higher than 48 inches (1219 mm) above the floor for forward reach.
 - 2. Provide 1 shelf located at bottom of locker no lower than 15 inches (381 mm) above the floor for forward reach.
 - 3. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf (22.2 N).
- E. Preinstallation Conference: Conduct conference at time and location specified by Construction Manager.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for metal locker installation.
- B. Deliver master and control keys and combination control charts to Owner.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:
 - 1. Concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed.
 - 2. Recessed openings.
 - 3. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish recessed opening dimensions and proceed with fabricating metal

lockers without field measurements. Coordinate wall and floor construction to ensure that actual recessed opening dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate size and location of concrete and concrete masonry bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.
 - 4. Warranty Period for All-Welded Metal Lockers: 10 years from date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below, before construction begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than 5 units:
 - a. Identification plates.
 - b. Hooks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each metal locker specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.
- B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.
- C. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 ALL-WELDED, CORRIDOR METAL LOCKERS

- A. Basis-of-Design Product: Sentry Corridor Lockers as manufactured by DeBourgh Mfg. Co. or a comparable product of one of the following:
 - 1. ASI Storage Solutions
 - 2. List Industries Inc.
 - 3. Lyon Workspace Products.
 - 4. Newline Corp.
 - 5. Penco Products, Inc., Subsidiary of Vesper Corporation.
- B. Locker Arrangement:
 - 1. Single tier
 - 2. Box.
- C. Overall Size: 12" wide x 15" deep x 60" high.
- D. Body: Assembled by welding body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Sides: 0.0528 inch (1.35 mm) thick.
 - 2. Backs: 0.0428 inch (1.1 mm) thick.
 - 3. Shelves: 0.0528 inch (1.35 mm) thick, with double bend at front and single bend at sides and back.
- E. Frames: Channel formed; fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
 - 1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

- F. Locker Base: Structural channels, formed from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet; welded to front and rear of side-panel frames.
- G. Doors: One-piece; fabricated from 0.0747-inch- (1.72-mm-) thick, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges.
1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
 2. Door Style: Vented panel as follows:
 - a. Louvered Vents:
 - 1) Not less than six louver openings at top and bottom for single-tier
 - 2) Not less than three louver openings at top and bottom for double-tier
 - 3) Not less than two louver openings at top and bottom, or three louver openings at top or bottom for triple-tier lockers.
- H. Hinges: Welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
1. Knuckle Hinges: Steel, full loop, 5 or 7 knuckles, tight pin; minimum 2 inches (51 mm) high. Provide not less than 3 hinges for each door more than 42 inches (1067 mm) high.
- I. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.
1. Single-Point Latching: Nonmoving latch with steel padlock loop that projects through recessed cup and is finished to match metal locker body.
 - a. Latch Hook: Equip each door with one latch hook, fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
 - b. Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- J. Combination Padlocks: Provided by Owner.
- K. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
- L. Accessories:
1. Continuous Sloping Tops: Fabricated from minimum 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet; approximately 20-degree pitch.
 - a. Closures: Vertical-end type.

2. Recess Trim: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.
 3. Filler Panels: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.
 4. Boxed End Panels: Fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet.
 5. Finished End Panels: Fabricated from 0.0209-inch- (0.55-mm-) thick, cold-rolled steel sheet.
- M. Finish: Baked enamel or powder coat.
1. Color(s):
 - a. Architect shall select from manufacturer's full line of standard colors

2.4 FABRICATION

- A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.
 2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.
- B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections, with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
- D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- E. Coat Rods: Fabricated from 1-inch- (25-mm-) diameter steel; nickel plated.
- F. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch (9 mm) high.
- G. Continuous Base: Formed into channel or Z profile for stiffness, and fabricated in lengths as long as practicable to enclose base and base ends of metal lockers; finished to match lockers.
- H. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.
1. Sloped top corner fillers, mitered.
- I. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practicable; finished to match lockers.
- J. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip joint filler angle formed to receive filler panel.

- K. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.
- L. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.5 STEEL SHEET FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- D. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
 - 2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
 - 3. Anchor back-to-back metal lockers to floor.
- B. All-Welded Metal Lockers: Connect groups of all-welded metal lockers together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.
4. Attach recess trim to recessed metal lockers with concealed clips.
5. Attach filler panels with concealed fasteners. Locate fillers panels where indicated on Drawings.
6. Attach sloping top units to metal lockers, with closures at exposed ends.
7. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
8. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

****END OF SECTION****

ROLLER SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes roller shades and motorized shade operators.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for wood blocking and grounds.
 - 2. Division 26 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
 - 1. Motorized Shade Operators: Include operating instructions.
 - 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.
 - 1. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 2. Wiring Diagrams: Power, system, and control wiring.
- C. Full size sample for verification purposes of each type of window shade showing all components, materials, and finishes to be exposed to view. Prepare samples from same materials to be used for fabricating units.
- D. Samples for Verification:
 - 1. Complete, full-size operating unit not less than 16 inches (400 mm) wide for each type of roller shade indicated.
 - 2. Shade Material: Not less than 3 inches (80 mm) square, with specified treatments applied. Mark face of material.
 - 3. Valance: Full-size unit, not less than 12 inches (300 mm) long.

- E. Window Treatment Schedule: Include roller shades in schedule using same room designations indicated on Drawings.
- F. Product Certificates: For each type of roller shade product, signed by product manufacturer.
- G. Product Test Reports: For each type of roller shade product.
- H. Qualification Data: For Installer.
- I. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.
- J. Warranty: Furnish a twenty five year (25) guarantee against defects in material and workmanship from the date of substantial completion.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of roller shades similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 - 1. Provide a list of three institutional-quality window shade projects successfully completed within the last five years. For each project include the following:
 - a. Project/building name and location.
 - b. Description of scope.
 - c. Representative's name and phone number.
- B. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Corded Window Covering Product Standard: Provide roller shades complying with WCMA A 100.1.
- E. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
 - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide MechoShades as manufactured by MechoShade Systems, Inc or equal products by one of the following:
 - 1. Draper Shade and Screen Co., Inc.
 - 2. Solarfective Products, Ltd.
- B. Refer to roller shade schedule in Part 3.

2.2 ROLLER SHADES

- A. Shade Band Material - Translucent
 - 1. Translucent Shades shall be light filtering, flame retardant, fade and soil resistant and washable.
 - a. Construction: Vinyl-coated Polyester
 - b. Openness Factor: 3 percent.
 - c. Meets Government Spec. #CCC-C-521-E.
 - d. Type I product
 - e. Weight: Must be a minimum of 6.4 oz. per square yard.
 - f. Color: As selected by Architect from manufacturer's full range.

- B. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube Provide capacity for one roller shade band per roller, unless otherwise indicated on Drawings.
- C. Direction of Roll: Regular, from back of roller.
- D. Mounting Brackets: Galvanized or zinc-plated steel.
- E. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings or in a window treatment schedule; removable design for access.
- F. Top/Back Cover: L shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.
- G. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide exposed-to-view, external-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.
- H. Shade Operation:
 - 1. Manual: Provide with spring roller continuous loop bead chain, clutch, and cord tensioner and bracket lift operator.
 - a. Position of Clutch Operator: Left or Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings or in a window treatment schedule.
 - b. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
 - c. Lift Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
 - d. Loop Length: Length required to make operation convenient from floor level.
 - e. Bead Chain: Nickel-plated metal or stainless steel.
 - f. Operating Function: Stop and hold shade at any position in ascending or descending travel.
- I. Valance: Style matching hem; as indicated by manufacturer's designation color or as indicated in a window treatment schedule.
- J. Mounting: Recessed in ceiling pocket and as indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

2.3 ROLLER SHADE FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - 1. Lifting Mechanism: With permanently lubricated moving parts.

- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
 - 2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.
- E. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- G. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range.

2.4 WARRANTY

- A. Furnish a twenty five year (25) manufacturer's guarantee against defects in material and workmanship from the date of substantial completion.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

3.6 ROLLER SHADE SCHEDULE

- A. Type A Shade Band Material: Translucent 3% Open
Operation: Manual
Installation: Non-Pocket-style
Hardware: L-Shaped Fascia and Top/Back Cover

END OF SECTION

PREFABRICATED CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Prefabricated laminate clad casework and components.
2. Countertops.

- B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for blocking within walls.
2. Division 6 Section "Finish Carpentry and Millwork" for custom cabinetry.
3. Division 15 for sinks and service fixtures, service waste lines, connections, ducting within or adjacent to casework, and vents.
4. Division 16 for electrical services.

1.3 DEFINITIONS

- A. Identification of casework components and related products by surface visibility.

1. Exposed Surfaces:

- a. Any storage unit exterior front, side, or rear surface that is visible after installation.
- b. Faces of doors and drawers when closed.
- c. Tops of cabinets less than 72 inches above furnished floor.
- d. Any open interior of a storage unit without solid door or drawer fronts and units with glass insert doors.

2. Semi-Exposed Surfaces:

- a. Any interior surface of a storage unit that is behind solid doors, drawer fronts, or sliding solid doors.
- b. Bottoms of wall cabinets.
- c. Tops of cabinets 72 inches or more above finished floor.

3. Concealed Surfaces: Any surface not visible after installation.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures.
 - 2. Indicate locations of plumbing and electrical service field connection by others.
- C. Samples for Initial Selection: Provide color charts for the following:
 - 1. Plastic laminates.
 - 2. PVC edging.
 - 3. Hardware finishes.
- D. Samples for Verification: Provide the following:
 - 1. Laminate clad panel products, 8-1/2 inches, by 11 inches for each type, color, pattern, and surface finish including edging, with separate samples of unfaced panel products used for core.
 - 2. Exposed cabinet hardware, one unit of each type and finish.
- E. Casework Samples: To be provided only upon request of the Architect.
 - 1. Base cabinet: Cabinet conforming to specifications, with drawer, door and countertop.
 - 2. Wall cabinet: Cabinet conforming to specifications, with door.
 - 3. Cabinet samples shall be complete with specified hardware for doors, drawers and shelves.
- F. Qualification Data: For Manufacturer and Installer.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Minimum of ten (10) years experience in providing manufactured casework systems for similar types of projects.
- B. Installer Qualifications: An installer with not less than five (5) years of successful experience in installing prefabricated casework similar to that required for this project and which is approved by manufacturer.
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. Michigan Building Code and Michigan Barrier Free requirements.
 - 2. ANSI A117.1 - 1998, Accessible and Usable Buildings and Facilities.

3. ADA, Accessibility Guidelines for Buildings and Facilities, Federal Register Volume 56, Number 144, Rules and Regulations.

1.6 DELIVERY, STORAGE, AND PRODUCT HANDLING

- A. Do not deliver completed laminate clad casework, countertops, and related products until spaces to receive them are clean, dry, and ready for casework installation.
- B. Environmental Requirements:
 1. Do not deliver or install casework until interior concrete work, masonry, plastering and other wet operations are complete.
 2. Store casework in a ventilated place, protected from the weather, with relative humidity range of 20 percent to 50 percent.
- C. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:
 1. Concealed framing, blocking, and reinforcements that support casework before they are enclosed.
 2. Cabinet layouts and locations.
 3. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish recessed opening dimensions and proceed with fabricating casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. General Basis-of-Design: Products and catalog numbers specified on the Drawings are from the catalog of TMI Systems Design Corporation and shall be used as a basis for identification, configuration, size, and quality. The design for each unit is based on the product called out on the Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by TMI Systems Design Corporation or equal by one of the following:
 - 1. Stevens Cabinet Co.
 - 2. LSI Corporation.
 - 3. Wood-Metal Industries, a division of Wood-Mode, Inc.

2.2 MATERIALS

- A. Core Materials:
 - 1. Particleboard up to 7/8 inch thick: Industrial Grade average 47-pound density particleboard, ANSI A 208.1-1999, M-3.
 - 2. Particleboard 1 inch thick and thicker: Industrial Grade average 45-pound density particle-board, ANSI A 208.1-1999, M-2.
 - 3. Moisture Resistant Particle Board, 1 inch thick: ANSI A208.1-1999 M-3 MR.
 - 4. Medium Density Fiberboard 3/4 inch thick: Average 48-pound density grade, ANSI A208.2.
- B. Decorative Laminates:
 - 1. High-pressure decorative laminate VGS (.028), NEMA Test LD 3-1995.
 - 2. High-pressure decorative laminate HGS (.048), NEMA Test LD 3-1995.
 - 3. High-pressure decorative laminate HGP (.039), NEMA Test LD 3-1995.
 - 4. High-pressure cabinet liner CLS (.020), NEMA Test LD 3-1995.
 - 5. High-pressure backer BKL (.020), NEMA Test LD3-1995.
 - 6. Thermally fused melamine laminate, NEMA Test LD 3-1995.
 - 7. Adhesive: Water based low Volatile Organic Compound (VOC), non-toxic, PVA adhesive.
- C. Edging Materials: Edging shall be a high impact, crack and chip resistant, rigid material, with integral color throughout.
 - 1. 1mm PVC banding.
 - 2. 3mm PVC banding.

- D. Glass: All glass shall be 1/4 inch thick laminated safety glass.

2.3 CABINET HARDWARE

- A. Hinges: Five knuckle, steel, institutional grade, capable of 270 degree swing, hospital tipped with non-removable pin. 0.095 inch thick. ANSI-BHMA standard A156.9, Grade 1.

1. Doors 48 inches and over in height have 3 hinges per door.

- B. Door Catches: Door catches shall be heavy-duty spring loaded large diameter roller type. Each door shall have a single catch mounted at the bottom edge. All doors over 48" high shall have a catch at both the top and bottom of the door.

1. Catch strike plates shall be injection molded nylon, with an integral molded engagement ridge. Strike plate shall also provide a wide face bumper insuring a positive doorstop.

- C. Pulls: Architect shall select from manufacturer's wire pulls and plastic molded pulls.

1. Molded pulls shall be injection molded ABS plastic contour style, semi-recessed.
2. Wire pulls shall be prefinished metal.

- D. Drawer Slides:

1. Kneespace, pencil drawers and all drawers 4" deep or less: Single extension, 100-pound load rated epoxy coated steel, bottom corner mounted with smooth and quiet nylon rollers. Positive stop both directions with self-closing feature.
2. File and all drawers over 4" deep: Full extension, 150-pound load rated epoxy coated steel, bottom corner or side mounted with smooth and quiet nylon rollers. Positive stop both directions with self-closing feature.

- E. Adjustable Shelf Supports: Injection molded clear polycarbonate clip with two (2) integral support pins, 5mm diameter, that shall friction fit into cabinet end panels and vertical dividers, adjustable on 32mm centers.

1. Clips shall incorporate integrally molded lock tabs to retain shelf from tipping or inadvertently being lifted out.
2. Each clip shall be capable of supporting a minimum of 200 pounds without failure.
3. Clips shall be adjustable with the option of being permanently fixed.

- F. Sliding Door Track: Anodized aluminum double channel.

- G. Coat Rods: 1 inch diameter, 14-gauge chrome plated steel installed in captive mounting hardware.

- H. Locks: Locks shall be die cast, cylinder type with a five-disc tumbler mechanism and a removeable core. Locks shall be cam style for drawers and doors. At other locations, use lock style required to suit application.

1. Locks shall be provided at all doors and drawers
2. All locks within a room shall be keyed alike and different than adjacent rooms. All locks on the Project shall be master keyed.

- a. Provide two (2) keys for each room and three (3) master keys.

2.4 MISCELLANEOUS ITEMS

- A. Provide all accessories and hardware for a complete installation including the following:
 1. Mounting hardware.
 2. Undercounter laminated support panels or undercounter metal support brackets as selected by the Architect.
- B. Grommets: Provide manufacturer's standard plastic grommets.

2.5 FABRICATION

- A. General: Fabricate casework, countertops and related products to dimensions, profiles, and details shown.
 1. Prefabricated casework shall comply with ANSI-A 161.1-1998.
- B. Tops and bottoms shall be glued and doweled to cabinet sides and internal cabinet components such as fixed horizontals, rails and verticals. Minimum 6 dowels each joint for 24 inch deep cabinets and a minimum of 4 dowels each joint for 12 inch deep cabinets.
 1. Dowels shall be fluted hardwood, minimum 8mm diameter.
 2. Assemble components with clamps under controlled conditions in order to maintain cabinet squareness and properly set joints.
 3. All joints shall be tight fitting and shall not rupture or loosen due to the following:
 - a. Dimensional changes in core materials.
 - b. Racking of casework during installation and shipping.
 - c. Normal use.
 4. Base and tall cabinets shall have one piece side panels continuous to floor.
- C. Back panels: Secure by one of the following methods:
 1. Set securely in grooved channel along entire perimeter and glued or screwed.
 2. Securely screwed or doweled in place and captured and supported by mounting rails.
- D. Mounting rails (stretchers) shall be fully concealed behind backs and sides. Rails shall be doweled into cabinet sides, sub-tops and/or bottoms.
 1. Wall and tall cabinets shall incorporate two mounting rails.
 - a. Wall cabinets shall have rails positioned at top and bottom.
 - b. Tall cabinets shall have rails positioned at top and intermediate location.
 2. Base units shall have rail positioned in the upper back area.
- E. Base units, except sink base units, shall have a full sub-top. Sink base units shall be manufacturer's standard reinforced open top with a removable split back panel.

- F. Side panels and vertical dividers shall be bored to receive adjustable shelf supports at 32mm on center.
- G. Drawers shall be full box design with a separate front, glued and doweled.
 - 1. Four sides shall be glued and doweled together.
 - 2. Bottom shall be screwed directly to bottom edges of the sides or set in grooves along all four sides and glued and screwed.
 - 3. Front face shall be screwed to subface of full box.
- H. Component minimum thicknesses shall be as follows:
 - 1. Structural components shall be 3/4 inch thick core material.
 - 2. Tops, sides and bottoms shall be 3/4 inch thick core material.
 - 3. Back panels shall be 1/4 inch thick core material.
 - 4. Mounting rails (stretchers) shall be 3/4 inch thick structural components.
 - 5. Exposed cabinet backs shall be 3/4 inch decorative laminated backs in lieu of mounting stretchers.
 - 6. Doors and drawer faces shall be 3/4 inch thick core material.
 - 7. Drawer sides and bottom shall be 1/2 inch thick core material.
 - 8. Shelves shall be 3/4 inch thick up to 30 inches wide, 1 inch thick over 30 inches wide.
- I. Component finishes shall be as follows:
 - 1. Decorative Laminates:
 - a. Exposed Surfaces: High-pressure decorative laminate VGS (.028).
 - b. Semi-Exposed Surfaces: Thermally fused melamine laminate.
 - 2. All laminated panels shall have balanced construction. Unfinished core stock surfaces, even on concealed surfaces (excluding edges), shall not be permitted.
 - a. Concealed Surfaces: High-pressure cabinet liner CLS (.020).
 - 3. PVC Banding: Exposed and semi-exposed edges shall be PVC banding applied with hot melt adhesive. Thicknesses shall be as follows:
 - a. Door and drawer fronts shall be edged with 3mm PVC.
 - b. All other edges including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels shall be edged with 1 mm PVC.

2.6 WORK SURFACES

- A. Countertop design shall be full wrap postformed edge with separate rectangular backsplash.

1. Continuous tops shall be joined with minimum number of splice joints and aligned with tight joint fasteners as required to provide a uniform and gapless joint.
- B. Core: 1 inch thick moisture resistant material.
- C. Surface: High-pressure decorative laminate HGS (.048) and HGP (.039).
1. Exposed edges shall be covered with same laminate as top surface.
 2. Backing sheet on underside shall be high-pressure backer BKL (.020).

2.7 FINISHES

- A. Cabinet exteriors:
1. Decorative laminate colors at cabinet exteriors, including door and drawer fronts, shall be selected by the Architect from manufacturer's full line.
 2. PVC edges shall be selected by Architect from manufacturer's full line of colors.
 3. Exposed cabinet body edges shall be color matched to cabinet sides.
 4. The underside of wall cabinets and the interior of open and glass door cabinets shall match the exterior cabinet colors.
- B. Cabinet interiors:
1. The interior of closed-door cabinets and drawer boxes shall be manufacturer's standard almond or white color.
 2. PVC edges on adjustable shelves, drawer boxes and interior panel components shall match the color of the interior cabinet.
- C. Cabinet hardware: Cabinet hardware finishes, including those for drawer pulls, drawer slides and hinges, shall be selected by Architect from manufacturer's full lines.
- D. Work surfaces: Colors shall be selected by Architect from any of the standard or premium solid color or pattern lines of Nevamar, WilsonArt, Formica and Pionite.

PART 3 - INSTALLATION

3.1 EXAMINATION

- A. Examine walls and floors with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install according to manufacturer's written instructions.

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CASEWORK

- B. Erect casework, plumb, level, true and straight with no distortions. Shim as required. Where laminate clad casework abuts other finished work, scribe and cut to accurate fit.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust casework and hardware so that doors and drawers operate smoothly without warping or binding.
 - 1. Verify that all locking devices operate properly.
- B. Repair minor damage per manufacturer's recommendations. Replace damaged items that cannot be restored to their original condition.
- C. Protect prefabricated casework from damage, abuse, dust, dirt, stain, or paint. Do not permit use of casework during construction.
- D. Clean Up: Remove all cartons, debris, sawdust, scraps, etc., and leave spaces clean and all prefabricated cabinets and countertops ready for Owner's use.

END OF SECTION

COMMON MOTOR REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Section does not include motors for fire pumps, elevators, centrifugal chillers, sealed refrigeration equipment, submersible sump pumps, and vertical hollow or solid shaft motors used with vertical turbine pumps.
- C. Related Sections include the following:
 - 1. Section 26 "Fuses".
 - 2. Section 26 "Enclosed Switches and Circuit Breakers".
 - 3. Section 26 "Enclosed Controllers".

1.3 DEFINITIONS

- A. ABMA: American Bearing Manufacturers Association.
- B. IEEE: Institute of Electrical and Electronics Engineers.
- C. NEMA: National Electrical Manufacturers Association.
- D. MG 1: (NEMA) Motors and Generators Standard.

1.4 SUBMITTALS

- A. Submit the following product data for approval:
 - 1. Manufacturer information.
 - 2. Dimensions and elevations.

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REQUIREMENTS FOR
EQUIPMENT

3. Complete NEMA nameplate electrical data including design type, insulation, service factor, and efficiency.
4. Materials of construction.
 - a. Bearing type, L10 bearing life, and seal construction (open, single, or double shielded).

1.5 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 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 1. Baldor Electric Company
 2. Dayton.
 3. General Electric.
 4. Leeson Electric.
 5. Marathon Electric.
 6. Reliance Electric.
 7. Toshiba Corporation.
 8. U.S. Electrical Motors.

