

PROJECT MANUAL FOR THE CONSTRUCTION OF:

PROJECT:

FORD WOODS PARK POOL

OWNER:

CITY OF DEARBORN
5700 Greenfield Road
Dearborn, Michigan 48126

TMP PROJECT NO.: 17071

DATE: October 25, 2017

ISSUED FOR BIDS

ARCHITECT

TMP ARCHITECTURE, INC.

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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****

SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: Proposed new contracts for the execution and completion of all Work as indicated on the Drawings and specified herein. The Contractor will assign portions of the work to the individual trades and perform all supervision and coordination required to secure completion of the work.

1.2 EXISTING CONDITION OF SITE

- A. Drawings of existing project conditions are furnished for reference.
- B. Neither the Owner nor the Architect warrants the adequacy of correctness of such drawings.

1.3 PRECAUTIONS

- A. Each Contractor and his Subcontractors shall provide and maintain necessary protections and precautionary measures as required to prevent damage due to subsequent operations to completed work already in place.
- B. Each Contractor shall promptly correct all such damage to his work and restore it to original condition at no additional expense to the Owner.
- C. Each Contractor shall cooperate with trades performing work under other contracts as necessary for completion.

1.4 CONSTRUCTION SEQUENCE

- A. Sequences and dates specified herein are for information only and indicate the intent of the Owner and the Contractor. Exact dates shall be as established in the Agreement.
- B. Sequence of operations shall be established by the Contractor within the guidelines established by the Owner as required to meet construction schedules. Schedule of work for individual subcontract trades shall be as directed by the Contractor.

1.5 SCOPE OF CONSTRUCTION WORK

- A. The Scope of the Construction Work defined herein as "Base Bid" includes the following except where otherwise specified hereinafter as "Not In Contract":
 - 1. To provide temporary fencing and soil erosion protection and other protections as specified in 015000 "TEMPORARY FACILITIES AND CONTROLS" keep general public out of the area of work and prevent debris from traveling beyond work area.
 - 2. Necessary grading and concrete paving work (including sidewalk, service drive, pool deck, curb ramp, and curb and gutter) for the new building's proposed site layout.
 - 3. Other site features shall include the installation of new chain link fencing/gates, lighting and landscape, and site furnishings such as benches, bicycle hoops, and litter receptacles.
 - 4. Underground utility work shall include re-routing the existing storm sewer line around the new building footprint, and the installation of additional storm sewer structures

including manholes, inlets, trench drains and field catch basins to provide the proposed site layout's drainage to the existing storm sewer system.

5. Sitework also includes the installation of the proposed building's sanitary sewer leads and connecting to the existing City sanitary sewer line located within the park, as well as constructing the proposed building's ductile iron water service line connected to an existing 4" ductile iron stub that the City has already installed and temporarily capped for this project's water service.
6. To provide all work associated with poured in place concrete as indicated.
7. To provide all work associated with masonry concrete masonry block walls as indicated.
8. To provide all work associated with glued-laminated and shop fabricated wood trusses.
9. To provide all work associated with wood decking, sheathing, and standing seam metal roofing, and accessories, including all water infiltration prevention and flashing as indicated on drawings and specified in specifications.
10. To provide all work associated with ceilings, lighting, ventilation, etc. as indicated on drawings. Including gypsum board ceilings and interior finish system ceilings.
11. To provide all work associated with plastic laminate reception desk, plastic laminate prefabricated casework, and crowd control devices as indicated.
12. To provide all work associated with new floor, wall, and ceiling finishes as indicated.
13. To provide all work associated with curtainwall, storefront, doors, glazing, louvers, and hardware as indicated.
14. To provide all work associated with plumbing fixtures, toilet partitions, and toilet accessories as indicated.
15. To provide all work associated with lockers and benches as indicated.
16. To provide all work associated with interior signage as indicated.
17. To provide all work associated with mechanical and plumbing work as indicated.
18. To provide all work associated with electrical work as indicated.
19. To provide all work associated with firestopping, and firestop joint systems as indicated.
20. To provide all work with joint sealants and indicated.
21. See specification section 131100 "SWIMMING POOL" for summary of work regarding the swimming pool
22. To provide ongoing clean-up of the site work, walks, and/or roads. Surrounding park will be occupied during open hours; therefore, contractor shall keep all areas clean and free of debris during workday. All areas shall be clean and free of materials prior to leaving site for the day. No on-grade storage of materials will be permitted. All materials shall be store at a secured location approved by Owner and/or Architect or brought to the site when needed.

23. To provide trash dumpsters as required for the work. The use of Owner's trash dumpsters or receptacles shall be strictly prohibited.

B. PERMITS:

1. The architect shall submit bid documents to the City of Dearborn and Bureau of Fire Services for plan approval.
2. The Contractor will be responsible to obtain all necessary permits as required by the City of Dearborn and State of Michigan, including but not limited to a Building Permit, Mechanical and Electrical.
3. The Contractor will be responsible for coordination with the Architect's office for inspections by the Bureau of Fire Services. The Architect shall call for inspections by the Bureau of Fire Services.
4. The Contractor will be responsible for obtaining all necessary inspections and final certificates from the State of Michigan for permits obtained for the commission of the work. Inspections and final certificates will be required by City of Dearborn Building, Mechanical, Electrical Divisions and Bureau of Fire Services.

C. Not In Contract (NIC): The Scope of the Construction Work as defined herein does not include the following:

1. All items or work and finishes noted on the drawings as Not In Contract.

END OF SECTION

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for Project Administration.
- B. Related Work: The following items of work are specified under other Sections of these Specifications:
 - 1. Division 1 Section "Construction Project Documentation"

1.2 SUPERINTENDENCE

- A. It is the Contractor's Superintendent's responsibility and duty to keep the Owner and the Architect advised as to the progress of the work at all times and to consult with them on any matters requiring clarification, instruction and decision in ample time to assure the correctness of the work.
- B. The Contractor's Field Superintendent shall have authority to sign Field Directives.

1.3 MEETING ADMINISTRATION

- A. The Contractor will schedule and administer a pre-construction conference, progress meetings, and specially called