2.2 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in Fire Protection, Plumbing or HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

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EQUIPMENT

- C. Comply with IEEE 841 for severe-duty motors.
- D. Comply with ABMA 9 for bearing life calculations. For belted applications, calculations shall be based on maximum external side load limits per NEMA MG 1 Table 14-1A. L10 life calculations for vertical motors and horizontal motors mounted in the vertical position shall consider the application's thrust loading.

2.3 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level. Maximum hot spot temperature shall not exceed the insulation temperature limit, when operated in an ambient temperature of 40 deg C, except as otherwise indicated.
- B. 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. Noise: Motors shall not exceed dBA levels listed in NEMA MG 1 section 12.54 at all speeds.

2.4 POLYPHASE MOTORS (1/2 HP and larger)

- A. Description: NEMA MG 1, Design B, squirrel cage, medium induction motor with open drip proof enclosure unless noted otherwise in equipment specifications of schedules. When totally enclosed fan cooled motors are specified or scheduled, provide external shaft slinger on drive end.
- B. Efficiency: Nominal (nameplate) full load efficiency and corresponding minimum efficiency equal to or greater than that stated in NEMA MG 1 Table 12-12 – Premium Efficient Motors Nominal Full Load Efficiencies.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors smaller than 15HP: Manufacturer's standard starting characteristic.

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REQUIREMENTS FOR
EQUIPMENT

J. Enclosure Material and Bearings:

1. Motors less than 3 HP: Steel or cast iron motor frames, cast aluminum, cast iron, or steel end plates, steel or cast iron terminal box, copper windings.
 - a. Bearings shall be regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings, selected for a minimum L10 bearing life of 26,280 hours, for belted and direct drive.
2. Motors 3 HP and above: Cast iron motor frames and mounting feet, cast iron end plates (bells), steel or cast iron terminal box, copper windings.
 - a. Bearings shall be regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings. Rated for a minimum L10 bearing life of 40,000 hours for belted or 130,000 hours for direct drive.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.6 SINGLE-PHASE MOTORS (less than 1/2 HP)

- A. Motors larger than 1/20 HP shall be one permanent-split-capacitor type, to suit starting torque and requirements of specific motor application:
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- F. Furnish with sliding base/slotted mounting holes adequate for proper belt tensioning and alignment of motor or motor/load.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and align motors in accordance with the equipment manufacturer's recommendations.

3.2 COMMISSIONING

- A. Perform commissioning activities as outlined in Division 1 Section, Commissioning Requirements, and other requirements of the Contract Documents.

3.3 ADJUSTING, CLEANING, PROTECTION

- A. Assure motor nameplate is legible and properly affixed.
- B. Verify bearings are factory lubricated before starting motors. Lubricate per manufacturer's instructions. Do not over lubricate bearings.
- C. Check motors for unusual heating, noise, or excessive vibration during operation. Correct any such deficiencies.
 - 1. Any motors with vibration exceeding specified limits, as noted in the Testing, Adjusting, and Balancing Section, or manufacturer's recommendations, whichever is more stringent, shall be corrected, at no cost to the Owner, until reduced below those limits.
- D. Clean the motor prior to start-up and immediately prior to final turn-over to the Owner.

****END OF SECTION****

GENERAL-DUTY VALVES FOR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

A. Section Includes:

- 1. Bronze ball valves.
- 2. Iron ball valves.

B. Related Sections:

- 1. Section 20 "Mechanical Identification" for valve tags and schedules.
- 2. Section 22 "Domestic Water Piping" for valves applicable only to this piping.
- 3. Section 22 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
- 4. Section 22 "Storm Drainage Piping Specialties" for valves applicable only to this piping.

1.3 DEFINITIONS

- A. ASME: American Society of Mechanical Engineers.
- B. ASTM: American Society for Testing and Materials.
- C. AWWA: American Water Works Association.
- D. CWP: Cold working pressure.
- E. EPDM: Ethylene propylene copolymer rubber.
- F. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- G. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- H. NRS: Nonrising stem.
- I. OS&Y: Outside screw and yoke.
- J. PTFE: Polytetrafluoroethylene plastic.

- K. RS: Rising stem.
- L. SWP: Steam working pressure.
- M. TFE: Tetrafluorethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Milwaukee Valve Company.
- c. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 600 psig.
- c. Body Design: Two piece.
- d. Body Material: Bronze.
- e. Ends: Threaded.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

2.3 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Kitz Corporation.
- d. Sure Flow Equipment Inc.
- e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-72.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.
- j.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

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 valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-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. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

6. For Steel Piping, NPS 5 and Larger: Flanged ends.

- D. General duty and specialty valves for fire protection systems are specified within the various Division 21 specification sections. For Division 22 and 23 piping systems, comply with the following subparagraphs for general duty valves. For specialty valves in Divisions 22 and 23, refer to individual Division 22 and 23 specification sections.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, regular port, bronze with bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, regular port, bronze with bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

****END OF SECTION****

HANGERS & SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for fire protection system, plumbing system, and HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Fastener systems.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
 - 3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. ASCE: American Society of Civil Engineers.
- B. ASME: American Society of Mechanical Engineers.
- C. ASTM: American Society for Testing and Materials.
- D. AWS: American Welding Society.
- E. IAPMO: International Association of Plumbing and Mechanical Officials.
- F. MFMA: Metal Framing Manufacturers Association.
- G. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- H. SSPC: Steel Structures Painting Council now the Society for Protective Coatings.
- I. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." AWS D1.3, "Structural Welding Code--Sheet Steel." [AWS D1.4, "Structural Welding Code--Reinforcing Steel." ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.

5. Empire Industries, Inc.
 6. ERICO/Michigan Hanger Co.
 7. Globe Pipe Hanger Products, Inc.
 8. Grinnell Corp.
 9. GS Metals Corp.
 10. National Pipe Hanger Corporation.
 11. PHD Manufacturing, Inc.
 12. PHS Industries, Inc.
 13. Piping Technology & Products, Inc.
 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Non-metallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, 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, provide products by one of the following:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.

- e. MKT Fastening, LLC.
- f. Powers Fasteners.

2.4 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Stainless Steel: ASTM A 304, stainless steel plates, shapes, and bars.
- C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and non-metallic 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 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 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 non-metallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts, or equipment.
- G. Hangers and supports shall also be provided at every change in direction and within 12 inches of any pipe fitting and valves.
- H. Pipe hangers in fan rooms and in mechanical equipment rooms shall be provided with spring hangers with elastomeric inserts to eliminate noise transmission between piping and the building structure. Refer to Division 20 "Vibration Controls."
- I. Hanger components shall not be used for purposes other than for which they were designed.
- J. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.

- K. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, braces, brackets or structural cross members may be used.
- L. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roll carriages shall be used.
- M. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring cushion hangers may be used where vertical movement does not exceed 1/4 inches.
- N. Pipe attachments for insulated pipe shall be outside the insulation. Insulation protection shields or high density insulation inserts shall be provided to protect the insulation.
- O. 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 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. 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 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-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.
 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 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 2 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 20, 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 not necessary.
 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 not necessary.
 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.
- P. 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 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- Q. 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.

- R. Building Attachments: Use of "C" clamps and beam clamps of "C" pattern and any modification thereof for pipe sizes 2-1/2 inches and larger is prohibited 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. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 9. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 10. 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.
 11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- S. 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.

- T. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- U. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- V. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- W. Use pipe positioning systems (Sioux Chief or approved equal) in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Provide necessary piping and equipment supporting elements including building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, or other pipes, ducts, or equipment.
- B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- C. 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.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- H. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- J. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 SUPPLEMENTARY STEEL

- A. Where it is necessary to frame structural members between existing structural steel members or where structural steel members are used in lieu of commercially rated supports, install such supplementary steel in accordance with American Institute of Steel Construction Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings. Connection to the existing steel shall be with clamps unless otherwise approved by the Engineer.

3.4 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.

3.5 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

****END OF SECTION****

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. 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 to include in maintenance manuals.

1.4 COORDINATION

- 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.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Brady Co.
2. Bramer.
3. Craftmark.
4. Emed.
5. Marking Services, Inc.
6. Seton Name Plate Corp.

2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
4. Fasteners: Stainless-steel self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures 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 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 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), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures 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 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 self-tapping screws.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.5 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures 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 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. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
 - 3. Size: Provide 1-1/2" diameter tags, except as otherwise indicated.
 - 4. Fill tag engraving with black enamel.

- B. 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. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.

2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section.

- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.

2. Stencil Paint: Use for pipe marking.

- C. 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. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Fire Protection:
 - a. Background Color: Red.
 - b. Letter Color: White.
2. Domestic Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
3. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
4. Heating Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.
- C. Coordinate location of labels in exposed occupied areas with architectural trades.

3.5 VALVE-TAG INSTALLATION

- 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

****END OF SECTION****

TESTING, ADJUSTING & BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. Hydronic Piping Systems:
 - a. Variable-flow systems.
 - 3. HVAC equipment quantitative-performance settings.
 - 4. Indoor-air quality measuring.
 - 5. Verifying that automatic control devices are functioning properly.
 - 6. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.

- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- M. TAB: Testing, adjusting, and balancing.
- N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- O. Test: A procedure to determine quantitative performance of systems or equipment.
- P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within 45 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 45 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC, NEBB, or TABB.
- B. Acceptable TAB Firms: Subject to compliance with requirements, select from one of the following TAB firms:
 - 1. Absolut Balance Co.
 - 2. Air Flow Testing, Inc.
 - 3. Barmatic Inspecting Co.
 - 4. EnviroAire – Total Balance, Inc.
 - 5. International Test & Balance, Inc
- C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- E. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- F. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

- H. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 7.2.2 - "Air Balancing."
- I. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: Provide a guarantee on NEBB or TABB forms stating that NEBB or TABB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that first subparagraph below is correct for this Project. Statement is true if AIA standard documents are used correctly.
 - 2. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 3. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine design data, including system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

- J. Examine equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.

- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. First two subparagraphs below may require changes to installed systems or equipment; these changes may require a contract modification.
 - 5. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

6. See Evaluations for discussion of fan-speed adjustments.
 7. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 8. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS
- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
 - B. Prepare schematic diagrams of systems' "as-built" piping layouts.
 - C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.

2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.

3. Motor rpm.

4. Efficiency rating.

5. Nameplate and measured voltage, each phase.

6. Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.10 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Refrigerant Coils: Measure the following data for each 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. Refrigerant suction pressure and temperature.

3.12 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.13 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

- A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.
 1. Observe and record the following conditions for each HVAC system.
 2. The distance between the outside-air intake and the closest exhaust fan discharge, cooling tower, flue termination, or vent termination.
 3. Specified filters are installed. Check for leakage around filters.
 4. Cooling coil drain pans have a positive slope to drain.
 5. Cooling coil condensate drain trap maintains an air seal.

6. Evidence of water damage.
 7. Insulation in contact with the supply, return, and outside air is dry and clean.
- B. Measure and record indoor conditions served by each HVAC system. Make measurements at multiple locations served by the system if required to satisfy the following:
1. Most remote area.
 2. One location per floor.
 3. One location for every 5000 sq. ft..
- C. Measure and record the following indoor conditions for each location two times at two-hour intervals, and in accordance with ASHRAE 113:
1. Temperature.
 2. Relative humidity.
 3. Air velocity.
 4. Concentration of carbon dioxide (ppm).
 5. Concentration of carbon monoxide (ppm).
 6. Nitrogen oxides (ppm).
 7. Formaldehyde (ppm).

3.14 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.

- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.15 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
 - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.16 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following as applicable:
1. Quantities of outside, 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.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, 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 rpm.
 - d. Discharge static pressure in inches wg.
 - e. 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. Outside airflow in cfm.

- j. Return airflow in cfm.
- k. Outside-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

G. 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. Outside-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. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

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. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:

- a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - 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 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. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Compressor make.
 - e. Compressor model and serial numbers.
 - f. Refrigerant weight in lb.
 - g. Low ambient temperature cutoff in deg F.
2. Test Data (Indicated and Actual Values):
 - a. Inlet-duct static pressure in inches wg.
 - b. Outlet-duct static pressure in inches wg.
 - c. Entering-air, dry-bulb temperature in deg F.
 - d. Leaving-air, dry-bulb temperature in deg F.
 - e. Condenser entering-water temperature in deg F.
 - f. Condenser leaving-water temperature in deg F.
 - g. Condenser-water temperature differential in deg F.
 - h. Condenser entering-water pressure in feet of head or psig.
 - i. Condenser leaving-water pressure in feet of head or psig.
 - j. Condenser-water pressure differential in feet of head or psig.
 - k. Control settings.
 - l. Unloader set points.
 - m. Low-pressure-cutout set point in psig.
 - n. High-pressure-cutout set point in psig.
 - o. Suction pressure in psig.
 - p. Suction temperature in deg F.
 - q. Condenser refrigerant pressure in psig.
 - r. Condenser refrigerant temperature in deg F.
 - s. Oil pressure in psig.
 - t. Oil temperature in deg F.
 - u. Voltage at each connection.
 - v. Amperage for each phase.
 - w. Kilowatt input.
 - x. Crankcase heater kilowatt.
 - y. Number of fans.
 - z. Condenser fan rpm.
 - aa. Condenser fan airflow rate in cfm.
 - bb. Condenser fan motor make, frame size, rpm, and horsepower.
 - cc. Condenser fan motor voltage at each connection.
 - dd. Condenser fan motor amperage for each phase.

L. Indoor-Air Quality Measurement Reports for Each HVAC System:

1. HVAC system designation.
2. Date and time of test.

3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

M. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.18 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.19 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

A. Section Includes:

- 1. Insulation Materials:
 - a. Calcium silicate.
 - b. Cellular glass.
 - c. Flexible elastomeric.
 - d. Mineral fiber.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied fabric-reinforcing mesh.
- 9. Field-applied cloths.
- 10. Field-applied jackets.
- 11. Tapes.
- 12. Securements.
- 13. Corner angles.
- 14. Protective shielding guards

B. Related Sections:

1. Division 23 Section "Metal Ducts" for duct liners.

1.3 DEFINITIONS

- A. ASHRAE/IESNA: American Society of Heating, Refrigeration, Air Conditioning Engineers/Illuminating Engineering Society of North America.
- B. ASTM: American Society for Testing and Materials.
- C. CFC: Chlorinated Fluorocarbon.
- D. HCFC: Hydrogenated Chlorofluorocarbon.
- E. MIL: Military.
- F. NPS: Nominal Pipe Size.
- G. VOC: Volatile Organic Compound.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
 8. Detail field application for each equipment type.
- C. Qualification Data: For qualified Installer.
- D. 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.

- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 20 Section "Hangers and Supports for Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and 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.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Insulation Group (The); Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket or III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- K. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb./cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; CrimpWrap.
- b. Johns Manville; MicroFlex.
- c. Knauf Insulation; Pipe and Tank Insulation.
- d. Manson Insulation Inc.; AK Flex.
- e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

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- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.

- b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

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1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.

4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.
7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Sealants 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."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be 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.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be 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.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.

- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch (2 strands by 2 strands/sq. mm) for covering equipment.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm), in a Leno weave, for duct, equipment, and pipe.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, 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 D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.

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.
5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and Kraft paper.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - 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. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.

- 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) 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 stucco-embossed aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Polyguard Products, Inc.; Alumaguard 60.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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 C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 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 (38-mm) galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 - c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
 - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
 - D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

2.13 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

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. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 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. Truebro; a brand of IPS Corporation.

- b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
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 and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

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- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- 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. Manholes.
 5. Handholes.
 6. 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 (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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 (50 mm).

1. Comply with requirements in Division 07 07 84 13 Section "Penetration Firestopping" and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. 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 (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 07 84 13 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100cent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. 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.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle

around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets,

valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 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.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Provide protective shielding guards on exposed piping serving barrier free sinks and lavatories.
- D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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.
- E. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached

insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) 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.

3.7 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Breechings and Ducts:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation material.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 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.

- F. 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 50 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 overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 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.

3.11 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 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; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers 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 factory-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.

3.12 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 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.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, 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.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed outdoor air.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.15 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air/outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb./cu. ft. nominal density.
2. Mineral-Fiber Board: 1 inches thick and 2.25-lb./cu. ft. nominal density.

B. Concealed, rectangular, supply-air/outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb./cu. ft. nominal density.
2. Mineral-Fiber Board: 1 inches thick and 2.25-lb./cu. ft. nominal density.

C. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb./cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 2.25-lb./cu. ft. nominal density.

3.16 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.

3.17 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water and Non Potable Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch thick.
- C. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - F. Stormwater and Overflow:
 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - G. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - H. Heating-Hot-Water Supply and Return 200 Deg F and below:
 1. NPS 12 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
 - I. Refrigerant Suction and Hot-Gas Piping:
 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - J. Refrigerant Suction and Hot-Gas Piping:
 1. All Pipe Sizes: Insulation shall be[the following:
 - a. Flexible Elastomeric: 2 inches thick.
- 3.18 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. Ducts and Plenums, Concealed:
 1. None.
 - D. Ducts and Plenums, Exposed:
 1. PVC: 20 mils thick.

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2. Aluminum, Stucco Embossed: 0.020 inch thick.

****END OF SECTION****

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

A. Section Includes:

- 1. Pipes, fittings, and specialties.
- 2. Fire-protection valves.
- 3. Sprinklers.
- 4. Alarm devices.
- 5. Pressure gages.

B. Related Sections:

- 1. Division 20 Sections.
- 2. "Division 28 Section "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

1.3 DEFINITIONS

- A. ASCE/SEI: American Society of Civil Engineers/Structural Engineering Institute.
- B. ASME: American Society of Mechanical Engineers.
- C. ASTM: American Society for Testing and Materials.
- D. AWS: American Welding Society.
- E. AWWA: American Water Works Association.
- F. EPDM: Ethylene-propylene-diene terpolymer rubber.
- G. FDA: Food and Drug Administration.
- H. FM: Factory Mutual.
- I. IBC: International Building Code.

- J. MSS: Manufacturers Standardization Society for the Valve and Fitting Industry Inc.
- K. NFPA: National Fire Protection Association.
- L. NPS: Nominal Pipe Size.
- M. OS&Y: Outside Stem and Yoke.
- N. PE: Polyethylene.
- O. PVC: Polyvinyl Chloride.
- P. UL: Underwriters Laboratories.

1.4 PRESSURE CLASSIFICATION

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.5 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm check valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.6 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Laundries: Ordinary Hazard, Group 1.
 - e. Machine Shops: Ordinary Hazard, Group 2.
 - f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - g. Office and Public Areas: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

- c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area
 - d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
- a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes .
 - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
- D. Sprinkler system shall be hydraulically designed to have a density of at least that required by the hazard rating of the area to be protected.
- E. Materials and components shall be UL listed and labeled.
- F. Pipe size shall be no less than 1 inch. The velocity of water in pipe shall not exceed 20 feet per second.

1.7 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Qualification Data: For qualified Installer and professional engineer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Welding certificates.
- G. Fire-hydrant flow test report.
- H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- I. Field quality-control reports.
- J. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of a recent summer season fire-hydrant flow test.

B. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

C. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.9 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

1.10 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies. Coordinate with structural plans and architectural reflected ceiling plans for soffits, ceiling elevation changes, beam pockets, and other obstructions to the sprinkler discharge pattern.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.
- C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Uncoated Steel Couplings: ASTM A 865, threaded.
- E. Uncoated Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tyco Fire & Building Products LP.
 - b. Victaulic Company.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
 3. Minimum Pressure Rating for High-Pressure Piping: 300 psig.
- B. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 2. Standard: UL 1091 except with ball instead of disc.
 3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 5. Valves NPS 3: Ductile-iron body with grooved ends.
- C. Bronze Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.
 2. Standard: UL 1091.
 3. Pressure Rating: 175 psig.
 4. Body Material: Bronze.

5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kennedy Valve; a division of McWane, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Potter Roemer.
 - i. Reliable Automatic Sprinkler Co., Inc.
 - j. Tyco Fire & Building Products LP.
 - k. Victaulic Company.
 - l. Viking Corporation.
 - m. Watts Water Technologies, Inc.
2. Standard: UL 312.
3. Pressure Rating: 300 psig.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Double-Check, Detector-Assembly Backflow Preventers:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1048 and is FM Global approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: psig maximum, through middle third of flow range.
5. Size: 6"
6. Design Flow Rate: 500gpm
7. Pressure Loss at Design Flow Rate: 7 psig
8. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved
9. End Connections: Flanged.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

G. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

H. Iron OS&Y Gate Valves:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Milwaukee Valve Company.
 - e. Mueller Co.; Water Products Division.
 - f. NIBCO INC.
 - g. Tyco Fire & Building Products LP.
 - h. Watts Water Technologies, Inc.
 2. Standard: UL 262.
 3. Pressure Rating: 300 psig.
 4. Body Material: Cast or ductile iron.
 5. End Connections: Flanged or grooved.
- I. Indicating-Type Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kennedy Valve; a division of McWane, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 2. Standard: UL 1091.
 3. Pressure Rating: 175 psig minimum.
 4. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 5. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 6. Valve Position Monitor: Integral visual indicating device.
- J. NRS Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Mueller Co.; Water Products Division.
 - d. NIBCO INC.
 - e. Tyco Fire & Building Products LP.
2. Standard: UL 262.
 3. Pressure Rating: [250 psig minimum.
 4. Body Material: Cast iron with indicator post flange.
 5. Stem: Nonrising.
 6. End Connections: Flanged or grooved.
- K. Indicator Posts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Mueller Co.; Water Products Division.
 - d. NIBCO INC.
 - e. Tyco Fire & Building Products LP.
 2. Standard: UL 789.
 3. Type: Horizontal for wall mounting.
 4. Body Material: Cast iron with extension rod and locking device.
- 2.5 TRIM AND DRAIN VALVES
- A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating: 175 psig minimum.
- B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
- C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Fire Protection Products, Inc.
 - c. Kennedy Valve; a division of McWane, Inc.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Potter Roemer.
 - g. Tyco Fire & Building Products LP.
 - h. Victaulic Company.
 - i. Watts Water Technologies, Inc.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: 175 psig minimum.
 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
 2. Standard: UL 199.
 3. Pressure Rating: 175 psig.
 4. Body Material: Brass.
 5. Size: Same as connected piping.
 6. Inlet: Threaded.
 7. Drain Outlet: Threaded and capped.
 8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: 300 psig.

4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
- B. General Requirements:
 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
 3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
 4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
 1. Early-Suppression, Fast-Response Applications: UL 1767.
 2. Nonresidential Applications: UL 199.

3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

E. Special Coatings:

1. Wax.
2. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.

2.10 PRESSURE GAGES

- A. Manufacturers: Refer to Division 20 Section "Meters and Gages for Piping."
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.

- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

2.11 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated finish with concealed hinge and set-screw.
- E. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.12 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

2.13 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Plastic or Stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.14 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink, and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 21 Section "Facility Fire-Suppression Water-Service Piping."
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

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- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in Division 20 Section "Hangers and Supports for Piping and Equipment" for hanger materials.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 20 "Heat Tracing for Piping" and for piping insulation in Division 20 Section "Mechanical Insulation."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors. Refer to Division 20 Section "Common Work Results".

3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."

3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."
- M. Acoustical Wall Penetrations: Provide acoustical wall sleeves of split sheet metal design with 3/4" neoprene foam in the entire annular space equal to type SWS as manufactured by Mason Industries, Inc. or other approved equal.

3.10 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Division 20 Section "Identification for Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Coordinate with fire-alarm tests. Operate as required.
 6. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.13 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.14 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.15 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, schedule 40 steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray or malleable-iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:
 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray or malleable-iron threaded fittings; and threaded joints.
 2. Schedule 10, black-steel pipe with cut or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.16 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:

SECTION 211313
WET-PIPE SPRINKLER
SYSTEMS

1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 3. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Pendent Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

****END OF SECTION****

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

1.3 SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.
- B. Water Samples: Specified in "Cleaning" Article.
- C. System purging and disinfecting activities report.
- D. Field quality-control reports.
- E. Qualification Data: For qualified Installer.
- F. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of water service.

2. Do not interrupt water service without Construction Manager's/Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. 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.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions:
 1. MSS SP-123.
 2. Cast-copper-alloy, hexagonal-stock body.
 3. Ball-and-socket, metal-to-metal seating surfaces.
 4. Solder-joint or threaded ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe:
 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
 1. AWWA C110/A21.10, ductile or gray iron.
 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
 1. AWWA C153/A21.53, ductile iron.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.5 PIPING JOINING MATERIALS

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 B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
2. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.
2. Description:
 - a. CPVC or PVC four-part union.
 - b. Brass or stainless-steel threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Comply with the requirements of Division 20 "Common Work Results."

2.8 ESCUTCHEONS

- A. Refer to Division 20 Section "Common Work Results" for requirements.

2.9 SLEEVES

- A. Refer to Division 20 Section "Common Work Results" for requirements.

2.10 SLEEVE SEALS

- A. Refer to Division 20 Section "Common Work Results" for requirements.

2.11 GROUT

- B. Refer to Division 20 Section "Common Work Results" for requirements.

PART 2 - EXECUTION

2.1 EARTHWORK

- A. Comply with requirements in Section 31 "Earth Moving" for excavating, trenching, and backfilling.

2.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 20 "Meters and Gages" and with requirements for drain valves and strainers in Section 22 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install domestic water piping level without pitch 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 sleeves for piping penetrations of walls, ceilings, and floors.
- P. Install sleeve seals for piping penetrations of concrete walls and slabs.

- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- R. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the top or side of the main pipe.

2.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

2.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

2.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Comply with the requirements of Division 20 "Common Work Results."

2.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 20 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- A. Install supports for vertical steel piping every 15 feet.

2.7 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.

1.2 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Comply with the requirements of Division 20 "Common Work Results."

1.3 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. Comply with the requirements of Division 20 "Common Work Results."

1.4 SLEEVE SEAL INSTALLATION

- A. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

1.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 20 "Mechanical Identification."
- B. Label pressure piping with system operating pressure.

1.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

1.7 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.

1.8 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 according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. 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.

1.9 PIPING SCHEDULE

- 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 piping, NPS 2 and smaller, shall be the following:
 - 1. Hard or soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
- E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 5 to NPS 8, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

1.10 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

****END OF SECTION****

DOMESTIC WATER 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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

A. Section Includes:

- 1. Vacuum breakers.
- 2. Balancing valves.
- 3. Temperature-actuated, water mixing valves.
- 4. Strainers.
- 5. Drain valves.
- 6. Water-hammer arresters.
- 7. Air vents.
- 8. Waterless trap seal systems.
- 9. Specialty valves.

B. Related Requirements:

- 1. Section 20 "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
- 2. Section 22 "Drinking Fountains & Electric Water Coolers" for water filters for water coolers.

1.3 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.
- C. Field quality-control reports.

- D. 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. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

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, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; a division of Watts Water Technologies, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
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: Chrome plated for exposed finished areas. Rough bronze for unfinished areas..

- B. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; a division of Watts Water Technologies, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.

5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TACO Incorporated.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Dezincification resistant 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. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc. (RADA)
 - b. Bradley Corporation.
 - c. Lawler Manufacturing Company, Inc.
 - d. Leonard Valve Company.
 - e. Powers; a division of Watts Water Technologies, Inc.
 - f. Watts Regulator; a division of Watts Water Technologies, Inc.
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: 130 deg F.
9. Valve Finish: Chrome plated.
10. Piping Finish: Copper.
11. Refer to schedule on drawings for additional requirements.

B. Individual-Fixture, Water Tempering Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc. Model MVD (34D series)
 - b. Bradley Corporation.
 - c. Lawler Manufacturing Company, Inc.
 - d. Leonard Valve Company. Series 170 and 270.
 - e. Powers; a division of Watts Water Technologies, Inc. Hydroguard Series e480 and LM495.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable from 85 deg F to 120 deg F.
6. Inlets and Outlet: 1/2 inch union or 3/8 inch compression; with integral check valves.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 105 deg F.
9. Tempered-Water Design Flow Rate: Minimum 0.5 gpm.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Keckley.
 - c. Metraflex.
 - d. Mueller Steam Specialty.
 - e. NIBCO, Inc.
 - f. Spence.

- g. SSI Equipment, Inc.
 - h. Yarway.
2. CWP: 200 psig minimum, unless otherwise indicated.
 3. SWP: 125 psig minimum, unless otherwise indicated.
 4. Pressure Rating: 125 psig minimum unless otherwise indicated.
 5. 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.
 6. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 7. Screen: Stainless steel with round perforations unless otherwise indicated.
 8. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.045 inch.
 9. Drain: Factory-installed, hose-end drain valve.

2.7 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 B 62 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.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.8 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.9 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.10 WATERLESS TRAP-SEAL SYSTEMS

A. Waterless Trap-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R Smith Manufacturing Co.; Quad Close Trap Seal Device Fig. 2692.
 - b. Sure Seal Manufacturing; Inline floor drain trap sealer.
2. Type: Preassembled inline floor drain trap sealer.
3. Standard: ASSE 1072-2007.
4. Diaphragm and Sealing Gasket: Neoprene Rubber or chemically resistant elastomer.
5. Size: 2 inch, 3 inch, or 4 inch. Refer to schedule on drawing.
6. Gravity Drain Outlet Connection: Compression fit sealing gasket.

2.11 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 20 "General-Duty Valves for Piping."

B. Spring Operated, Diaphragm Assist Safety Relief Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.

- c. Bell & Gossett Domestic Pump; a division of Xylem, Inc.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Brass.
 3. Disc: Glass and carbon-filled PTFE.
 4. Seat: Brass.
 5. Stem Seals: EPDM O-rings.
 6. Diaphragm: EPT.
 7. Wetted, Internal Work Parts: Brass and rubber.
 8. Valve Seat and Stem: Noncorrosive.
 9. Spring: Alloy steel
 10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
 11. Maximum Temperature Rating of 250 deg F.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flex-Hose Co., Inc.
 2. Hyspan Precision Products, Inc.
 3. Metraflex, Inc.
- 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install balancing valves in locations where they can easily be adjusted.
- B. Install individual fixture temperature-actuated, water mixing valves on each lavatory/sink designated for hand washing.
- C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- D. Install Y-pattern strainers for water on supply side of each pump.
- E. Install water-hammer arresters in water piping according to PDI-WH 201.
- F. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- G. Install waterless trap-seal systems in floor drains per manufacturer recommendations.
- H. Install flexible hose connections on inlet and outlet of each pump and water service connections to vibration producing mechanical equipment,

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 26 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 26 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Calibrated balancing valves.
 - 3. Primary, thermostatic, 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 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Test each pressure vacuum breaker according to authorities having jurisdiction and the device's reference standard.
 - B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
 - C. Prepare test and inspection reports.
- 3.5 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.

****END OF SECTION****

SANITARY WASTE & VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Construction Manager/Owner no fewer than seven days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Construction Manager's/Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. 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.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301. Pipe shall be cast vertically or by centrifugal process and the inside and outside diameters shall be concentric, smooth, and free from cracks, sand holes, and other defects.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Mission Rubber Company; a division of MCP Industries, Inc.
 - c. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky; SD 4000.
 - b. Clamp-All Corp; 125.
 - c. Ferguson Enterprises, Inc.; ProFlo (Private labeled Ideal Clamp Products, Inc.)

d. Ideal Clamp Products, Inc.; a Tomkins Company.

2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer 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."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 SPECIALTY PIPE FITTINGS

A. Specialty pipe fitting requirements are specified in Section 20 "Common Work Results."

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 "Earth Moving."

3.2 PIPING INSTALLATION

- 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 from 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 wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- J. Install piping to allow application of insulation.
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. 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. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste drainage and vent piping at the minimum slopes required by code.

- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- O. Install steel piping according to applicable plumbing code.
- P. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.
- Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- R. PVC pipe shall not be exposed in return air plenums. Provide fire rated insulation as necessary for piping to comply with code required flame spread index and smoke-developed index when located within a return air plenum.
- S. Install underground PVC piping according to ASTM D 2321.
- T. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- U. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping.
 - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 22 "Sanitary Waste Piping Specialties."
- V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 20 "Common Work Results."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 20 "Common Work Results."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 20 "Common Work Results."

3.3 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Grooved Joints: Cut groove ends of pipe according to 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.
- E. 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.
- F. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Specialty pipe fitting installation requirements are specified in Section 20 "Common Work Results."

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 20 "General-Duty Valves for Piping."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 20 "Hangers and Supports for Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- 3.7 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 drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage 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 drainage 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 "Sanitary Waste Piping Specialties."
 - 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 20 "Identification for Piping and Equipment."

3.9 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 drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. 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. 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. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. 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.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:

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1. Hubless, cast-iron soil pipe and fittings; heavy-duty CISPI hubless-piping couplings; and coupled joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Indirect aboveground sanitary piping shall be the following:
1. Copper DWV tube, copper drainage fittings, and solder joints.
- D. Aboveground, vent piping NPS 4 and smaller shall be the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty CISPI hubless-piping couplings; and coupled joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty CISPI hubless-piping couplings; and coupled joints.
 2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty CISPI hubless-piping couplings; coupled joints.
 2. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

****END OF SECTION****

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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

A. Section Includes:

- 1. Cleanouts.
- 2. Floor drains.
- 3. Roof flashing assemblies.
- 4. Through-penetration firestop assemblies.
- 5. Miscellaneous sanitary drainage piping specialties.
- 6. Flashing materials.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Josam Company.
- 2) MIFAB, Inc.
- 3) Smith, Jay R. Mfg. Co.
- 4) Tyler Pipe.
- 5) Watts Water Technologies, Inc.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.

3. Size: Same as connected drainage piping

4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.

5. Closure: Countersunk or raised-head, drilled-and-threaded brass or bronze plug with tapered threads.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Josam Company.
- 2) Sioux Chief Manufacturing Co., Inc.

- 3) Smith, Jay R. Mfg. Co.
 - 4) Tyler Pipe.
 - 5) Watts Water Technologies, Inc.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
 3. Size: Same as connected branch.
 4. Type: Heavy-duty, adjustable housing.
 5. Body or Ferrule Material: Cast iron.
 6. Clamping Device: Required.
 7. Outlet Connection: Spigot.
 8. Closure: Brass, bronze or plastic with tapered threads.
 9. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy. In finished areas provide a recessed cover for finished floor material.
 11. Frame and Cover Shape: Round.
 12. Top-Loading Classification: Medium Duty.
 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure: Countersunk or raised-head, drilled-and-threaded brass or bronze plug with tapered threads.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Not required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Top Loading Classification: Drains located in Corridors and other occupied spaces shall be heavy duty loading.
16. Funnel: Not required.
17. Inlet Fitting: Not required.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
2. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, which 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.

B. 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.

C. 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.

D. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

E. Expansion Joints:

1. Standard: ASME A112.21.2M.
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.

2.5 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Applications: 12 oz./sq. ft..
 2. Vent Pipe Flashing: 8 oz./sq. ft..
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

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. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. 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.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- M. Install wood-blocking reinforcement for wall-mounting-type specialties.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 22 "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.
- C. Ground equipment according to Section 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
1. Notify Construction Manager/ no fewer than seven days in advance of proposed interruption of storm-drainage service.
 2. Do not proceed with interruption of storm-drainage service without Manager's//Owner's/written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. 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.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. MIFAB, Inc.
 - c. Mission Rubber Company; a division of MCP Industries, Inc.
 - d. Tyler Pipe.
 2. Standards: ASTM C 1277 and CISPI 310.
 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. MIFAB, Inc.
 - d. Mission Rubber Company; a division of MCP Industries, Inc.
 - e. Tyler Pipe.
 2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer 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."
- D. Solvent Cement: ASTM D 2564.
 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 SPECIALTY PIPE FITTINGS

- A. Specialty pipe fitting requirements are specified in Section 20 "Common Work Results."

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: High-density, cross laminated PE film of 0.004-inch.
- C. Form: tube
- D. Color: Black

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 "Earth Moving."

3.2 PIPING INSTALLATION

- 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 from 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 wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- J. Install piping to allow application of insulation.
- K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install storm drainage piping at the minimum slopes required by code.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- O. PVC pipe shall not be exposed in return air plenums. Provide fire rated insulation as necessary for piping to comply with code required flame spread index and smoke-developed index when located within a return air plenum.
- P. Install underground PVC piping according to ASTM D 2321.
- Q. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 22 "Storm Drainage Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 20 "Common Work Results."
- A. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 20 "Common Work Results."
- B. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 20 "Common Work Results."

3.3 JOINT CONSTRUCTION

- A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- C. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Specialty pipe fitting installation requirements are specified in Section 20 "Common Work Results."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 20 "Hangers and Supports for Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 4. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- 3.6 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 2. Comply with requirements for cleanouts and drains specified in Section "Storm Drainage Piping Specialties."
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 20 "Identification for 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.
 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 storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. 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 storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 and smaller shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- C. Aboveground, storm drainage piping and larger shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- D. Underground storm drainage piping NPS 6 and smaller shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, storm drainage piping NPS 8 and larger shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. Dissimilar Pipe-Material Couplings Shielded, nonpressure transition couplings.

END OF SECTION

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. Water closet flushometer valves.
 - 3. Toilet seats.
 - 4. Urinals.
 - 5. Urinal flushometer valves.
 - 6. Lavatories
 - 7. Lavatory Faucets.
 - 8. Utility sinks.
 - 9. Counter sinks.
 - 10. Sink faucets.
 - 11. Laminar-flow, faucet-spout outlets.
 - 12. Supply fittings.
 - 13. Waste fittings.
 - 14. Grout.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.
 - C. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.
 - D. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
 1. In addition to items specified in Section 01"Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. 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 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

- A. Water Closets: Floor mounted, bottom outlet, top spud.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Rim Contour: Elongated.
 - f. Water Consumption: 1.6 gal. (6 L) per flush.

- g. Spud Size and Location: NPS 1-1/2 (DN 40); top.
 - h. Color: White.
- 3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.
 - 4. Flushometer Valve.
 - 5. Toilet Seat.

2.4 WATER CLOSET FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company, Regal Model III
 - b. Zurn Industries, LLC.
- 2. Standard: ASSE 1037.
- 3. Minimum Pressure Rating: 125 psig.
- 4. Features: Include integral check stop and backflow-prevention device.
- 5. Material: Brass body with corrosion-resistant components.
- 6. Exposed Flushometer-Valve Finish: Chrome plated.
- 7. Style: Exposed.
- 8. Consumption: 1.6 gal. per flush.
- 9. Minimum Inlet: NPS 1.
- 10. Minimum Outlet: NPS 1-1/4.

2.5 TOILET SEATS

A. Toilet Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company, 1955SSC/1955SSCT.
 - b. Centoco Manufacturing Corporation.
 - c. Church Seats; 295SSC/295SSCT.
 - d. Olsonite Seat Co; Model 10SSC/10SSCT.
 - e. ProFlo; PFTSCOF2000WH.
- 2. Standard: IAPMO/ANSI Z124.5.
- 3. Material: Plastic.

4. Type: Commercial (heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check [].
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

2.6 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, washout, accessible.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America, Statebrook 1.0gpf
 - b. Kohler Co.
 - c. ProFlo; PF1810WH.
 - d. Sloan Valve Company.
2. Fixture:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Washout with extended shields.
 - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
 - e. Water Consumption: 1.0 gpf.
 - f. Spud Size and Location: NPS 3/4, top.
 - g. Outlet Size and Location: NPS 2, back.
 - h. Color: White.
3. Waste Fitting:
 - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
 - b. Size: NPS 2.
4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.7 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company, Regal Model III
 - b. Zurn Industries, LLC.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Consumption: 1.0 gal. per flush.
9. Minimum Inlet: NPS 1.
10. Minimum Outlet: NPS 1-1/4.

2.8 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory: Oval, self-rimming, vitreous china, counter mounted.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: Self-rimming for above-counter mounting.
 - c. Faucet-Hole Location: Top.
 - d. Color: White.
 - e. Mounting Material: Sealant.
 - f. Refer to schedule on drawings for additional information.

2.9 LAVATORY MANUALLY OPERATED FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Manual-type, two-handle mixing, commercial, solid-brass valve.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets; Geberit Company.
 - b. Kohler Co.

- c. T & S Brass and Bronze Works, Inc.
- 2. Standard: ASME A112.18.1/CSA B125.1.
- 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
- 4. Body Type: Centerset.
- 5. Body Material: Commercial, solid brass.
- 6. Finish: Polished chrome plate.
- 7. Maximum Flow Rate: 0.5 gpm.
- 8. Mounting Type: Deck, concealed.
- 9. Valve Handle(s): Vandal resistant lever.
- 10. Spout: Rigid type.
- 11. Spout Outlet: Aerator.
- 12. Operation: Noncompression, manual.
- 13. Drain: Pop up drain.

2.10 SERVICE SINKS

- A. Service Sinks: Enameled, cast iron, floor mounted.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Zurn Industries, LLC; Commercial Brass and Fixtures.
 - 2. Fixture:
 - a. Standard: ASME A112.19.1/CSA B45.2.
 - b. Style: With front apron and raised back.
 - c. Nominal Size: 28 by 28 inches (710 by 710 mm).
 - d. Color: White.
 - e. Drain: Grid with NPS 2 outlet.
 - f. Rim Guard: Coated wire.

2.11 SERVICE SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type

1. Commercial, Solid-Brass Faucets.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) American Standard America.
 - 2) Chicago Faucets; Geberit Company.
 - 3) Delta Faucet Company.
 - 4) Elkay Manufacturing Co.
 - 5) Kohler Co.
 - 6) Zurn Industries, LLC.
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Chrome plated.
7. Handle(s): Lever.
8. Mounting Type: Back, exposed.
9. Spout Type: Rigid, solid brass.
10. Vacuum Breaker: Required for hose outlet.
11. Spout Outlet: Aerator.

2.12 COUNTER SINKS

A. Sinks: Stainless steel, lay-in counter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing
2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Lay-in.
 - c. Number of Compartments: One or Two.
 - d. Refer to Plumbing Fixture Schedule on drawings for additional information.
 - e. Metal Thickness: 0.050 inch.
 - f. Each Compartment:

- 1) Drains: Grid with NPS 1-1/2 tailpiece and twist drain.
 - 2) Drain Location: Centered in compartment.
3. Faucet(s):
- a. Number Required: One.
 - b. Mounting: Deck.
4. Supply Fittings:
- a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Loose key.
 - 2) Risers: NPS 1/2.
5. Waste Fittings:
- a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 1-1/2.
 - 2) Material: 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.
6. Mounting: On counter with sealant.

2.13 COUNTER SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets : Manual type, two-lever-handle mixing valve.
 1. Commercial, Solid-Brass Faucets.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) American Standard America.
 - 2) Chicago Faucets; 895-317.
 - 3) Kohler Co; K7305-5A.
 - 4) T & S Brass and Bronze Works, Inc.
 - 5) Zurn Plumbing Products Group.
 2. Standard: ASME A112.18.1/CSA B125.1.
 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.

4. Body Material: Commercial, solid brass.
5. Finish: Chrome plated.
6. Spout Type: Rigid/Swing Swivel 5" gooseneck.
7. Vacuum Breaker: Required for hose outlet for service/utility sinks.
8. Refer to schedule on drawings for additional requirements.

2.14 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AM Conservation Group, Inc.
 2. Chronomite Laboratories, Inc.; a division of Acorn Engineering Company.
 3. NEOPERL, Inc.
- C. Description: Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.15 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," 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.
- F. Risers:
 1. Refer to fixture schedule for sizes.
 2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces riser.

2.16 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.

B. Lavatory:

1. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
2. Trap:
 - a. Size: NPS 1-1/4 unless otherwise scheduled.
 - b. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.

C. Sink:

1. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
2. Trap:
 - a. Size: NPS 1-1/2 unless otherwise scheduled.
 - b. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.17 GROUT

- A. Refer to Division 20 Section "Common Work Results" for requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine counters and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
4. Support Installation:

- a. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
 - b. Use carrier supports with waste-fitting assembly and seal.
 - c. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
 - d. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
5. Flushometer-Valve Installation:
- a. Install flushometer-valve, water-supply fitting on each supply to each water closet.
 - b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 - c. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
 - d. Install actuators in locations that are easy for people with disabilities to reach.
 - e. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
6. Install toilet seats on water closets.
7. Wall Flange and Escutcheon Installation:
- a. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
 - b. Install deep-pattern escutcheons if required to conceal protruding fittings.
 - c. Comply with escutcheon requirements specified in Section 20 "Common Work Results."
8. Joint Sealing:
- a. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
 - b. Match sealant color to water-closet color.
 - c. Comply with sealant requirements specified in Section 07 "Joint Sealants."
- B. Urinal Installation:
1. Install urinals level and plumb according to roughing-in drawings.
 2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
 3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
 4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
 5. Support Installation:
 - a. Install supports, affixed to building substrate, for wall-hung urinals.
 - b. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
 - c. Use carriers without waste fitting for urinals with tubular waste piping.
 - d. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

6. Flushometer-Valve Installation:

- a. Install flushometer-valve water-supply fitting on each supply to each urinal.
- b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- c. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
- d. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

7. Wall Flange and Escutcheon Installation:

- a. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
- b. Install deep-pattern escutcheons if required to conceal protruding fittings.
- c. Comply with escutcheon requirements specified in Section 20 "Common Work Results."

8. Joint Sealing:

- a. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
- b. Match sealant color to urinal color.
- c. Comply with sealant requirements specified in Section 07 "Joint Sealants."

3.3 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 22 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to fixtures, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets, flushometer valves, shower heads, etc. to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

****END OF SECTION****

DRINKING FOUNTAINS & ELECTRIC WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section includes pressure water coolers and related components.

1.3 DEFINITIONS

- A. Accessible Drinking Fountain: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler unless one is specifically indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of drinking fountain.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.
- C. Maintenance Data: For drinking fountains to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; State of Michigan Barrier Free Design; and Public Law 101-336, "Americans with Disabilities Act" ; for fixtures for people with disabilities.

- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- A. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- B. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than one of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Pressure Water Coolers: Wall mounted, standard, wheelchair accessible.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Tri Palm International, LLC; Oasis Brand.
 - e. Tri Palm International, LLC; Sunroc Brand.
 - 2. Cabinet: Single, all stainless steel.
 - 3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - 4. Control: Push button.
 - 5. Bottle filler: Refer to schedule on drawings on if required.
 - 6. Drain: Grid with NPS 1-1/4tailpiece.
 - 7. Supply: NPS 3/8 with shutoff valve.
 - 8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
 - 9. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.

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10. 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.
 - 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.
 11. Capacities and Characteristics: Refer to schedule on drawings.
 12. Support: ASME A112.6.1M, Type I water-cooler carrier.
- B. Pressure Water Coolers: Wall mounted, standard, wheelchair accessible.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Tri Palm International, LLC; Oasis Brand.
 - e. Tri Palm International, LLC; Sunroc Brand.
 2. Cabinet: Bi-level with two attached cabinets, all stainless steel.
 3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 4. Control: Push button.
 5. Bottle filler: Required.
 6. Drain: Grid with NPS 1-1/4tailpiece.
 7. Supply: NPS 3/8 with shutoff valve.
 8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
 9. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 10. 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.
 - 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.
 11. Capacities and Characteristics: Refer to schedule on drawings.
 12. Support: ASME A112.6.1M, Type I water-cooler carrier.

2.2 FIXTURE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
- C. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Type I: Hanger-type carrier with two vertical uprights.
 - 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

2.3 ESCUTCHEONS

- A. Refer to Division 20 Section "Common Work Results" for requirements.

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 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install recessed drinking fountains secured to wood blocking in wall construction.
- E. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- F. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.
- G. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 20 "General-Duty Valves for Piping."
- H. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- I. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings.
- J. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors. Refer to Section 20 "Common Work Results".

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- E. Comply with water piping requirements specified in Section 22 "Domestic Water Piping."

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- F. Install ball, gate, or globe shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 20 "General-Duty Valves for Piping."
- G. Comply with soil and waste piping requirements specified in Section 22 "Sanitary Waste and Vent Piping."

3.6 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.7 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.8 CLEANING

- A. After installing fixtures, 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

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping. Condensate-drain piping.
 - 2. Air-vent piping.

1.3 DEFINITIONS

- A. ANSI: American National Standards Institute.
- B. ASME: American Society of Mechanical Engineers.
- C. ASTM: American Society for Testing and Materials.
- D. AWS: American Welding Society.
- E. CDA: Copper Development Association.
- F. CFR: Code of Federal Regulations.
- G. CSA: Canadian Standards Association.
- H. CWP: Cold Working Pressure.
- I. DWV: Drainage, Waste and Vent.
- J. EPDM: Ethylene-propylene-diene terpolymer rubber.
- K. EPT: Ethylene-propylene terpolymer.
- L. LEED: Leadership in Energy and Environmental Design.
- M. MSS: Manufacturers Standardization Society for the Valve and Fitting Industry, Inc.
- N. NFPA: National Fire Protection Association.

- O. NPS: Nominal Pipe Size.
- P. NRTL: Nationally Recognized Testing Laboratory.
- Q. PTFE: Polytetrafluoroethylene.
- R. UL: Underwriters Laboratories Inc.
- S. VOC: Volatile Organic Compound.
- T. WOG: Water/Oil/Gas.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: 125 psig at 200 deg F.
 - 2. Condensate-Drain Piping: 150 deg F.
 - 3. Air-Vent Piping: 200 deg F.

1.5 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air control devices.
 - 3. Hydronic specialties.
- B. Welding certificates.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Hydronic Service: Do not interrupt hydronic service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary hydronic service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of hydronic service.
2. Do not interrupt hydronic service without Construction Manager's written permission.

1.8 EXTRA MATERIALS

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. DWV Copper Tubing: ASTM B 306, Type DWV.

C. Wrought-Copper Fittings: ASME B16.22.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A 733 made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

- A. Refer to Division 20 Section "Common Work Results for Fire Protection, Plumbing, and HVAC" for requirements.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Type L (B) , drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install silent check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.
- G. Provide standard balance valves at terminal devices. Provide auto-flow style balance valves at branches off piping mains. Do not provide auto-flow valves in series.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- 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. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 200523 Section "General-Duty Valves for Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and hose-end ball valve with cap in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 20 Section "Expansion Fittings and Loops for Piping."
- U. Identify piping as specified in Division 20 Section "Identification for Piping and Equipment."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 20 Section "Hangers and Supports for Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in Division 20 Section "Vibration Controls."
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 - 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 - 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 - 10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

- F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.

- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 20 Section "Meters and Gages for Piping."

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

- B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" values in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

- 6. Prepare written report of testing.

- C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.

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4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

****END OF SECTION****

HYDRONIC 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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Condensate-drain piping.
 - 3. Air-vent piping.

1.3 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.
- B. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.5 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
1. Hot-Water Heating Piping: 125 psig at 200 deg F.
 2. Condensate-Drain Piping: 150 deg F.
 3. Air-Vent Piping: 200 deg F.

2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 20 20 05 23 "General-Duty Valves for Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 23 23 09 00 "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Plug: Resin.
 5. Seat: PTFE.
 6. End Connections: Threaded or socket.
 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum 125 psig.
 10. Maximum Operating Temperature: 250 deg F.
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Stem Seals: EPDM O-rings.
 5. Disc: Glass and carbon-filled PTFE.
 6. Seat: PTFE.
 7. End Connections: Flanged.
 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 9. Handle Style: Lever, with memory stop to retain set position.
 10. CWP Rating: Minimum 125 psig.
 11. Maximum Operating Temperature: 250 deg F.

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig.

8. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

END OF SECTION

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.

1.3 DEFINITIONS

- A. ASCE/SEI: American Society of Civil Engineers/Structural Engineers Institute.
- B. ASHRAE: American Society of Heating, Refrigeration, and Air Conditioning Engineers.
- C. AWS: American Welding Society.
- D. CFR: Code of Federal Regulations.
- E. EPA: Environmental Protection Agency.
- F. EPDM: Ethylene-propylene-diene terpolymer rubber.
- G. ICC: International Code Council.
- H. IESNA: Illuminating Engineers Society of North America.
- I. HEPA: High Efficiency Particulate Arrestor.
- J. LEED: Leadership in Energy and Environmental Design.
- K. NADCA: National Air Duct Cleaners Association.
- L. NAIMA: North American Insulation Manufacturers Association.

- M. NFPA: National Fire Protection Association.
- N. NRTL: Nationally Recognized Testing Laboratory.
- O. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
- P. SPIDA: Spiral Duct Manufacturers Association.
- Q. UL: Underwriters Laboratories, Inc.
- R. VOC: Volatile Organic Compound.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

1.5 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.

8. Seam and joint construction.
 9. Penetrations through fire-rated and other partitions.
 10. Equipment installation based on equipment being used on Project.
 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Fire alarm devices.
 - g. Perimeter moldings.
- D. Welding certificates.
- E. Field quality-control reports.
- 1.6 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. Welding Qualifications: Qualify procedures and personnel according to 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 D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."
- E. NFPA Compliance; Comply with the following NFPA Standards:
 - 1. NFPA 90A, "Standard for the Installation of Air conditioning and Ventilation Systems." Except as indicated otherwise.
 - 2. NFPA 90B, "Standard for the installation of Warm Air Heating and Air Conditioning Systems.
 - 3. NFPA 96, "Standard for the installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for commercial Cooking Equipment," chapter 3 "duct System," for kitchen hood duct systems, except as indicated otherwise.
- F. Comply with UL standards listed within this section. Provide mastic and tapes that are listed and labeled in accordance with 181A and marked according to type.
- G. National Air Duct Cleaners Association, Inc. (NADCA): Clean ductwork system in accordance with the standards Assessment, cleaning and Restoration of HVAC System (ACR 2002)

1.7 PROTECTION AND REPLACEMENT

- A. Protect ductwork during shipping and storage from dirt, debris and moisture damage. Provide plastic covers over ends of ductwork during shipping, storage and installation.
- B. Replace duct liner that is damaged and cannot be repaired satisfactorily. Replace duct liner that has gotten wet during shipping, storage or installation. Dry surfaces prior to installing new duct liner.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," 2005 Edition, Tables 2-1 through 2-28, including their associated details, based on indicated static-pressure class unless otherwise indicated. Conform to the requirements in the reference standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
 - 1. Fabricate rectangular ductwork of minimum 26 gauge sheet metal.
 - 2. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 - 3. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides are 19 inches and larger are 20 gauge or less, with more than 10 sqft unbraced panel area, as indicated in SMACNA "HVAC

Duct Construction Standards," 2005 Edition, Figure 2-9, unless they are lined or are externally insulated.

- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) 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."
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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."
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "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."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. Single wall round ducts and fittings may be factory fabricated or shop fabricated.
- B. Provide round ducts in lengths not less than 12 feet. Fabricate round and flat oval spiral ductwork of minimum 26 gauge sheet metal. No longitudinal seam ductwork allowed
- C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eastern Sheet Metal, Inc.
 - b. Lindab Inc.
 - c. McGill AirFlow LLC.
 - d. SEMCO Incorporated.
 - e. Sheet Metal Connectors, Inc.
 - f. Spiral Manufacturing Co., Inc.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Factory- or Shop-Applied Antimicrobial Coating:
1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 5. Shop-Applied Coating Color: White.
 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- 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.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 2. 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 shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA Inc.
 - b. Armacell LLC.
 - c. Rubatex International, LLC
 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Bonded Logic, Inc.
 - b. Reflectix Inc.
2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. 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 (38-mm) 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.
- E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "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.
 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; and when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to 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 w.g. 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.
 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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 w.g., 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. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch w.g., positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch w.g. and shall be rated for 10-inch w.g. 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.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated 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 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through required exit stairwells, elevator hoistways and machinery rooms, transformer vaults and electrical equipment rooms and enclosures.
- J. 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

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 the 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.

4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch w.g. and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch w.g.: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch w.g. and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch w.g.: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch w.g.: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 3-Inch w.g. or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts with a Pressure Class of 2-Inch w.g. or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of 2-Inch w.g. or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - e. Outdoor Air Ducts with a Pressure Class of 2-Inch w.g. or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days' advance notice for testing.
- 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 according to "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 shall 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.

3.8 DUCT CLEANING

A. Clean new and existing (where identified on drawings) duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.

6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Terminal Units:
 - a. Pressure Class: Positive 2-inch w.g..
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 6-inch w.g..
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 6-inch w.g..
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- C. Return Ducts:
 1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Negative 2-inch w.g..
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.

 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Negative 2-inch w.g..
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- D. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch w.g..
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.

- E. Outdoor-Air Ducts:
 1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Negative 6-inch w.g..
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- F. Intermediate Reinforcement:
 1. Galvanized-Steel Ducts: Galvanized steel.

- G. Liner (where indicated on drawings):
 1. Supply Air Ducts: Fibrous glass, Type I 1 inchthick.
 2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
 3. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick.
 4. Supply Fan Plenums: Fibrous glass, Type II, 1 inch thick.

5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 2 inches thick.
6. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "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 2-3, "Vanes and Vane Runners," and Figure 2-4, "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 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

A. Section Includes:

- 1. Manual volume dampers.
- 2. Fire dampers.
- 3. Flange connectors.
- 4. Turning vanes.
- 5. Duct-mounted access doors.
- 6. Flexible connectors.
- 7. Flexible ducts.
- 8. Duct accessory hardware.

B. Related Sections:

- 1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
- 2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 DEFINITIONS

- A. AMCA: Air Movement and Control Association International, Inc.
- B. ASHRAE: American Society of Heating, Refrigeration, and Air Conditioning Engineers.
- C. ASTM: American Society for Testing and Materials.
- D. LEED: Leadership in Energy and Environmental Design.
- E. NFPA: National Fire Protection Association.
- F. NRTL: Nationally Recognized Testing Laboratory>

- G. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
- H. STC: Sound Transmission Class.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- 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. Duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.
- C. Source quality-control reports.
- D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Comply with applicable portions of SMACNA "Duct Construction Standards, metal and Flexible", 2005 Edition.
- B. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
- C. UL Compliance:
 - 1. Construct flexible ductwork in compliance with UL Standard 181 " Factory-Made Air Ducts and Connections".
 - 2. Duct tape shall be labeled in accordance with UL Standard 180B and marked 181B-FX. Non-metallic duct clamps shall be labeled in accordance with UL Standard 181B and marked 181B-C
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- E. Comply with AMCA 500-D testing for damper rating.
- F. Products shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 "Surface Burning Characteristics" (NFPA 225) method.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, 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.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Vent Products Company, Inc.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:

- a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
- a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch w.g. or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Vent Products Company, Inc.
 2. Standard leakage rating.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with 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. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch w.g. or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

2.3 Tie Bars and Brackets: Aluminum.FIRE DAMPERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Air Balance Inc.; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
11. If both types of dampers are required in first paragraph below, indicate location of each on Drawings.
12. Type: Dynamic ; rated and labeled according to UL 555 by an NRTL.
13. Retain first paragraph below for dynamic fire dampers.
14. Closing rating in ducts up to 4-inch w.g. static pressure class and minimum 4000-fpm velocity.
15. If both 1-1/2- and 3-hour ratings are required in first paragraph below, indicate location of each rating on Drawings.
16. Fire Rating: Damper ratings shall be as required to maintain the fire rating noted on the architectural drawings.
17. Type 304, stainless-steel dampers are available for corrosive atmospheres.
18. Frame: Curtain type with blades outside airstream ; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
19. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
20. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
21. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
22. Mounting Orientation: Vertical or horizontal as indicated.

23. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
24. Not all manufacturers use blade locks for horizontal units.
25. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
26. Retain one of two paragraphs below. If multiple temperature ratings are required, indicate location of each heat-responsive-device rating on Drawings.
27. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- 28.

2.4 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.5 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. METALAIRE, Inc.
 4. SEMCO Incorporated.
- B. Manufactured Turning Vanes for Metal Ducts: 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"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.6 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Flexmaster U.S.A., Inc.
 - 5. Greenheck Fan Corporation.
 - 6. McGill AirFlow LLC.
 - 7. Nailor Industries Inc.
 - 8. Pottorff; a division of PCI Industries, Inc.
 - 9. Ruskin.
 - 10. Ventfabrics, Inc.
 - 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:

- a. Access Doors Less Than 12 InchesSquare: No hinges and two sash locks.
- b. Access Doors up to 18 InchesSquare: Two hinges and two sash locks.
- c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches .
- d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 10-inch w.g.] .
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.7 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inchcarbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch w.g.positive or negative.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 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.
- E. 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.
- F. 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.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd.
 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd..
 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.9 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flexmaster U.S.A., Inc.
 2. Thermaflex
- B. Construction: Provide flexible ductwork conforming to UL 181-Class I, NFPA 90A and NFPA 90B and as follows. Duct types of manufacturers are indicated for reference in regards to required quality of construction and materials.
 1. Low Pressure (duct pressure class up and including 2" w.g.) and medium pressure (duct pressure class 2.1" to 6" w.g.) flexible duct shall have fire retardant polyethylene (Flexmaster Type 8B, Thermaflex Type G-KM) or reinforced metalized (Flexmaster Type 8M, Thermaflex Type M-KE) protective vapor barrier. High pressure (duct pressure class over 6" w.g.) flexible duct shall have fire retardant polyethylene (Flexmaster Type 4B) or reinforced metalized (Flexmaster Type 4M, Thermaflex Type M-KC) protective vapor barrier.
 2. Flexible ductwork shall have CPE liner with steel wire helix mechanically locked or permanently bonded to the liner.
 3. Provide acoustical, fiberglass insulated duct with minimum R-value of R-6.
 4. Connect each end with duct clamps and duct tape as specified in part 3. Duct clamps shall be labeled in accordance with UL-181B and marked 181B-C. Duct tape shall be labeled in accordance with UL 181B and marked 181B-FX.
- C. Flexible Duct Connectors
 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

- D. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

2.10 DUCT ACCESSORY HARDWARE

- A. 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.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install 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. 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.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. 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. At outdoor-air intakes and mixed-air plenums.
 - 3. At drain pans and seals.
 - 4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.

5. At each change in direction and at maximum 50-foot spacing.
 6. Upstream from turning vanes.
 7. Upstream or downstream from duct silencers.
 8. Control devices requiring inspection.
 9. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. 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.
- J. Label access doors according to Division 20 Section "Identification for Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5-inch w.g. and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect terminal units to supply ducts with maximum 6-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect flexible ducts to metal ducts with draw bands.
- O. Install duct test holes where required for testing and balancing purposes.
- P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.
- 3.2 FIELD QUALITY CONTROL
- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

****END OF SECTION****

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Mfg. Corp.
 2. Aerovent; a Twin City Fan Company
 3. Breidert Air Products.
 4. Carnes Company HVAC.
 5. Greenheck.
 6. Hartzell Fan, Inc.
 7. Loren Cook Company.
 8. Penn Ventilation.
- B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
1. Hinged Sub-base: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
1. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, 3 pound density, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Built-in cant and mounting flange for flat roof deck; and 2-inch treated wood nailer. Size as required to suit roof opening and fan base. For sloped roofs, slope curb as required to install fan level.
 - 2. Metal Liner: Galvanized steel.
 - 3. Mounting Pedestal: Galvanized steel with removable access panel.

2.2 MOTORS

- A. Comply with requirements in Division 20 Section "Common Motor Requirements for Fire Suppression, Plumbing, and HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support units using spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 20 Section "Vibration and Seismic Controls for Piping and Equipment."
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 20 Section "Identification for Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

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- B. Adjust belt tension.
- C. Refer to Division 20 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

****END OF SECTION****

DIFFUSERS, 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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

A. Section Includes:

- 1. Ceiling diffusers.
- 2. Registers and grilles.

B. Related Sections:

- 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
- 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

- 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, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Ceiling Diffusers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Hart & Cooley Inc.
 - d. Krueger.

- e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Price Industries.
 - h. Titus.
 - i. Tuttle & Bailey.
2. Except as otherwise indicated, provide manufacturers standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provide with accessories as required for complete installation.
 3. Provide ceiling air diffusers that have a minimum temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
 4. Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffusers.
 5. Accessories:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.

2.2 REGISTERS AND GRILLES

A. Registers and Grilles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Hart & Cooley Inc.
 - d. Krueger.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Price Industries.
 - h. Titus.
 - i. Tuttle & Bailey.
2. Except as otherwise indicated, provide manufacturers standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provide with accessories as required for complete installation.
3. Provide ceiling air diffusers that have a minimum temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

4. Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffusers.
5. Accessories:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles 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, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Support flexible duct connectors at connection to air diffusion devices with "FLEXFLOW ELBOW" elastomeric duct elbow support as manufactured by Thermaflex or approved equal.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

- A. After installation of diffusers, registers and grilles, inspect exposed finish. Clean exposed surfaces to remove dirt and smudges. Replace any air device that has damaged finishes.

****END SECTION****

HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section Includes:

- 1. Roof hoods.

1.3 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; material surfaces.
- B. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated
- B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 1. Use types and sizes to suit unit installation conditions.
 2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.3 ROOF HOODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Acme Engineering & Mfg. Corporation.
 2. Aerovent.
 3. Carnes.
 4. Greenheck Fan Corporation.
 5. Loren Cook Company.
 6. PennBarry.
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.
- C. Materials: Aluminum sheet, minimum 0.063-inch-; suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
- E. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire .
- F. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.
- G. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
 2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
 3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Install gravity ventilators with clearances for service and maintenance.
- C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

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- D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during installation.
- E. Label gravity ventilators according to requirements specified in Division 20 Section "Identification for Piping and Equipment."
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 23 31 13 "Metal Ducts" and Section 23 31 16 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION

PACKAGED ROOFTOP UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
 - 1. Direct-expansion cooling.
 - 2. Economizer outdoor- and return-air damper section.
 - 3. Integral, space temperature controls.
 - 4. Roof curbs.

1.3 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electrically commutated motor.
- C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

H. VVT: Variable-air volume and temperature.

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Warranty: Special warranty specified in this Section.
- E. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. ARI Compliance:
 - 1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 15 for refrigeration system safety.
 - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 2. Warranty Period: One year complete unit parts and labor warranty.
 3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fan Belts: One set for each belt-driven fan.
 2. Filters: One of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AAON, Inc.
 2. Carrier Corporation.
 3. Daikin/McQuay International.
 4. Johnson Controls.
 5. Trane; American Standard Companies, Inc.

2.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
1. Exterior Casing Thickness: 0.079 inch thick.

- C. Inner Casing Fabrication Requirements:
 - 1. Inside Casing: Galvanized steel, 0.034 inchthick.
- D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: ASTM C 1071, Type I.
 - 2. Thickness: 1 inch.
 - 3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
 - 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep and complying with ASHRAE 62.1.
 - 1. Drain Connections: Threaded nipple.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

- A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- C. Relief-Air Fan: Forward curved, shaft mounted on permanently lubricated motor.
- D. Fan Motor: Comply with requirements in Division Section 20 "Common Motor Requirements for Fire Suppression, Plumbing and HVAC Equipment."

2.4 COILS

- A. Supply-Air Refrigerant Coil:
 - 1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
 - 3. Coil Split: Row split interlaced.
 - 4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.
- B. Outdoor-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

2.5 REFRIGERANT CIRCUIT COMPONENTS

- A. Number of Refrigerant Circuits: Four.
- B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief and crankcase heater.
- C. Refrigeration Specialties:
 1. Refrigerant: R-410A.
 2. Expansion valve with replaceable thermostatic element.
 3. Refrigerant filter/dryer.
 4. Manual-reset high-pressure safety switch.
 5. Automatic-reset low-pressure safety switch.
 6. Minimum off-time relay.
 7. Automatic-reset compressor motor thermal overload.
 8. Brass service valves installed in compressor suction and liquid lines.
 9. Low-ambient kit high-pressure sensor.
 10. Hot-gas bypass solenoid valve with a replaceable magnetic coil.

2.6 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 1. Pleated: Minimum 90 percent arrestance, and MERV 13.

2.7 DAMPERS

- A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.
- B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.
3. Powered exhaust fan.

2.8 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.9 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 23 09 00 "Instrumentation and Control for HVAC."

- B. Basic Unit Controls:

1. Control-voltage transformer.
2. Wall-mounted thermostat or sensor with the following features:
 - a. Heat-cool-off switch.
 - b. Fan on-auto switch.
 - c. Fan-speed switch.
 - d. Manual changeover.
 - e. Adjustable deadband.
 - f. Exposed set point.
 - g. Exposed indication.
 - h. Degree F indication.
 - i. Unoccupied-period-override push button.
 - j. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.

- C. DDC Controller:

1. Safety Control Operation:
 - a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
 - b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
 - c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Section "Digital, Addressable Fire-Alarm System" and Section "Zoned (DC Loop) Fire-Alarm System."

2.10 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Filter differential pressure gauge with integral switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- C. Coil guards of painted, galvanized-steel wire.
- D. Hail guards of galvanized steel, painted to match casing.

2.11 ROOF CURBS

- A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Division Section 20 "Vibration and Seismic Controls for Piping and Equipment."
- B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C 1071, Type I or II.
 - b. Thickness: 1 inch.
 - 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - d. Liner Adhesive: Comply with ASTM C 916, Type I.
- C. Curb Height: 14 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Division Section 20 "Vibration and Seismic Controls for Piping and Equipment."

- B. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts.", ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

- C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20, Division 22, and Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

- C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 23 33 00 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

- B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Remove packing from vibration isolators.
12. Inspect operation of barometric relief dampers.
13. Verify lubrication on fan and motor bearings.
14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
15. Adjust fan belts to proper alignment and tension.
16. Start unit according to manufacturer's written instructions.

- a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
17. Inspect and record performance of interlocks and protective devices; verify sequences.
 18. Operate unit for an initial period as recommended or required by manufacturer.
 19. Calibrate thermostats.
 20. Adjust and inspect high-temperature limits.
 21. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 22. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
 23. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
 24. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
 25. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
 26. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. Low-temperature safety operation.
 - b. Filter high-pressure differential alarm.
 - c. Economizer to minimum outdoor-air changeover.
 - d. Relief-air fan operation.
 - e. Smoke and firestat alarms.
 27. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 01 79 00 "Demonstration and Training."

****END OF SECTION****

AIR COILS AND DRAIN PANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section includes hydronic heating and cooling air coils.
 - 1. Hydronic.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
 - 2. Include rated capacities, operating characteristics, and pressure drops for each air coil.
- B. LEED Submittals:
 - 1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
- C. Shop Drawings: Diagram power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.
- B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.6 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. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 2. Comply with ASHRAE 15 for refrigeration system safety.
- C. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

PART 2 - PRODUCTS

2.1 HYDRONIC COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerofin.
 - 2. Carrier Corporation.
 - 3. Daikin.
 - 4. Greenheck Fan Corporation.
 - 5. Heatcraft Worldwide Refrigeration.
 - 6. Johnson Controls.
 - 7. Trane.
- B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
- D. Source Quality Control: Factory tested to 300 psig.
- E. Tubes: ASTM B 743 copper, minimum 0.020 inch thick.
- F. Fins: Aluminum, minimum 0.010 inch thick.
- G. Headers: Seamless copper tube with brazed joints, prime coated .
- H. Frames, Hot Water Coils: Galvanized-steel channel frame, minimum 0.052 inch thick for slip-in mounting.
- I. Special Coating: Heresite P-403 baked phenolic for coils installed in stainless steel ductwork.
- J. Hot-Water Coil Capacities and Characteristics:
 - 1. Refer to drawings for requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Straighten bent fins on air coils.
- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 "Instrumentation and Control for HVAC," and other piping specialties are specified in Division 23 "Hydronic Piping."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections :
 - 1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Prepare test and inspection reports.

END OF SECTION

VERTICAL UNIT VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section. Verify Division 1 specification is included in project. Delete if project is small.

1.2 SUMMARY

- A. This Section includes unit ventilators and accessories with the following heating and cooling features:
 - 1. Hydronic heating coil.
 - 2. Direct-expansion refrigerant cooling coil.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for each unit type and configuration.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Details of anchorages and attachments to structure and to supported equipment.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For unit ventilators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 - D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- 1.5 COORDINATION
- A. Coordinate layout and installation of unit ventilators and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
 - B. Coordinate size and location of wall sleeves for outdoor-air intake and relief dampers.
- 1.6 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Compressor failure.
 - b. Condenser coil leak.
 - 2. Warranty Period: One years from date of Substantial Completion.
 - 3. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
 - 4. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.
- 1.7 EXTRA MATERIALS
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Unit Ventilator Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Airedale.
 - 2. Change Air.

2.2 MANUFACTURED UNITS

- A. Description: Factory-packaged and -tested units rated according to ARI 840, ASHRAE 33, and UL 1995, including finished cabinet, filter, cooling coil, drain pan, supply-air fan and motor in draw-through configuration, and hydronic cooling coil.

2.3 CABINETS

- A. Insulation: Minimum 1-inch (25-mm thick, coated glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- B. Cabinet Frame and Access Panels: Welded-steel frame with removable panels fastened with hex-head tamperproof fasteners and key-operated control and valve access doors.
 - 1. Steel components exposed to moisture shall be hot-dip galvanized after fabrication.
- C. Cabinet Finish: Baked enamel, in manufacturer's standard paint color as selected by Architect.
- D. Return-Air Inlet: Side inlet grille].
- E. End Panels: Matching material and finish of unit ventilator.

2.4 COILS

- A. Test and rate unit ventilator coils according to ASHRAE 33.
- B. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.
- C. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and brazed joints at fittings. Comply with ARI 210/240, and leak test to minimum 450 psig (3105 kPa) for a minimum 300-psig (2070-kPa) working pressure. Include thermal expansion valve.

2.5 COOLING

- A. First stage: Fully modulating economizer.
- B. Second stage: Unit mounted direct expansion coil; low stage compressor with low fan speed.
- C. Third stage: Unit mounted direct expansion coil; high stage compressor with low fan speed.
- D. Fourth Stage: Unit mounted direct expansion coil; high stage compressor with high fan speed.

2.6 DRAIN PANS

- A. Non-Corrosive Stainless Steel.

2.7 FILTERS

- A. Accessible from front of unit and positioned to filter mixed air prior to conditioning. Microbial treated, and with minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pleated Cotton-Polyester Media: 2 inch thick, MERV 8.

2.8 REFRIGERATION SYSTEM:

- A. Fully hermetic, two stage, scroll type compressor, internally equalized expansion valve, filter/dryer, factory installed high and low refrigerant pressure switches and service valves, suitable for HCFC R-410a.
- B. Compressor Acoustic Wrap with Base: For improved sound attenuation, compressor casing consists of 18oz PVC barrier laminated to 1/2 inch non-woven polyester. Casing includes integral 4 inch foil backed fiberglass heat shield for use with crankcase heater. Compressor base consists of 2 pound EVA barrier with embedded 1/4 inch layered closed cell foam. Cover is easily removable for service.
 - 1. Compressor protected against excessive motor temperatures and current by means of internal overload protector.
 - 2. Compressor to contain internal unloading mechanism to provide capacity control and increase part load efficiencies.
 - 3. Evaporator coils: Aluminum micro-channel CFTM.
 - 4. Condenser coils: Aluminum fins mechanically bonded to copper tubes.
 - a. Condenser coil: High-efficiency cross-rifle type.

2.9 HEATING COIL

- A. Copper tubes with aluminum fins. Factory piped and complete with 2-way modulating control valve, isolation valves, balance valve, PT ports, drain valve, strainer, and manual air vent. 3/8" wall closed cell type insulation shall cover all factory installed piping.

2.10 INDOOR FAN

- A. Fan and Motor Board: Removable.
 - 1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels; and aluminum, painted-steel, or galvanized-steel fan scrolls.
 - 2. Fan Shaft and Bearings: Hollow steel shaft with permanently lubricated, resiliently mounted bearings.
 - 3. Motor: Permanently lubricated, multispeed, resiliently mounted on motor board. Comply with requirements in Division 20 Section "Common Motor Requirements for Fire Suppression, Plumbing and HVAC Equipment."

2.11 WIRING TERMINATION

- A. Connect motor to chassis wiring with plug connection.

2.12 FANS AND FAN MOTOR

- A. Indoor fan assembly: Consisting of a blower and electronically commutated motor (ECM).
 - 1. ECM having a wide range of programmable speed and torque characteristics.
 - 2. ECM fully programmable to compensate for wide variety of static pressures as well as lack of maintenance.
- B. Outdoor fan assembly: Consisting of blower and electronically commutated motor (ECM).
- C. Unit shall be set to provide design airflow at specified static pressure on high speed.

2.13 DAMPERS

- A. Mixing Modulating Dampers: Galvanized-steel blades with edge and end seals and nylon bearings; with electric actuator.; spring return type, designed to mix outside air with return air.
- B. Capable of permitting 100 percent outside air into the conditioned space, or recycling return air and allowing minimum outside air into the conditioned space.
- C. Fully modulating allowing any mixture of outside air and return air with minimum damper position setting to continuously maintain outside air ventilation requirements dependent on control via signal from building managements system through unit controller.
- D. Outdoor-Air Dampers: Galvanized-steel blades with edge and end seals and nylon bearings; with electric actuator.
- E. Comply with ASHRAE/IESNA 90.1-2004.

2.14 LOUVERS

- A. Aluminum blades, storm-proof, mounted at 45 degree angle in heavy gage extruded aluminum frames.
- B. Blade profile and louver size designed to prevent water penetration during full economizer operation.
- C. ½ inch mesh bird screen shall be attached to louver frame.

2.15 ACCESSORIES

- A. Return-air plenum, 6 inches (150 mm) thick, designed to take return air from top inlet grilles in cabinets on both sides of unit ventilator with gasket seals on wall and outdoor-air plenum extension.
- B. Duct flanges for supply-, return-, and outdoor-air connections.
- C. FCondenser coil filters: Minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

2.16 REMOTE CONDENSING UNITS (WHERE APPLICABLE)

- A. Description: Factory assembled and tested; consisting of compressors, condenser coils, fans, motors, refrigerant receiver, and operating controls. Construct, test, and rate condensing units according to ARI 210/240 and ASHRAE 15.
- B. Casing: Steel with baked-enamel finish; removable panels for access to controls, weep holes for water drainage, and mounting holes in base.
 1. Casing Finish: Baked enamel, in manufacturer's [standard] [**custom**] paint color as selected by Architect.
- C. Compressor: Hermetic, [**scroll**] [reciprocating] type; internally isolated for vibration with factory-installed safety devices as follows:
 1. Antirecycle timer.
 2. High-pressure cutout.
 3. Low-pressure cutout or loss-of-charge switch.
 4. Internal thermal-overload protection.
 5. Current and voltage sensitive safety devices.
- D. Compressor Motor: Start capacitor, relay, and contactor. Comply with requirements in Division 20 Section "Common Motor Requirements for Fire Suppression, Plumbing and HVAC Equipment."
- E. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."
- F. Refrigerant Piping Materials: (Not applicable)
 1. Drawn-Temper Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B).
 2. Annealed-Temper Copper Tube: ASTM B 88, Type L ASTM B 88M, Type B)
 3. Wrought-Copper Fittings: ASME B16.22.
- G. Refrigerant: R-407C or R-410A.
- H. Low ambient controls to permit operation down to 45 deg F (7 deg C).
- I. Crankcase heater.
- J. Charging and service fittings on exterior of casing.
- K. Filter dryer.
- L. Air-to-Air Heat Pump: Pilot-operated, sliding-type reversing valve with replaceable magnetic coil, and controls for air-to-air heat pump operation with supplemental heat.
- M. HGBP, constant-pressure expansion valve and controls to maintain continuous refrigeration system operation at 10 percent of full load.

- N. Condenser: Copper-tube, aluminum-fin coil, with liquid sub-cooler.
- O. Condenser Fan: Direct-drive, aluminum propeller fan; motor with thermal-overload protection.
- 1. Motor: Comply with requirements in Division 20 Section "Common Motor Requirements for Fire Suppression, Plumbing and HVAC Equipment."
- P. Accessories: Polyethylene mounting base to provide a permanent foundation.

2.17 INTEGRAL COOLING CHASSIS

- A. Description: Assembly mounted within unit ventilator, factory assembled and tested; consisting of compressors, condenser coils, fans, motors, and refrigerant receivers; removable for maintenance, with plug and receptacle connections for control and power wiring. Construct, test, and rate condensing units according to ARI 210/240 and ASHRAE 15.
- B. Casing: Galvanized steel with removable panels for access to controls and refrigerant piping.
- C. Exterior Louver: Extruded aluminum.
- D. Compressor: Hermetic, scroll type; internally isolated for vibration with factory-installed safety devices as follows:
 - 1. Antirecycle timer.
 - 2. High-pressure cutout.
 - 3. Low-pressure cutout or loss-of-charge switch.
 - 4. Internal thermal-overload protection.
 - 5. Current- and voltage-sensitive safety devices.
- E. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."
- F. Refrigerant Piping Materials:
 - 1. Drawn-Temper Copper Tube: ASTM B 88, Type L.
 - 2. Annealed-Temper Copper Tube: ASTM B 88, Type L.
 - 3. Wrought-Copper Fittings: ASME B16.22.
- G. Refrigerant: R-410A.
- H. Crankcase heater.
- I. Charging and service fittings.
- J. Filter dryer.

- K. HGBP, constant-pressure expansion valve and controls to maintain continuous refrigeration system operation at 10 percent of full load.
- L. Condenser: Copper-tube, aluminum-fin coil, with liquid sub-cooler.
- M. Direct-Driven Condenser Fan: Forward curved, double width, centrifugal; thermoplastic or painted-steel wheels and galvanized-steel fan scrolls.
 - 1. Motor: Comply with requirements in Division 20 Section "Common Motor Requirements for Fire Suppression, Plumbing and HVAC Equipment.

2.17 BASIC UNIT CONTROLS

A. Basic Unit Controls:

- 1. Control voltage transformer. 40 VA minimum.
- 2. Unit mounted CO2 sensor.
- 3. Unit-mounted temperature sensor.
- 4. Unoccupied-period-override push button.
- 5. Data entry and access port.
 - a. Input data includes room temperature and humidity set points, and occupied and unoccupied periods.
 - b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

B. DDC Terminal Controller:

- 1. Data entry and access port.
 - a. Input data includes room temperature and occupied and unoccupied periods.
 - b. Output data includes room temperature, supply-air temperature, temperature, operating mode and status.
- 2. Safety Controls Operation: Freezestat shall stop fan and close outdoor-air damper if air less than 38 deg F enters coils and open hot water coil valve. Should open valve anytime freeze stat trips if hot water coil reaches a temperature less than 38 deg F.
- 3. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
- 4. Unoccupied Period Override Operation: Two hours.
- 5. Dual-Temperature Coil Operation:
 - a. Occupied Periods: When hot water is available, modulate control valve if room temperature falls below thermostat set point.

- b. Unoccupied Periods: When hot water is available, modulate control valve if room temperature falls below thermostat setback temperature.
- 6. Refrigerant-Coil Operation:
 - a. Occupied Periods: Start compressor to maintain room temperature.
 - b. Unoccupied Periods: Stop compressor cooling.
- 7. Outdoor-Air Damper Operation: Open to 25 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II during occupied periods, and close during unoccupied periods. Microprocessor controller shall permit air-side economizer operation when outdoor air is less than 60 deg F.
- 8. Carbon Dioxide Sensor Operation: During occupied periods, reset minimum outdoor-air ratio down to minimum 25 percent to maintain maximum 800-ppm concentration.
- 9. Controller shall have volatile-memory backup.
- C. BAS Interface Requirements:
 - 1. Interface relay to provide indication of fault at the central workstation.
 - 2. Provide BACnet interface for central BAS workstation for the following functions:
 - a. Adjust set points.
 - b. Unit ventilator start, stop, and operating status.
 - c. Data inquiry to include supply- and room-air temperature.
 - d. Occupied and unoccupied schedules.
- D. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit ventilators for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit ventilator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install unit ventilators to comply with NFPA 90A.
- B. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above finished floor.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20, Division 22 and Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Install piping adjacent to machine to allow service and maintenance.
 - 2. Connect piping to unit ventilator factory hydronic piping package. Install piping package if shipped loose.
 - 3. Connect condensate drain to indirect waste.
- B. Install refrigerant piping as required by Division 23 Section "Refrigerant Piping," and add refrigerant as required to compensate for length of piping.
- C. Connect supply and return ducts to unit ventilators with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory service representative to train Owner's maintenance personnel to adjust, operate, and maintain unit ventilators.

END OF SECTION

CONVECTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hydronic convectors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

- B. Shop Drawings:

- 1. Include plans, elevations, sections, and details.
- 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Include details and dimensions of custom-fabricated enclosures.
- 4. Indicate location and size of each field connection.
- 5. Indicate location and arrangement of piping valves and specialties.
- 6. Indicate location and arrangement of integral controls.
- 7. Include enclosure joints, corner pieces, access doors, and other accessories.
- 8. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- 1. Structural members, including wall construction, to which convectors will be attached.
- 2. Method of attaching convectors to building structure.
- 3. Penetrations of fire-rated wall and floor assemblies.

- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER CONVECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Modine.
 2. Rittling.
 3. Sterling HVAC Products; a Mestek company.
 4. Trane.
 5. Vulcan.
- B. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and rolled into cast-iron headers with inlet/outlet and air vent; steel side plates and supports. Factory-pressure-test element at minimum 100 psig (690 kPa).
1. Characteristics and Capacities: Refer to Drawings.
- C. Front and Top Panel: Minimum 0.0677-inch- (1.7-mm-) thick steel with exposed corners rounded; removable front panels with tamper-resistant fasteners braced and reinforced for stiffness.
- D. Wall-Mounted Back and End Panels: Minimum 0.0428-inch- (1.1-mm-) thick steel.
- E. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.
- F. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.
- G. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure.
1. Enclosure Style: Refer to drawings

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive convectors for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of convector.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install convectors level and plumb.

- B. Install valves within reach of access door provided in enclosure.
- C. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- D. Install piping within pedestals for freestanding units.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water convectors and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Section 230923.11 "Control Valves."
- D. Install piping adjacent to convectors to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field 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 convectors to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Convectors will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

****END OF SECTION****

FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hydronic finned-tube radiation heaters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details and dimensions of custom-fabricated enclosures.
 - 4. Indicate location and size of each field connection.
 - 5. Indicate location and arrangement of piping valves and specialties.
 - 6. Indicate location and arrangement of integral controls.
 - 7. Include enclosure joints, corner pieces, access doors, and other accessories.
 - 8. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER FINNED-TUBE RADIATION HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Rittling.
 - 2. Sterling HVAC Products; a Mestek company.
 - 3. Trane.

4. Vulcan.
 - B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."
 - C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.
 - D. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.
 - E. Front Panel: Minimum 16 gauge steel.
 - F. Wall-Mounted Back Panel: Minimum 20 gauge steel, full height, with full-length channel support for front panel without exposed fasteners.
 - G. Floor-Mounted Pedestals: Conceal insulated piping at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.
 - H. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.
 - I. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.
 - J. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure.
 - K. Enclosure Style: Sloped top.
 1. Front Outlet Grille: Punched louver; painted to match enclosure.
 - a. Clear anodized finish.
 - L. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of finned-tube radiation heaters.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FINNED-TUBE RADIATION HEATER INSTALLATION

- A. Install units level and plumb.

- B. Install enclosure continuously around corners, using outside and inside corner fittings.
- C. Join sections with splice plates and filler pieces to provide continuous enclosure.
- D. Install access doors for access to valves.
- E. Install enclosure continuously from wall to wall.
- F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
- G. Install valves within reach of access door provided in enclosure.
- H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- I. Install piping within pedestals for freestanding units.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Section 230923.11 "Control Valves."
- D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field 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 operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.

1.2 SUMMARY

- A. Section includes cabinet unit heaters with centrifugal fans and hot-water heating coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include location and size of each field connection.
 - 4. Include details of anchorages and attachments to structure and to supported equipment.
 - 5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 6. Indicate location and arrangement of piping valves and specialties.
 - 7. Indicate location and arrangement of integral controls.
 - 8. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cabinet Unit-Heater Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sterling.
 - 2. Trane Inc.
 - 3. Rittling.
 - 4. Vulcan

2.2 DESCRIPTION

- A. Factory-assembled and -tested unit complying with AHRI 440.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 2021.

2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 CABINETS

- A. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
 - 1. Vertical Unit, Exposed Front Panels: Minimum 16-ga. galvanized sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
 - 2. Horizontal Unit, Exposed Bottom Panels: Minimum 16-ga. galvanized sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
 - 3. Recessed Flanges: Steel, finished to match cabinet.
 - 4. Base: Minimum 18-ga. steel sub-base, finished to match cabinet, 6 inches high with leveling bolts.

2.5 FILTERS

- A. Minimum Arrestance: According to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pleated: 90 percent arrestance and MERV 7.

2.6 COILS

- A. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

2.7 CONTROLS

- A. Fan and Motor Board: Removable.
 - 1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
 - 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 20 Section "Common Motor Requirements for Fire Suppression, Plumbing and Mechanical Equipment."
 - 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- B. Control devices and operational sequences are specified in Section 23 09 00 "Instrumentation and Control for HVAC" and on the drawings."
- C. Basic Unit Controls:
 - 1. Control voltage transformer.
 - Wall-mounted thermostat with the following features:
 - a. Heat-off switch.
 - b. Fan on-auto switch.
 - c. Manual fan-speed switch.
 - d. Adjustable deadband.
 - e. Concealed set point.
 - f. Concealed indication.
 - g. Deg F (Deg C) indication.
- D. Electrical Connection: Factory-wired motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 07 92 00 "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 20 Section "Vibration and Seismic Controls for Piping and Equipment."
- D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 23 21 13 "Hydronic Piping," Section 23 21 16 Hydronic Piping Specialties" . Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Section 23 33 00 "Air Duct Accessories."
- E. Comply with safety requirements in UL 1995.
- F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 23 21 13 "Hydronic Piping".
- G. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Prior to substantial completion, clean unit's exposed surfaces and vacuum clean internal components including fan wheel, coil sections, and filters.

B. Adjust initial temperature set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 INSTALLATION

A. Locate cabinet unit heaters as indicated, coordinate with other trades to assure correct recess size of recessed cabinet unit heaters.

B. Provide for hot water coil, water supply, return connection, strainer, gate valves, automatic temperature regulating valve, balancing cocks, as indicated.

C. Pipe installation requirements are specified in in other Division 23 and 20 sections. The drawings indicated the general arrangement of piping, valve, fitting, and specialties. The following are specific connection requirements.

1. Arrange piping installation adjacent to units to allow unit servicing the maintenance.
2. Connect water supply piping to the air leaving side of water coils.

3.7 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical installer.

3.8 Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION

PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes propeller unit heaters with hot-water coils.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PTFE: Polytetrafluoroethylene plastic.
- C. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include location and size of each field connection.
 - 4. Include details of anchorages and attachments to structure and to supported equipment.
 - 5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 6. Indicate location and arrangement of piping valves and specialties.
 - 7. Indicate location and arrangement of integral controls.
 - 8. Wiring Diagrams: Power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Rittling.
 - 2. Sterling.
 - 3. Trane.

2.2 DESCRIPTION

- A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 2021.
- D. Comply with UL 823.

2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

- A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

- A. General Coil Requirements: Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.
- B. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

2.6 FAN AND MOTOR

- A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.7 CONTROLS

- A. Control Devices:
 - 1. Wall-mounted thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install propeller unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.
- C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 200548 "Vibration Controls for HVAC."
- D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Comply with safety requirements in UL 1995.
- D. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of propeller unit heater.

Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."

- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters.

****END OF SECTION****

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions and Requirements of the contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to the work of this section and all electrical specification sections.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultants and other Consultants. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on electrical drawings and specifications shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural, Mechanical or other Systems drawings and specifications.

1.2 SCOPE OF WORK

- A. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on Drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for the completion of electrical systems.
- B. These Specifications and the accompanying Drawings contemplate the furnishing and installation of all materials, equipment, supplies, labor and supervision required for the complete performance of all operations relating to the Electrical Trades work.
- C. The work shall be done in accordance with best practice so as to contribute to efficiency of operation and minimum maintenance and shall be installed with proper accessibility. The materials and equipment, including all necessary accessories, shall be put into proper adjustment so that the component parts function together as a workable system. The Electrical Contractor shall provide all equipment, materials and operations as indicated either on the Drawings or contained herein or as may be reasonably implied by either to accomplish a complete electrical system.
- D. All work shall be performed in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved. None but experienced persons in the work to be performed shall be allowed to do the work. This applies particularly to items such as cable splicing, control work, systems connections, etc.
- E. Work shall include but shall not be limited to the following, refer to plans and all specifications sections for complete project requirements:
 - 1. Temporary electrical facilities to facilitate construction.
 - 2. Electrical demolition as required for the project.
 - 3. All conduit, boxes, raceways, etc. required for the project for all systems.

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4. All branch circuit and power wiring 120 volts and greater required for project.
5. Separate neutral conductors for all 120 volt circuits.
6. Ground conductor for all conduits serving power wiring 120 volts or greater.
7. New electrical distribution equipment and modifications to existing as required for the project including, overcurrent protective devices, etc.
8. Disconnect switches for all building and mechanical equipment unless specifically indicated otherwise.
9. All lighting fixtures required for the project.
10. All lighting controls required for the project. All lighting controls to be in accordance with the Michigan energy code.
11. Emergency and exit lighting revisions required for the project including. All exit and emergency lighting to be powered from the life safety generator panel.
12. All electrical services required for project mechanical equipment and building equipment.
13. Visitor notification/card access system revisions.
14. Fire Alarm system revisions.
15. Sound system revisions.
16. Provide identification and nameplates for all electrical equipment, panels, disconnects, starters, etc.
17. Label all receptacles to indicate the panel and circuit from which they are served.
18. Label all junction boxes serving power 120 volts and greater with the panel and circuit of the wiring installed in the junction box.
19. Label all building and mechanical equipment, etc. with the panel and circuit from which it is served.
20. All above ceiling coordination with other trades as required for the installation of light fixtures, conduits, boxes, etc.
21. All conduit sleeves for all low voltage wiring including voice and data.
22. Fireproofing of all conduits, conduit sleeves and penetrations installed under this contract regardless of what trade or contractor installs the actual wiring. Fireproofing shall include both inside and outside the conduit or raceway.
23. Complete shop drawings for all materials, systems and equipment.

24. All installation instructions, operating manuals, spare parts lists, etc. For all materials, systems and equipment.
25. Record as built drawings of all work installed under this contract.
26. Owner training.
27. Complete testing of all electrical systems and equipment. Submit test report for review and approval.

1.3 DEFINITIONS

- A. In the Electrical Sections of the Specifications, and on drawings, the terms "Electrical Trades", "The Contractor", or "This Contractor" shall mean the Electrical Subcontractor.
- B. "Provide" shall mean "furnish and install" or "furnish all labor and materials required for the installation of."

1.4 CODES, PERMITS, AND FEES

- A. All required permits, licenses, inspections and approvals shall be secured and all fees for same paid by this Contractor.
- B. References to standards, codes, specifications, recommendations, etc., shall mean the latest edition of such publications adopted and published at date of invitation to submit Bid Proposals.

1. Applicable Standards and Codes:

- a. In addition to requirements shown or specified, comply with the applicable standards, specifications, and codes listed below. Where requirements of the Contract Documents are in excess of these standards or code requirements, the Contract Documents shall govern.
- b. Listing of associations, codes, standards and abbreviations:

CBM	Certified Ballasts Manufacturers Association
NEC	National Electrical Code
ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronics Engineers
ASTM	American Society for Testing Materials
IPCEA	Insulated Power Cable Engineers Association
NEMA	National Electrical Manufacturers Association
UL	Underwriters Laboratories, Inc.
NFPA	National Fire Protection Assoc.
ETL	Electrical Testing Laboratories
MEC	Michigan Energy Code

- C. All work shall be in accordance with the State of Michigan, Department of consumer and Industry Services, Bureau of Construction Codes, Part 8, Electrical Code.

- D. For all codes, the edition of the code, or year code, shall be that enforced by the authority having jurisdiction at the time of permit application. The contractor shall verify with the authority having jurisdiction the edition of the code in effect.

1.5 ALTERNATIVES

- A. For a complete listing of all alternatives, and requirements related to the alternatives, refer to "Alternatives" described and listed in the specification front end.
- B. All work performed on Alternatives shall be in accordance with applicable Trade Sections of the Specifications and Alternative details as shown in Contract Documents.
- C. Alternatives contain references to principal trades affected. This reference is for convenience only and is not intended to define the limits of work or Trades involved. It shall be the responsibility of each Bidder to determine to his/her own satisfaction, and for his/her own purpose, the limits and extent of the work affected by the Alternatives, and to make full and proper allowance therefore in the Alternative Bid Amount.

1.6 BARRIER FREE DESIGN

- A. The Contractor shall revise installation requirements for conforming to the Handicapped Barrier Free regulations. In particular, mounting heights of outlets and accessibility of controls shall be complied with.

1.7 DRAWINGS AND MEASUREMENTS

- A. The Drawings show the general arrangement, general design and location of equipment. The Drawings are to be considered diagrammatic and are not intended to be scaled for rough-in measurements, or to serve as shop drawings.
- B. Outlets connected by lines show switch control or circuiting only and are not actual runs of conductors. All light and receptacle outlets are lettered and numbered; the letter indicates the panel from which the circuit is to be controlled. All outlets bearing the same letter and number shall be connected to the same circuit.
- C. Follow the Drawings in laying out the work, consult Architectural, Structural and Mechanical Construction Documents to become familiar with all conditions affecting the work and verify all spaces in which work will be installed. Field measurements shall be taken, where necessary, for ordering materials and fitting the installation to the building construction.
- D. The Drawings are not intended to be scaled for rough-in measurements, or to serve as shop drawings.
- E. Where job conditions require reasonable changes in indicated locations or arrangement, such changes shall be made without extra cost to the Contract.

1.8 DOCUMENT REVIEW

- A. Before submitting a Proposal, this Contractor shall review the documents (plans, and specifications) of all trades in order to arrive at a clear understanding of the project requirements and the work required. The bidder shall have reviewed the documents to arrive at a clear under-

standing of the work required and the conditions under which work is to be performed. He/she shall be held to have compared the electrical documents and the documents of other trades to have satisfied him/her self as to the interfaces and electrical work and materials required to accommodate systems, equipment, devices, etc. furnished or furnished and installed by other trades.

- B. Prior to submitting the bid, request clarification, in writing, of any ambiguities, questions, uncertainties, etc. Requests shall be made in writing to the construction manager a minimum of ten (10) days before the bid due date.
- C. Requests for material substitutions or for material consideration as an equal shall be made in writing to the construction manager a minimum of ten (10) days before the bid due date.
- D. No allowances or extra consideration in behalf of the Contractor will subsequently be allowed because of error or failure on the part of the Contractor to conform to the requirements described herein.

1.9 ELECTRONIC DOCUMENTS

- A. Electrical drawings in a CAD format will be made available to the electrical contractor for use in preparing layout drawings, shop drawings, as-built drawings, etc at the cost of \$50.00 per drawing payable to Berbiglia Associates, Inc (BAI). The electrical contractor shall include in his/her bid, costs for electronic drawings, which they or their vendors, suppliers, etc. will require for the project.
- B. Drawings will be provided via email or on compact disc, at the contractor preference in the format and version in which they were prepared.
- C. Drawings will include all addendums, bulletins or revisions issued as of the date of transmission or transmittal of the electronic media to the Contractor. BAI assumes no responsibility for providing the contractor with future revisions or drawing updates in an electronic format. Additional or future requests for updated or revised electronic drawings will be provided if so requested at the cost of \$50.00 per drawing payable to Berbiglia Associates.
- D. Vendors or suppliers desiring CAD documents should request same from the electrical contractor.
- E. Because data stored as electronic media can be modified without Berbiglia Associates, Inc. knowledge, the contractor agrees that BAI will not be held liable for the completeness or correctness of the electronic media after an acceptance period of 10 days after delivery of the electronic files. BAI stands by the accuracy of the hardcopy (prints, etc.) which are included with documents distributed for the project. Any drawings produced from the electronic file(s) provided by BAI shall not be considered property of BAI, nor will BAI be held liable for such drawings. Contractor in using the electronic documents agrees to the provisions of this section.
- F. All drawing produced from the electronic files should be checked against the hard copy supplied to ensure accuracy and consistency.
- G. Due to the ever increasing complexity and growth of electronic media viruses, it is mandatory that the contractor scan any disk or email received from BAI. While BAI takes great strides in trying to keep our system clean of viruses, occasionally one may be passed undetected. If any

virus is detected by the contractor on any media received from BAI, please contact us immediately.

1.10 MATERIALS LIST

- A. Submit a complete list of all materials and equipment and their manufacturers, for approval within two (2) weeks after award of Contract, prior to submittal of shop drawings.
- B. Shop drawings will not be reviewed until the materials list has been reviewed and approved by the Architect/Engineer.

1.11 APPROVED MANUFACTURERS

- A. Approved manufacturers shall be as indicated herein and in accordance with the requirements of Division 26. All manufacturers shall be subject to the approval of the Engineer. Such approval concerns the manufacturer only and does not, in any way, act to permit any deviation from strict compliance with the requirements of these Specifications.

1.12 ALTERNATE MANUFACTURERS

- A. Products and materials for use on this project shall be based on one of the manufacturers listed on plan or specified. Base bid shall be based on using the listed manufacturers only. Alternate manufacturers, if desired shall be indicated in a voluntary alternate to be submitted by the contractor. The Owner reserves the right to reject any alternates.

1.13 MANUFACTURER'S INSTRUCTIONS

- A. All operating instructions, service instructions, parts lists, etc., which are shipped with electrical equipment are to be retained and on completion of the work and turned over to the Architect/Engineer for the Owner's use. If this information is not shipped, this Contractor shall obtain said information from the manufacturer at this Contractor's cost.

1.14 GRADE OF MATERIALS AND/OR EQUIPMENT

- A. Do not purchase any used or second-hand material of any kind for use on this project.
- B. All items purchased for this Contract shall be new, unused material and shall be manufacturer's first or specification grade and meet the approval of the Architect/Engineer. No commonly called "competitive" grade wiring devices shall be purchased or installed.
- C. In all instances where materials or methods indicate higher quality than the minimum required by codes, the Plans and Specifications shall govern.
- D. All equipment of the same or similar systems shall be of the same manufacturer. Receive, handle and move to required locations all materials and equipment for the electrical work.
- E. All materials and equipment shall be listed by Underwriter Laboratories, Inc., and shall show their label wherever standards have been established.

1.15 ASSEMBLY OF EQUIPMENT

- A. The Contract Drawings and Specifications make mention of numerous items to be purchased and installed and are noted by a manufacturer's name, catalog number, series and/or brief description.
- B. The catalog number as mentioned may not be complete to designate all the accessory parts and appurtenances required for the particular use or function.
- C. It shall be the responsibility of the Electrical Contractor to provide the equipment complete with all accessories as required for a complete and operable system including all special finishes as indicated.

1.16 USE OF EQUIPMENT

- A. The use of any equipment or any part thereof for purposes other than testing, even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, or to be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Owner's lamps shall not be used for temporary lighting except as allowed and directed by Owner. All lighting fixtures shall be equipped with new lamps when project is turned over to the Owner.

1.17 EQUIPMENT CONNECTIONS/ELECTRICAL ARRANGEMENTS

- A. This Contractor shall be responsible for final electrical connections to all light fixtures and all equipment provided by this contractor as well as equipment provided by the Owner or other trades and all equipment provided by the Architectural and Mechanical trades. This contractor shall also be responsible for the arrangement of electrical equipment installed to serve equipment provided by these trades.
- B. Final connections and the arrangement of electrical equipment, boxes, conduit, raceways, disconnects, etc. shall be made in accordance with equipment shop drawings and rough in measurements furnished by the manufacturer of the particular equipment furnished.
- C. All equipment shall be connected and applied in accordance with its UL Listing.
- D. Any and all additional connections not shown on plan but called for by the equipment manufacturer's shop drawings or required for the successful operation of the particular equipment furnished shall be installed as part of this contract at no additional charge to the Owner.
- E. Prior to installing equipment services (including conduit, wiring, boxes, etc.) or releasing equipment shop drawings for distribution equipment that will serve equipment services, including mechanical and building equipment, Electrical Contractor shall verify with the specific equipment shop drawings, equipment data sheet and trade (or owner) providing equipment that the proper electric service will be provided and electrical equipment will be properly arranged and ordered in order to service the equipment nameplate rating and equipment requirements notwithstanding information indicated on plan or specified. Should it be found that improper service is indicated for the particular piece of equipment, this Contractor shall immediately notify the Owner's Representative or Engineer of the apparent discrepancy in order for verification and clarification. If improper electric service(s) is installed due to failure by the Electrical Contractor to verify equipment requirements, the Electrical Contractor shall remove

the installed service and provide the proper service at no additional cost to the owner. The electric service shall include over current protective device, conduit, wire, motor starting, safety switch and/or receptacle as applicable.

1.18 COORDINATION WITH OTHER TRADES

- A. Install all work so as to avoid interference with the work of other Trades, including Architectural and Mechanical Trades. This Contractor shall be responsible for removing and relocating any Electrical work which, in the opinion of the Construction Manager or Architect/Engineer, causes interference.

1.19 STRUCTURAL DIFFICULTIES

- A. Should any construction conditions prevent the proper installation of panel boards, transformers, switches, conduit, outlet boxes, junction boxes, conductors, lighting fixtures and/or other related equipment at locations shown on Drawings, minor deviations may be permitted as directed by the Construction Manager or Architect/Engineer and made without any additional cost to Owner.

1.20 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

- A. All cutting and patching of finished surfaces, necessary for the installation of electrical work shall be performed by the Trade who installed, or who regularly installs the surface, at the direction of the Construction Manager.
- B. All cutting and patching of unfinished surfaces, necessary for the installation of electrical work shall be performed by the Electrical Trades as directed by the Construction Manager.
- C. All costs for cutting and patching as required for the installation of electrical work shall be borne by the Electrical Contractor and included in the Electrical Bid.
- D. The Electrical Contractor will be held responsible for Coordination with the Construction Manager for sizes and location of all openings, recesses, repairing, etc.

1.21 ACCESS DOORS

- A. All control devices, junction boxes, specialties, etc., shall be so located so as to provide for easy access for operation, repairs and maintenance; if concealed, access panels or extended operators shall be provided.
- B. Access doors shall be furnished by Electrical Contractor as required to satisfy code requirements and installed by the Architectural Trades. Doors shall be as manufactured by Milcor or approved equal. In the walls and ceilings, doors shall be as required to make all controls, electrical boxes and equipment accessible, minimum size 18" x 18". Areas with lay-in or accessible ceilings shall not require access door.
- C. Prior to installation, the location of all access doors must be approved by the project Architect.
- D. When access doors are in fire resistant walls or ceilings, they must bear the Underwriters' Laboratories, Inc., label with time design rating equal to or exceeding that of the wall or ceiling, unless they are a part of the tested assembly.

1.22 SETTING DRAWINGS AND TEMPLATES

- A. Provide all necessary templates, patterns, etc., for installing work and for the purpose of making adjoining work conform. Furnish setting plans and shop details to other trades as required. Templates, setting plans, etc. shall all be furnished in time to meet all construction schedules.

1.23 PROTECTION, HANDLING AND CLEANING

- A. Responsibility for care and protection of electrical work including assigned equipment rests with Electrical Trades until the installation has been accepted.
- B. After delivery, before and after installation, protect equipment and materials against dampness, theft, injury or damage from all causes.
- C. Protect lighting fixtures and other equipment with finished enamel or glazed surfaces from damage by covering as approved or directed by the Construction Manager.
- D. Protect equipment outlets, conduit openings, etc., with temporary plugs or caps.
- E. Provide adequate storage space for all electrical equipment conduit and materials delivered to the job site under a weather protected enclosure. Location of the space will be designed by the General Contractor. Equipment set in place in unprotected areas must be provided with temporary protection.
- F. Receive, properly house, handle, hoist, and deliver to proper location, equipment and other material required under Division 16, including "Owner Furnished" equipment.
- G. Be responsible for keeping the premises free from accumulations of waste materials and rubbish. At completion of work, remove all rubbish from and about the building and leave the electrical systems and equipment clean and ready for use, including lighting fixtures, panels, fire alarm equipment, etc. Clean and flush the interior of all conduits and accessible equipment of all mud, debris, oils, welding slag, loose mill scale and other extraneous material.

1.24 AS-BUILT DRAWINGS

- A. After completion of the work, provide a complete set of "As-Built" drawings to the Architect. Show the exact locations of all buried services both inside and outside of the building, with dimensions given from fixed reference points. "As-Built" drawings shall be kept up to date as the job progresses and shall be kept at the job site for inspection at any time by the Architect's Field Representative.

1.25 PARTS RECEIPT

- A. Retain all portable and detachable portions of the installations such as keys, tools, manuals, etc., until the completion of the work and turn them over to the Owner and obtain itemized receipt. This receipt shall be attached to the "Final Application" for payment.

1.26 TEMPORARY FACILITIES

- A. Refer to the appropriate Section of the Architectural Specifications for Temporary Facilities.

- B. Provide 120/240 volt or 120/208 volt, single phase, 3 wire service and branch wiring per OSHA Lighting Standard, Subpart D, Rule 1926.56 (a) and (b) for 120 volt lighting and small tool power outlets throughout the area of construction. General lighting shall consist of 150 watt (minimum) lamps in weatherproof sockets and safety type power outlets consisting of 120 volt, pendant type cord connectors for fractional horsepower electrical tools shall be install as directed.
- C. 120 volt power outlets shall be located such that no point in the area of construction is over 50 feet from an outlet. 240 volt power outlets shall be located at each end of the building at grade level.
- D. One (1) 60 Amp., 240 or 208 volt power outlet shall be provided at four (4) places, located as required for larger construction tools or as directed by the Construction Manager.
- E. All rooms, as they become enclosed and usable, shall have temporary lighting and power installed. All lamp holders and cords shall be constructed as approved by OSHA Standard and lighting units shall be "Plas-Socket" P660W/111.
- F. Provide maintenance service for temporary power and lighting facilities including lamps, during regular working hours. Any additional maintenance serviced required during overtime work, on Saturdays, Sundays or holidays shall be arranged for and paid for by the Contractors requiring the facilities.
- G. If any Contractor requires additional extension, he shall furnish his/her own portable cords, lamps and connectors from the above locations in order to properly complete his/her work.
- H. Building panel boards may be used for construction power, use of permanent building switches or circuit breakers shall not exceed their capacity for any power tools.
- I. Complete installation shall be in compliance with all applicable codes.
- J. All temporary 120 volt, 1 phase receptacles (15A. and 20A.) shall be protected by a ground fault circuit interrupter (GFCI).

1.27 INTERRUPTION OF THE PRESENT SYSTEMS

- A. When an interruption of any existing service, system or equipment is required to facilitate electrical work or revisions to existing systems, this Electrical Contractor shall notify the Construction Manager in writing, a minimum of ten (10) days prior to the planned interruption.
- B. Receive the Construction Managers/Owners permission prior to the actual scheduling of the interruption.
- C. Provide temporary wiring and equipment services where required to maintain the operation of the Owners equipment and operations, include all costs for same in the Electrical bid.
- D. Following the restoration of service or equipment operation, the Electrical Contractor shall be responsible for resetting all time clocks, restarting all motors as required and assisting the Owner with restoring normal operations. Employ the services of other Trades and Utility Companies where required and include all costs for same in the Electrical bid.

1.28 WORK AND CHANGES IN PRESENT BUILDING

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- A. Provide all labor, materials and supervision required to complete all demolition, alterations or modifications of existing electrical work necessary to complete the work as indicated on the Drawings and specified herein.
- B. The Electrical Contractor shall direct such miscellaneous cutting and patching of the existing building construction as made necessary by the installation of his work, same to be accomplished under the direction and supervision of the Architect.
- C. The cutting of holes through the existing building construction shall only be done by the use of abrasive saws and a rotary coring machine similar to Molco Drilling Machines, Inc. The use of hammer and drill points will not be permitted. The openings shall not be cut larger than necessary for the installation of the electrical services. All openings shall then be grouted in. Where present piping, etc., is removed, the unused openings shall be grouted in.
- D. The drilling or punching of structural members, such as holes through beams or columns, shall not be done without the specific permission of the Architect. Burning of holes through columns is not acceptable.
- E. Cutting of holes through floors and walls shall be done only at such locations as may be agreed upon between the Contractor and the Architect.
- F. The Electrical Contractor shall cooperate with the other Contractors so that all cutting and repairing in any given area will be done simultaneously.
- G. Materials salvaged from this work shall not be reused except where reuse is specifically indicated.
- H. The installation of all steel conduit in finished areas shall be concealed in walls and above ceiling. Where the project Architect and/or Engineer agrees that the installation of concealed conduit is not possible due to the existing building construction a finished surface mounted raceway "Wiremold" (or approved equal) shall be installed. Surface raceways shall be installed perpendicular to and/or parallel to walls and ceilings. Finished surface raceways shall, where possible, be ran low on the wall. Where this is not possible due to door openings, mechanical units and air conditioning units, the surface raceway shall be installed on the wall at the intersection of the ceiling and wall.
- I. It is the intention of this specification that exposed steel conduit not be used in any finished area but rather the steel conduit be concealed, where this is not possible, a finished surface mounted raceway "Wiremold" (or approved equal) be installed as inconspicuously as possible.
- J. Prior to the installation of any finished surface mounted raceway "Wiremold" (or approved equal) the routing shall be reviewed with and approved by the project Architect. Failure to gain such approval will cause the Electrical Contractor, at his own expense, to remove and reinstall the finished raceway as directed by the project Architect.
- K. All conduit installed in unfinished areas without ceilings shall be run exposed, parallel or perpendicular to walls, etc., as noted above. Ceiling drops for outlets, switches, etc., shall be run concealed in the wall construction and enter the wall as high as possible.
- L. As previously mentioned, Bidders are expected to visit the premises and thoroughly check for themselves any and all existing conditions in any manner affecting the work covered by these Specifications and the accompanying Drawings.

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- M. Any and all electrical work which may interfere with changes in, or be necessitated by the installation of new apparatus, piping, ducts or other mechanical equipment, as well as conduits and outlets that may be uncovered by the cutting of new openings in present building, shall be removed at the direction of the Engineer.
- N. The electrical work and revisions in the existing building shall be as indicated on the Plans, but shall not be limited to the same, as the work shall be complete in all details and requirements and ready for proper operation.
- O. Installation of all electrical equipment shall be correlated with the installation of mechanical ducts, units, piping, etc., and adjustments in locations shall be made to suit all field conditions. Disconnect, remove or relocate present equipment, outlets, fixtures, etc., as indicated on the Plans, as herein specified or as required to conform to the Mechanical, Electrical and Architectural revisions.
- P. Removed conduit, wire, receptacles, toggle switches, etc., shall not be reused, shall become the property of this Contractor and he shall remove same from the premises. Where re-wiring or recircuiting is indicated or required, the old wire shall be pulled out and new wire used.
- Q. Present fixtures removed and not reused shall be disposed of away from the site.
- R. Where equipment or fixtures are removed, outlets shall be properly blanked off, and conduits capped. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect.
- S. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or shown on the Plans.
- T. Any disruptive work, such as saw-cutting or power disruptions shall be completed during non-school hours.

1.29 TESTING, ACCEPTANCES AND GUARANTEE

- A. When the systems are completed, the Contractor shall operate equipment as directed by Architect/Engineer/Inspector. Replace all faulty equipment and make necessary adjustments before final acceptance. Upon final acceptance of work, the Contractor shall give the Construction Manager a written guarantee that he will make good, at his/her own expense, any defects in materials or workmanship which develop within one (1) year from date of final acceptance.

- B. Tests shall include, but shall not be limited to the following:

- All Distribution Equipment
- Grounding System
- Branch Circuiting
- Lighting Fixtures
- Lighting Controls
- Emergency Lighting System
- Wiring Devices
- Mechanical and Lab Equipment Connections
- Control Interlocking
- All Power Wiring
- Fire Alarm

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- C. Refer to individual specification sections for additional testing requirements.
- D. Occupancy will not be granted until such tests are made to the satisfaction of the project engineer and local inspection authority.
- E. Provide four (4) complete operating instructions, operating manuals and repair parts list for the Owner's personnel. Instruct Owner's personnel in the operation of all systems.
- F. Each receptacle shall be checked for polarity, opens, grounds, etc., using an approved receptacle tester, Hubbell #5200 or equal. Provide a letter to the Engineer stating that all equipment has been tested and adjusted properly.
- G. Perform all tests required by Owner, state, city, county and/or other agencies having jurisdiction.
- H. Provide all materials, equipment etc., and labor required for the tests.

****END OF SECTION****

ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.

- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, and XHHW.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Stranded copper.
- B. Branch Circuits: Stranded Copper 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

- A. Feeders and branch circuits above grade: Type THHN-THWN, single conductors in raceway.
- B. Feeders and branch circuits below grade, or below slab or in wet areas: Type XHHW-2, single conductors in raceway.
- C. Type MC cable maybe used for branch circuit wiring, as permitted by NEC but only where concealed with in building construction and not for use as homeruns to panel boards. Where exposed limited to six feet in length.
- D. Type MC cable shall include a continuous ground wire with green insulation.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Provide sleeves for all low voltage wiring including voice and data.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified as specified under "Penetration Firestopping."
- C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both wall surfaces.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to "Penetration Firestopping."
- K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.

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- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

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.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 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.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs (continuous ground wire).

3.3 INSTALLATION

- A. Grounding Conductors: Install grounding conductors as required for conformance with NFPA 70. All conduits serving wiring 120 volts or greater shall include an insulated green ground conductor.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

****END OF SECTION****

HANGERS AND SUPPORTS 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.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. Section includes:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.

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SYSTEMS

2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - 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. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- 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:

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SYSTEMS

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hilti Inc.
 2. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 3. MKT Fastening, LLC.
 4. Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Empire Tool and Manufacturing Co., Inc.
 3. Hilti Inc.
 4. ITW Ramset/Red Head; a division of 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 Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

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SYSTEMS

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- D. 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 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in 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 shall 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 Wood: Fasten with lag screws or through bolts.
 - 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 3. To Existing Concrete: Expansion anchor fasteners.
 - 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.

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- 7. 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 reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

RACEWAY AND BOXES 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.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, cabinets and floor boxes for electrical wiring.

1.3 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. EMT: ANSI C80.3.
- C. FMC: Zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.

- E. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Fittings for EMT: Steel, set-screw type.
 - 2. Fittings for rigid steel: Threaded.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. RNC: NEMA TC 2, Type EPC-80-PVC except where Type EPC-40-PVC is indicated.
- C. LFNC: UL 1660.
- D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: UL 514B.

2.3 FINISHED SURFACE RACEWAYS

- A. Where indicated on plan, provide a surface raceway for low voltage outlets, system devices, and branch circuit wiring. Raceway serving both branch circuit and low voltage wiring shall utilize an internal barrier to separate power and low voltage wiring where required. Surface raceways shall be installed perpendicular to and/or parallel to walls and ceilings.
- B. All conduit connections to raceway shall be with concealed conduits, install a flush box in wall behind the raceway in order to facilitate the conduit connection, surface conduit connections are not acceptable unless specifically approved by the Architect/Engineer.
- C. Where the installation of concealed conduit in finished areas, is not possible, due to the existing building masonry construction, a finished surface mounted raceway "Wiremold" (or approved equal) may be installed as inconspicuously as possible and only where specifically approved by the Project Architect. Surface raceways shall be installed perpendicular to and/or parallel to walls and ceilings.
- D. Prior to the installation of any finished surface mounted raceway "Wiremold" (or approved equal) the Architects approval must be received, utilize concealed conduit in lieu of a finished surface raceway where directed. Where approved for use, the routing of the finished surface mounted raceway "Wiremold" (or approved equal) shall be reviewed with and approved by the project Architect. Failure to gain such approval will cause the Electrical Contractor, at his own expense, to remove and reinstall the finished raceway as directed by the project Architect.
- E. Finished surface metal raceway for the routing of limited wiring shall be metal, Wiremold 200 series or 500 series as determined by the size and type of conductors which must be accommodated. Where indicated utilize Wiremold finished raceway to house wiring devices, pushbutton operators, access control readers, door operator pushbuttons, etc. Unless otherwise indicated, the smallest size raceway capable of serving the wiring required and satisfying the National Electrical Code shall be used. Surface metal raceways shall be complete with all accessories required for a complete installation. Finished surface raceways shall be attached to the building construction using two hole finished straps made for the purpose, installed on maximum 3 feet on centers. Where a surface box is used to connect to the finished surface raceway, the surface box shall also be finished and shall match the

raceway. Where the surface box is used to house a fire alarm device, including pull stations, strobes or horns, the surface box shall be manufactured specifically for the fire alarm device and provided with the fire alarm package of equipment.

- F. Two compartment finished wireway housing devices shall be Wiremold 3000 series. Surface metal raceways shall be complete with all accessories required for a complete installation including but not limited to couplings, bushings, supporting clips, straps, connection covers, flat elbows, internal elbows, "TEE" fittings, utility boxes, gang boxes, extension rings, ground clamps, etc. Complete installation shall be in accordance with the manufacturer's instructions and National Electric Code requirements. Coverplates used with two compartment finished wireway shall match coverplates for use on wall outlets.
- G. Finished surface raceways shall be ivory in color.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Nonmetallic Floor Boxes: Nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
- I. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 - a. Exposed and Subject to Physical Damage: Rigid steel conduit.
 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 3. Connection to Vibrating Equipment (Including Transformers or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 4. Damp or Wet Locations: Rigid steel conduit.
 5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- B. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Conduit above grade: Rigid steel conduit.
 2. Underground Conduit: RNC, Type EPC-80-PVC, direct buried except where EPC-40-PVC is indicated.
 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- C. Minimum Raceway Size: 3/4-inch trade size, unless noted otherwise on plan.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. EMT: Use set screw connectors.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- 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. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

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- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways embedded horizontally in slabs are not allowed.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. 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.
- K. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- L. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
 - 1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
 - 2. 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.
 - 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, 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.
- N. 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.

3.3 TESTING DUCTS AND CONDUITS FOR OBSTRUCTIONS

- A. Ducts and conduits which are installed underground or concealed in concrete floor slab, foundations, etc., shall be cleared of foreign material and obstructions after installation and before conductors or pull-wires are drawn in by wire brushing, swabbing and employing an iron or hardwood mandrel which is 1/4" smaller in diameter than the internal diameter of the duct or conduit.
- B. The installation of conductors or pull wire shall not be made until the raceways are found acceptable.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in "Penetration Firestopping."

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Equipment identification labels.
 - 5. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Labeling materials, including label stocks, laminating, and inks used by label printers, shall comply with UL 969.

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.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Engraved Nameplates: Lamicoid, white background with black letters except where generator power is used provide red letters. On distribution equipment and safety switches. Letters shall be 5/8" high.
- E. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Where served with generator power, letters shall be red. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label. Adhesive labels shall be used for interior receptacles only. Exterior equipment and receptacle labels shall utilize engraved nameplates attached with self-tapping screws.
- B. Engraved, Laminated Acrylic or Melamine Label, black letters on a white background. All loads served with generator power shall be with red letters. Minimum letter height shall be 5/8 inch.
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.
- D. All engraved labels shall be secured with self-taping screws.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 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. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. For all panelboards, new and existing, provide complete and accurate typed circuit directories. Include all panelboards where revisions are made.
- B. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device. Use adhesive labels for branch circuit identification only such as to identify the panel and circuit on receptacles.
- C. Engraved Nameplates: Install on all new and existing panelboards, distribution panels, power panels, safety switches, fused switches, motor starters, etc. Secure with self-tapping screws only.

3.2 IDENTIFICATION

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use color-coding conductor tape to identify the phase. Color coding shall match existing.
- C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- D. 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.
- E. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION

PANELBOARDS AND DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and new three pole circuit breakers being installed in existing distribution panels or switchboards or related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
- C. Field quality-control reports.
- D. Panelboard schedules for installation in panelboards.

- E. Operation and maintenance data.

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 NEMA PB 1.
- C. Comply with NFPA 70.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DISTRIBUTION EQUIPMENT

- A. Fabricate and test panelboards according to IEEE 344.
- B. Enclosures: Surface as indicated on plan.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. All panelboards and power panel shall utilize a door in door construction.
 - 5. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location as determined by contractor.
- D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity. Aluminum bus will not be approved.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression type.
 - 3. Ground Lugs and Bus Configured Terminators: Compression type.

- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices. All distribution equipment shall be fully bussed.
- G. Panelboard Short-Circuit Current Rating: 22 kAIC. Fully rated to interrupt symmetrical short-circuit current available at terminals.
- H. Distribution Panels Short-Circuit Current Rating: 42 kAIC. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 EXISTING DISTRIBUTION EQUIPMENT

- A. Modify existing distribution equipment as required to accommodate project requirements.
- B. Include all modifications required for code conformance.
- C. All components, devices, switches, breakers, etc. used in existing distribution equipment shall be of the same manufacturer as the existing and shall be compatible with the existing equipment.
- D. Provide recertification thru UL or an independent testing agency where required by the authority having jurisdiction.
- E. Update all labeling on existing distribution panel to accurately indicate all loads served. Provide tracing of existing circuits and wiring as required.
- F. Where required, install new circuit breakers or fusible switches in existing panelboards or distribution panels or switchboards to facilitate circuiting indicated on plan.
- G. Field verify existing conditions and electrical requirements indicated on plans, where new circuits or feeders are required, and the circuiting is not indicated, contractor shall determine the panel and circuit from which the load is to be served. Serve the load from the nearest available panelboard or distribution panel as appropriate. Indicate exact panel and final circuiting on As-Built drawings.
- H. New circuit breakers or fusible switches shall match existing and shall be completely compatible with the existing distribution equipment.
- I. Include all modifications to existing distribution equipment as required to accommodate necessary project revisions. Include all covers, blank offs, breakers, switches, bussing, run backs, cables, etc. verify the extent of work required and include all costs in the electrical bid.

2.3 PANELBOARDS AND POWER PANEL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- B. Panelboards: NEMA PB 1 and PB 2 branch-circuit type.
- C. 277/480 volts, three phase, four wire, 480 volt, three phase, three wire or 120/208 volts, three phase, four wire, as noted on plan.

1. Mains: As indicated on plan.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Concealed hinges; secured with flush latch with tumbler lock; keyed alike, door in door construction with double hinge permitting panel cover to be hinged open exposing panel interior.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1 and PB2 requirements as applicable.
- B. Comply with mounting and anchoring requirements as recommended by the manufacturer.
- C. Mount top of trim at 72" above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices not already factory installed.
 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA
- I. Where new circuit breakers or switches are installed in existing panelboards or distribution equipment they shall be of the same manufacturer, make and model as the existing devices used in the equipment.
- J. Where required, install new circuit breakers in existing panelboards to facilitate circuiting indicated on plan. Field verify existing conditions and serve new loads from the nearest available panelboard.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

****END OF SECTION****

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Wall-box occupancy sensors.
 - 3. Snap switches.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 TYPICAL STANDARD STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498, white finish:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5362 (duplex).
 - b. Hubbell; 5362 (duplex).
 - c. Leviton; 5362 (duplex).
 - d. Pass & Seymour; 5362 (duplex).

2.3 SURGE PROTECTION STRAIGHT BLADE RECEPTACLES

- A. Surge Protection Convenience Receptacles, designer shape, non-feed thru, grey finish, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498, with indicating light, 240 joules/15000A per mode.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL5362SA (duplex) or approved equal, Leviton, Cooper, Pass & Seymour.

2.4 SURGE PROTECTED IN SERIES RECEPTACLES

- A. Series protected (from adjacent receptacle) Convenience Receptacles, designer shape, non-feed thru, grey finish, 125 V, 20 A: Comply with NEMA WD 1.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
3. Hubbell; HBL-DR20GY (duplex) or approved equal, Leviton, Cooper, Pass & Seymour.

2.5 TYPICAL STANDARD GFCI STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498, white finish:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL5362GFCI (duplex) or approved equal, Leviton, Cooper, Pass & Seymour.

2.6 GFCI DESIGNER SHAPE RECEPTACLES

- A. General Description: Straight blade, non-feed-through type, designer shape, white finish Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell; HBL-DR2Y-GFCI (duplex) or approved equal, Leviton, Cooper, Pass & Seymour.

2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A, white finish:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.8 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
2. Description: Passive-infrared type, 120/277 V, white finish, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

2.9 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head to match plate finish.
2. Material for Finished Spaces: 0.04-inch- thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover.

2.10 FINISHES

- ### A. All receptacles and switches shall be white body except those with surge suppression or protected by upstream surge suppression receptacle shall be gray as noted above.

PART 3 - EXECUTION

3.1 INSTALLATION

- #### A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- #### B. All wiring devices shall be wired using the device terminal. Back or pressure fit wired connections are not permitted.
- #### C. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- D. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- E. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped machine printing with black lettering on clear background on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. Section Includes: Cartridge fuses rated 250 or 600-V ac and less for use in control circuits, enclosed switches, switchboards and enclosed controllers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

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 NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.

4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

- A. Feeders: Class L, RK1, RK5 or J as applicable.
- B. Motor Branch Circuits: Class RK1 or RK5, time delay.

3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

END OF SECTION

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible and Non-fusible switches
 - 2. Circuit breakers.
 - 3. Enclosures.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed switch, accessory, and component indicated.
- B. Shop Drawings: For enclosed switches: Include plans, elevations, sections, details, and attachments to other work.
- C. Field quality-control reports.
- D. Operation and maintenance data.

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 NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, fusible or non-fusible as required, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Suitable for number, size, and conductor material.

2.2 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings.
- C. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- D. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5
- F. Circuit breakers shall be as follows:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor: NEMA 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Enclosed switches will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

END OF SECTION

LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Lighting fixtures, lamps, and ballasts.
 - 2. Lighting fixture supports.

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- D. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Regarding lighting fixture schedule included on plan, the following requirements apply to product selection:
 - 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 manufacturers listed in the lighting fixture schedule.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metalized Film: 90 percent.
- G. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.

2.3 BALLASTS

- A. Electronic Ballasts for Linear Fluorescent Lamps: Comply with ANSI C82.11; programmed-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
 - 1. Sound Rating: A.
 - 2. Total Harmonic Distortion Rating: Less than 10 percent.
 - 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 4. Operating Frequency: 20 kHz or higher.

5. Lamp Current Crest Factor: 1.7 or less.
 6. BF: 0.85 or higher.
 7. Power Factor: 0.95 or higher.
- B. Electromagnetic Ballasts are not permitted.

2.4 EMERGENCY LIGHTING

- A. Provide emergency lighting as indicated on plan. Emergency lighting shall be powered from the generator fed life safety panels only.
- B. Emergency lighting shall be arranged to automatically illuminate upon loss of normal power.

2.5 LAMPS

- A. Low-Mercury Fluorescent Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 Rapid-Start low-mercury Fluorescent Lamps: Rated 28 W maximum, nominal length 48 inches, 2600 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- H. All lighting fixtures shall be supported independently of the ceiling system. All recessed 2' x 4' fixtures shall have two corners supported from the building structure.

2.7 LED FIXTURES AND POWER SUPPLIES

- A. LED light fixtures shall be used for EXIT lights and outdoor light fixtures only.
- B. All light fixtures utilizing LED's shall be provided as a complete assembly including LED fixture, power supply, overcurrent protection and surge suppression, mounting brackets, clips, etc. All LED product including power supplies shall be warranted for a minimum of 5 years but not less than 50,000 hours of operation.
- C. All LED's shall maintain a light output exceeding 70% of initial values for a minimum of 50,000 hours.
- D. LED power supplies shall have a power factor of 92% or greater. THD shall be 20% or less. All power supplies shall include minimum 10 kV surge suppression protection standard and shall withstand high repetition noise transients. Surge suppression shall be appropriate for surges which would typically be experienced at the installation location based on electric service from Wyandotte Municipal Services. The Surge protection shall be tested in accordance with IEEE/ANSI C62.41.2. Manufactures to provide additional surge protection where light fixture on its own provides less then the specified value. All costs for same shall be included.
- E. Power supplies shall meet radio frequency interference (RFI) emission limits set forth in FCC Title 47, Subpart B, Section 15.
- F. LED power supplies shall include integral overcurrent protection or fusing as required to protect the power supply and disconnect power if current exceeds 125% of nameplate current.
- G. Each power supply shall operate over a range of 100 to 140 volts, for 120 volt circuits and 200 volts to 305 volts for 277 volt circuits, 60 HZ. Fluctuations in line voltage shall have no effect on luminous output of LED's.
- H. LED fixtures and/or lighting products using LED's shall be provided complete with power supplies. Quantity and sizing of power supplies shall be determined by the manufacturer. All costs for installing and wiring power supplies shall be included in the contractors bid. Mounting locations of power supplies shall be determined by the contractor with input from the manufacturer. Power supplies shall be located in accessible ceiling spaces only or in unfinished equipment rooms. Do not locate power supplies above hard ceilings. All power supply locations shall be approved by the Architect.
- I. All wiring including 120 volt wiring to power supply and low voltage wiring from power supply to LED fixture shall be included in the contractors bid. Manufacturer shall provide complete wiring diagrams showing each individual piece or section of LED fixture, strip or panel. Include all power supplies, 120 volt input wiring and all low voltage wiring required for each individual piece or section of LED fixture, strip or panel. Each and all wiring connections required for the complete LED product to be used shall be shown on wiring diagrams. Wiring diagrams shall be provided with product shop drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.

- C. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Adjust aimable lighting fixtures to provide required light intensities.
- E. Connect wiring according to Division 26 Section "Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

****END OF SECTION****

ACCESS CONTROL AND VISITOR NOTIFICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Existing system description.
 - 2. Security access operating system.
 - 3. Door Modules.
 - 4. Readers, standard width.
 - 5. Readers, narrow width.
 - 6. Power supplies.
 - 7. Panic lock down button.
 - 8. Access Control Panels (existing).
 - 9. Door Position Switches (not used).
 - 10. Electric Locks (furnished with door hardware).
 - 11. Wiring and raceways.

1.3 DEFINITIONS

- A. VNS: The district utilizes a visitor notification system. The VNS utilizes a number of integrated building systems including card access, video security, telephone/intercom, lock down, etc.
- B. CCTV: Closed-circuit television.
- C. CPU: Central processing unit.
- D. Credential: Data assigned to an entity and used to identify that entity.
- E. GFI: Ground fault interrupter.
- F. I/O: Input/Output.

1.4 SYSTEM INTEGRATOR

- A. Card Access/VNS system revisions shall be performed by a system integrator with a minimum 5 years' experience in the installation of card access systems and the integration of building systems.
- B. The system integrator shall be a subcontractor to the electrical contractor.
- C. The system integrator shall be responsible for the following:
 - 1. Purchase, installation, wiring and connections of all system components as indicated on plan and herein specified.
 - 2. Installation, wiring and connections of all electrified door hardware.
 - 3. System programming revisions.
 - 4. System tip switch settings and adjustments.
 - 5. System testing.
- D. The following system integrators are acceptable:
 - 1. Electronic Security Systems: 586-765-8400
 - 2. Progressive Hardware: 586-491-6900
 - 3. Flint Builders Hardware (FBH): 810-239-9471

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

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1. Cable installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.
- B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70, "National Electrical Code."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Diagrams for cable management system.
 2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
 3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
 - a. Cable Administration Drawings: As specified in "Identification" Article.

1.7 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals.
 1. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
 2. System installation and setup guides with data forms to plan and record options and setup decisions.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Project Electronics:
 - 1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.
 - 2. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
 - 3. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.
 - 4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. The card access system is existing manufactured by Vanderbilt Industries. The system utilizes a VRCNX series controller with VRINX series door modules.
- B. The existing card access main entry door is interfaced with the existing Valcom telephone system in order to provide intercom functions and to unlock the door remotely from the main office when locked.
- C. The existing system will be modified and expanded to accommodate this project. New readers, door controllers, power supplies, cabling, etc., will be installed and will interface with door hardware including locks, door operators, etc.
- D. A panic door lock down (regrets) pushbutton will be installed at the main office and will control doors into or out of the office.

2.2 SOFTWARE

- A. The system software is existing and will be maintained. Modify system programming as required to accommodate the sequence of security operations.

2.3 ACCESS CONTROL PANELS

- A. Access control panels are existing. Modify access control panels as required to accommodate project revisions. Access control panels are Vanderbilt Industries VRCNX series.

2.4 DOOR MODULES

- A. Furnish and install new door modules and modify existing as required.
- B. New door modules shall be Vanderbilt industries model VRINX.
- C. The system software is existing and will be maintained. Modify system programming as required to accommodate this project. Door control modules shall:
 - 1. VRINX connects one read head to a reader.
 - 2. Be RS-485 protocol.
 - 3. Dual voltage 12 and 24 volt DC.
 - 4. Supports proximity, smart card, magnetic stripe, biometrics, bar code and Wiegand technologies.
 - 5. Provide two Form "C", single pole/double throw, mechanically latching 1 A relay outputs.
 - 6. Monitor four supervised or unsupervised contact inputs.
 - 7. NEMA one metal enclosure with hinged and dual screw door.
 - 8. On board connection for tamper switch.
 - 9. Tamper switch, lock and key option available
 - 10. Dimensions: 3-13/16" H x 3-13/16" W x 3/4" D
 - 11. Enclosure dimensions: 8-1/4" H x 7-1/2" W x 3-1/2" D
 - 12. Power consumption: 120 mA (without read heads).
 - 13. BAA compliant
 - 14. UL 294 Approved

2.5 POWER SUPPLIES

- A. Existing door power supplies may be used to serve new load provided the power supply is not loaded more than 75% of its nameplate rating.
- B. Submit shop drawings on all card access system equipment and components. Include with shop drawings the rating and loading of all new power supplies.
- C. All power supply loading shall be based on door hardware shop drawings.
- D. All power supplies shall be labeled with the panel and circuit from which it is served.
- E. 120 volt circuits serving existing power supplies may be used to serve new power supplies provided the existing 120 volt circuit is not loaded greater than 14 amps.
- F. All new 120 volt circuits serving door power supplies shall originate from the circuit breaker panel currently serving power supplies in the area. Typically this will be a panelboard provided with transient voltage surge suppression and served from the generator. All card access system power must be served from a generator powered panel.
- G. New power supplies shall be Vanderbilt 3 amp, 5 amp or 10 amp, 24 volt DC by Vanderbilt Industries. Power supplies shall not be loaded beyond 75% of their nameplate. Power supplies shall be as follows:
 - 1. SMS-3APS 24VDC @ 3A Power Supply/Charger
 - 2. SMS-5APS 24VDC @ 5A Power Supply/Charger
 - 3. SMS-10APS 24VDC @ 10A Power Supply/Charge
 - 4. Precise battery regulation for all lead acid batteries
 - 5. LED's indicate AC, power good, and DC on
 - 6. Electronic power limited short circuit protection
 - 7. Thermal regulation to prevent overheating
 - 8. Output ON/OFF service switch
 - 9. No switch over or voltage drop when input power fails
 - 10. Non latching or latching mode
 - 11. Universal 11-29VDC Operation
 - 12. Reverse polarity protected
 - 13. Normally on & normally off Output

14. Output LED indicates condition
15. Form C contacts indicates trigger status
16. 12A transfer relay contacts
17. Outputs can be triggered with:
 - a. N/O or N/C switch with supervised EOL
 - b. N/C switch with over ride
 - c. N/C switch with AUX-IN auxiliary
 - d. Ground on any trigger input when green jumper is enabled
18. RoHS Lead Free
19. Module Dimensions: 2.23"W x 3.75"L x .8"H
20. UL listed for UL 294 Access Control
21. Up to 1A continuous supply current
22. Electronically protected against over current and temperature

2.6 ACCESS CONTROL READERS AND READER/KEYPADS

- A. Manufacturer:
 1. Reader only (standard width): Allegion aptiQ MT15
 2. Reader only (narrow width): Allegion aptiQ MT11
 3. Reader and key pad: Allegion aptiQ MTK15
 4. No substitutes will be accepted.
- B. Requirements: Multi-technology Contactless reader
- C. Multi-technology contactless reader shall read access control data from both 125 kHz and 13.56 MHz contactless smart cards and NFC-compatible. The multi-technology contactless reader shall be optimally designed for use in access control applications that require reading both 125 kHz Proximity and 13.56 MHz contactless smart cards and devices.
- D. Product construction suitable for both indoor and outdoor applications.
- E. Customizable behavior for indicator lights and beeper.
- F. Multi-technology contactless reader shall comply with the following 13.56MHz-related standards to ensure product compatibility and predictability of performance in accordance with ISO 14443.

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- G. Multi-technology contactless reader shall be suitable for global deployment by meeting worldwide radio and safety regulatory compliance including:
 - 1. FCC Certification
 - 2. UL294
 - 3. ULC-S319
 - 4. FIPS201 / PIV I
 - 5. IP65
- H. Multi-technology contactless reader shall provide the ability for mounting to standard electrical boxes through the use of universal international mounting holes.
- I. Multi-technology contactless reader shall be provided with a full potted assembly.
- J. Multi-technology contactless reader shall be provided with a quick connect wire harness.
- K. The Multi-technology contactless reader shall provide customizable reader behavior options either from the factory, or defined in the field through the use of pre-configured command cards. Reader behavior programming options shall include:
 - 1. LED & Audio configurations.
 - 2. Ability to disable reading of specific card technologies or frequencies.
 - 3. ISO 14443/15693 CSN output configuration.
 - 4. Wiegand output spacing and timing.
- L. Multi-technology contactless reader shall provide the following programmable audio/visual indication:
- M. An audio beeper shall provide tone sequence to signify: access granted, access denied, power up, and diagnostics.
- N. A light bar shall provide clear visual status (red/green/amber).
- O. Multi-technology contactless reader shall be designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing access control panels and/or power supplies. Contactless smart card power requirements shall be:
 - 1. Operating voltage: 5 – 16 VDC, reverse voltage protected.
 - 2. Current requirements: 125 mA DC, 140 mA PEAK @ 12 VDC
 - 3. Color shall match existing.

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4. Multi-technology contactless reader shall meet the following environmental specifications:
5. Operating temperature: -31 to 151 degrees F (-35 to 67 degrees C)
6. Operating humidity: 5% to 95% relative humidity non-condensing
7. Weatherized design suitable to withstand harsh environments
8. Certified rating of IP65

P. Proximity Key Fob ADD 01

1. Include 1,000 key FOB credentials for use with the readers. ADD 01.
2. Access key fobs shall be used with access readers to gain entry to access control portals (e.g. doors, gates, turnstiles) and to hold information specific to the user. ADD 01.
3. The fob shall function at 125 kHz. Presentation to the access control reader at any angle within a minimum distance of one (1) inch shall result in an accurate reading of the fob. ADD 01.
4. The fob shall be compatible with HID, XceedID and Schlage proximity readers. ADD 01.
5. This fob shall be compatible with aptiQ multi-technology readers. The fob shall be composed of polycarbonate material. ADD 01.

2.7 PANIC BUTTONS

- A. Furnish and install panic buttons and wire to trigger a door lock down as indicated on plan.
- B. Panic buttons shall be located as coordinated with district staff and architectural trades prior to rough-in.
- C. Panic buttons shall be push to activate, twist and pull to deactivate, maintained contact, (1) N.O. and (1) N.C.
- D. Button head shall be grey.
- E. Provide all programming and dip switch settings required for operation.
- F. Because doors are fail secure, they shall be normally powered and unlocked. Use of the panel button shall via the door module cause doors to be deenergized and locked.
- G. Panic buttons shall be Allen Bradley #800H-FXT-4-A-AV or equal General Electric, Siemens, Square-D or Eaton.
- H. Install on stainless steel coverplate on single gang box.

2.8 DOOR HARDWARE

- A. Door hardware including locks will be furnished by the door contractor. Door position switches will not be used. Refer to door hardware specifications and coordinate all work with the architectural trades as required for complete and operating systems.

2.9 MOTORIZED DOOR OPERATORS

- A. Motorized door operators will be furnished and installed by architectural trades.
- B. 120 volt service and the local disconnect switch shall be furnished and installed by this electrical contractor.
- C. Door operator pushbuttons will be provided with the operators and shall be installed and wired by this electrical contractor.
- D. Provide interface wiring and connections between the door operator control panel and the card access door module so that the door operator can only be activated when access is approved.
- E. Coordinate all work with architectural trades.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. All card access system revisions shall be coordinated with door hardware revisions and architectural trades.
- B. Refer to architectural drawings and specifications for the sequence of operation at each door and a description of the intended door control security.
- C. The exact location of all readers, operators, pushbuttons, etc. Shall be coordinated with and approved by architectural trades and district staff prior to rough-in.
- D. All readers, operators, pushbuttons, etc. Shall be located at 48" AFF unless otherwise noted or indicated.
- E. Wiring, connections and revisions for all door hardware components and devices shall be in accordance with the manufactures recommendations, wiring diagrams and installation instructions and the equipment shop drawings. Installer shall obtain same prior to installation.
- F. All card access and/or VNS system revisions shall be tested for proper operation.
- G. Card access system details and diagrams are provided to convey the system operation and design intent. Details and diagrams are not guaranteed to be complete or accurate or to reflect the final installation requirements or complete existing conditions. Field verify all existing

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conditions including ceiling construction, wall construction, architectural conditions, etc. And adjust details and diagrams accordingly. Provide all additional or modify existing as required, raceways, wiring, devices, boxes, connections, etc. And include all costs for same. Include all programming, dip switch settings, etc. As required for the intended security operation and include all costs for same. Bidder shall be responsible for any additional engineering or design required, and shall include all costs for same as required for complete and operating systems in accordance with the design intent. In bidding this project, bidder acknowledges that no additional costs will be approved during construction unless a change in scope is requested by the district.

- H. Provide complete system as built drawings reflecting the system installation.

3.2 PREPARATION

- A. Comply with recommendations in SIA CP-01.

3.3 CABLING

- A. Comply with TIA 569-B, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Comply with NECA 1, "Good Workmanship in Electrical Construction."
- C. Refer to power and system general notes for additional requirements.
- D. Conduits, boxes, raceways, etc. shall be subject to the requirements of specification section 260533 Raceway and Boxes for Electrical Systems.
- E. Wiring, connections and revisions for all door hardware components and devices shall be in accordance with the manufactures recommendations, wiring diagrams and installation instructions and the equipment shop drawings.
- F. One VRINX door module onboard relay shall serve a maximum of two electric strikes or mortise locks. Relays are rated 1 amp at 30 VDC.
- G. All card access and/or VNS system revisions shall be tested for proper operation.
- H. All wiring serving the card access system shall be plenum rated.
- I. The color coding of all wiring serving the card access system shall be the same throughout and shall match existing.
- J. All conduit serving the card access system shall be concealed within building construction. Utilize a finished surface raceway such as Wiremold where concealing conduit is not feasible as a result of existing masonry construction. In existing drywall construction, conceal the conduit.
- K. All card access system low voltage wiring shall be installed in conduit or a finished surface

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raceway except as follows:

- L. Where installed above an accessible lay-in ceiling.
- M. Where installed in a door or window frame mullion
- N. Low voltage wiring installed above a lay-in accessible ceiling and not in conduit, shall be supported on j-hooks installed at maximum 4 foot on centers. Existing j-hooks maybe used for new wiring.
- O. When transitioning from conduit to no conduit, utilize a bushing on the end of the conduit.
- P. All junction boxes provided to serve a reader, door operator pushbutton, etc., shall be approved by the manufacturer to serve that device and for the intended purpose. Surface boxes shall be finished, smooth edged and without sharp edges. Box finish shall match the connected raceway.
- Q. Include all conduit sleeves through walls as required for the routing of low voltage cabling. Sleeves installed in existing walls shall utilize a neat hole made with a coring machine or hole saw. Coring in masonry surfaces shall be continuous from one wall surface to the opposing wall surface without spalling. No conduit less than 1" shall be used for sleeves.
- R. Fire proof inside and out all conduit sleeves.
- S. Low voltage cabling shall be installed as required for conformance with the cabling recommendations of the cable manufacturer. Obtain same from the manufacturer.
- T. Low voltage cabling shall be installed as follows:
 - 1. Not installed within 18 inches of light fixture ballasts or within 36 inches of motors or transformers.
 - 2. In accordance with maximum bending radius as recommended by the manufacturer.
 - 3. Installed perpendicular to power conduit runs upon their intersection wherever possible.

3.4 GROUNDING

- A. Coordinate this article with Drawings.
- B. Comply with Section 280526 "Grounding and Bonding for Electronic Safety and Security."
- C. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."
- D. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

- E. Bond shields and drain conductors to ground at only one point in each circuit.
- F. Signal Ground:
 - 1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
 - 2. Bus: Mount on wall of main equipment room with standoff insulators.
 - 3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.5 IDENTIFICATION

- A. In addition to requirements in this article, comply with applicable requirements in Section 260553 "Identification for Electrical Systems" and with TIA/EIA 606-A.
- B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - 1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
 - 2. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when

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tests have been satisfactorily completed.

- C. Devices and circuits will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Verify the proper operation of all system components and sequences.

****END OF SECTION****

FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed under any section of the electrical specifications is subject to all requirements contained under other electrical specification sections.
- C. Refer to drawings and specifications prepared by the Architect as well as those prepared by the Mechanical Systems Consultant. Include all equipment, wiring, materials, labor and services indicated to be the responsibility of the electrical contractor. Work and responsibilities indicated on drawings and specifications prepared by Berbiglia Associates Inc. shall not restrict, negate, limit or supersede compliance with the work or requirements indicated on the Architectural and/or Mechanical Systems drawings and specifications.

1.2 SUMMARY

- A. Section Includes fire alarm system revisions.

1.3 CODES AND STANDARDS

- A. Fire alarm system revisions shall be in accordance with all applicable codes and requirements including NFPA-72 and National Electrical Code with particular attention to Article 760.
- B. Fire alarm system installer shall be certified with the State of Michigan.
- C. Fire alarm system devices and equipment shall be factory mutual approved and shall be by the manufacturer of the existing system.

1.4 SCOPE OF WORK

- A. The existing fire alarm system is an addressable system manufactured by National Time and Signal. The main fire alarm panel is a series 902 intelligent panel. All work and services performed by National Time and Signal shall be as the result of a contract with the electrical contractor. The electrical contractors bid shall include the cost of all equipment, devices, materials, labor, services, raceways, wiring, etc. Required for complete fire alarm system revisions.
- B. All new fire alarm system devices shall be compatible with the existing system and shall be provided by the system manufacturer.
- C. All fire alarm wiring revisions shall be as directed by the manufacturer and shall be clearly indicated on equipment shop drawings.
- D. Provide all wiring and connections. All wire to be copper and approved for use with fire alarm systems per the National Electrical Code, article 760.

- E. All wiring to be installed in raceway unless located above lay-in ceilings. Wiring installed above lay-in ceilings shall be properly supported with J-hooks or bridal rings. J-hooks or bridge rings used for fire alarm cabling shall be dedicated to fire alarm system use. Wiring in exposed ceiling areas shall be in conduit.
- F. Provide all junction boxes, pull boxes, etc. as required. Paint inside of covers and boxes "Red".
- G. All components shall be FM approved and shall be listed by Underwriters Laboratories, Inc. for use as a fire protective signaling system.
- H. All fire alarm system equipment, devices and revisions shall be in accordance with current code requirements. Include all revisions required for code conformance.
- I. All fire alarm system revisions related to central equipment, control panels, NAC panels, power supplies, etc. Shall be as required to accommodate device revisions indicated on plan and shall be as directed by National Time and Signal. Include all costs in the electrical bid for same.
- J. All new fire alarm system devices shall be compatible with the existing system and shall be the specific type and model number as directed by National Time and Signal. Existing fire alarm devices may be reused where their reuse conforms to all applicable and current code requirements.
- K. All system programming revisions shall be by National Time and Signal.

1.5 SUBMITTALS

- A. The Contractor shall submit a complete and accurate listing of all major items of equipment to be used.
- B. System drawings shall include a system wiring diagram indicating all wiring and devices to be provided and installed under this electrical contract. Electrical Contractor shall include in his bid all wiring required to accommodate system revisions as directed by National Time and Signal.
- C. It shall be the responsibility of the Electrical Contractor to submit for approval complete shop drawings together with applicable contract documents (plans and specifications) to the Fire Marshal for approval. Reproducible contract documents will be provided by the Architect when requested by the Electrical Contractor. The responsibility for approval by the Fire Marshal rests solely with the Electrical Contractor and all costs for same shall be included in his bid.
- D. National Time and Signal shall prepare and submit, to the electrical contractor, fire alarm system shop and layout drawings indicating all device, wiring and equipment revisions. Fire alarm shop drawings shall include battery, power supply, voltage drop and amplifier calculations for all equipment and devices serving the renovated areas.
- E. After system approval by the Fire Marshal submit shop drawings for approval to the Architect. Shop drawings submitted to the Architect shall clearly indicate the Fire Marshal approval.

PART 2 - MATERIALS

2.1 MANUFACTURERS

- A. Manufacturer of all system devices and equipment shall be National Time and Signal.

2.2 AUDIO VISUAL DEVICES

- A. Alarm strobe/horns: the alarm horns shall be polarized 24 VDC type. The mechanisms shall be fully enclosed and dustproof. They shall be designed to be mounted on a wall at a height of 80" above finished floor or six inches below the ceiling.
- B. Alarm Strobes (Visual): Visual alarm signals shall be furnished with minimum light intensity of 15/75 candela, provide strobes of higher candela intensity as indicated on plan. Strobes shall comply with ADAAG, NFPA, ANSI guidelines and the following:
 - 1. Xenon strobe with minimum repetition rate of 1 HZ, not exceeding 3HZ and a maximum duty cycle of 40% with a pulse duration of .2 seconds.
 - 2. Unfiltered or clear white light.
 - 3. Visual signals shall be mounted at a height of maximum 80 inches above finish floor level, or six inches below ceiling level whichever is lower.
- C. Audible devices shall be furnished and installed to provide minimum of 15 dB above ambient sound levels. Maximum sound levels shall not exceed 100 dB, provisions shall be made to adjust the audible levels accordingly.
- D. Provide combination units where indicated or required.
- E. Provide new power supplies as required to serve audio and or visual devices. Include all wiring including 120 volt wiring. All 120 volt wiring to be served from a dedicated circuit breaker.
- F. Provide battery, power supply and voltage drop calculations. Provide calculations for all existing power supplies that receive new load as well as new power supplies.

2.3 WIRING

- A. All wiring shall be in conduit or approved metal raceway, except where wiring is routed above lay-in ceiling locations. Wiring installed above lay-in ceilings shall be properly supported with J-hooks or bridle rings. J-hooks or bridle rings used for fire alarm cabling shall be dedicated to fire alarm system use. Wiring in exposed ceiling areas shall be in conduit. Provide and install all wiring as directed by the National Time and Signal not withstanding wiring indicated on plan. All wiring shall be color coded and clearly tagged. No other wiring shall be permitted in the fire alarm raceway. All color coding shall match existing. \
- B. All branch circuit breakers serving the fire alarm system shall be painted red. No other project breakers shall be red unless specifically noted.
- C. All fire alarm system wiring shall be installed in conduit except where above a lay-in accessible ceiling, fire alarm system wiring maybe supported over head in the accessible ceiling space with "j" hooks.

2.4 INSTALLATION

- A. All wiring shall be installed in accordance with the National Time and Signal requirements. Where herein specified requirements exceed National Time and Signal requirements, the herein specified requirements shall apply.

- B. Install flip lids on fire alarm pull stations as noted on plan. Flip lids shall be SDI Stopper series as currently used in district.
- C. Wiring color coding shall remain the same throughout the system. Colors used for coding shall match the existing building color coding scheme.
- D. Coordinate exact wiring requirements with the manufacturer and include all wiring costs as required to accommodate the revisions.
- E. All wire shall be copper and as approved for use on a fire alarm system and in accordance with N.E.C. article 760.
- F. The Electrical Contractor shall provide all mounting hardware, junction boxes, back boxes, etc., for the complete installation of the systems.
- G. Junction boxes for surface mounted equipment shall be standard octagonal box, 2&1/4" deep minimum, securely supported from building structural system and not supported from ceiling tiles.
- H. Boxes for smoke detectors shall be standard octagonal box, 2&1/4" deep minimum, securely supported from building structural system and not supported from ceiling tiles. Provide flush boxes where detectors are ceiling mounted in finished areas and surface boxes where detectors are surface mounted in unfinished areas.
- I. Upon completion of the installation, assist the manufacturer in testing of the system including each and every alarm initiating and indicating device as required by the authority having jurisdiction. Include all testing costs in the bid.
- J. A Certificate report shall be submitted to the Owner or his representative, indicating proper operation, compliance and date of testing.
- K. The Electrical Contractor shall prepare "Record As-Builts" that indicate the final location of all devices, conduit routings and wiring methods.
- L. If wiring errors are identified as the result of testing, this Contractor shall revise the wiring as directed by the system manufacturer in order to eliminate the wiring error. Following the wiring revisions a second test (by the manufacturer) shall be performed. The cost of retesting shall be paid for by this Contractor.

PART 3 - EXECUTION

3.1 WARRANTY

- A. All equipment and devices shall be warranted by the manufacturer for a period of one year following acceptance. The warranty shall include all parts. All warranty costs shall be included in the price of the device or equipment.

3.2 ENGINEERING

- A. The cost of engineering including all calculations, investigations, sizing and design shall be included in the device or equipment price.
- B. Provide all calculations and data required by the engineer, Owner, Fire Marshal and/or State inspector.

- C. Provide with shop drawings battery, power supply and voltage drop calculations. Provide calculations for all existing power supplies that receive new load as well as new power supplies.

3.3 TESTS AND REPORTS

- A. National Time and Signal shall perform system testing of all equipment and each device prior to testing by the AHJ as required for system approval.
- B. Testing shall include the percentage of existing system unaltered devices, wiring and equipment as required by the AHJ.
- C. National Time and Signal shall be present and shall assist with testing as required for AHJ testing/approval.
- D. The manufacturer shall perform all tests required for certification. All test and report costs shall be included in the device or equipment price. A checkout report shall be prepared by the manufacturer technician and submitted.
- E. The completed smoke detection system shall be tested to insure that it is operating properly. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period.
- F. Testing shall include a walk test that demonstrates the proper operation of all devices. Final tests and inspection shall be held in the presence of engineer, owner and Fire Marshal or State inspector.
- G. Testing shall be as required for acceptance by the Fire Marshal or State inspector.

END OF SECTION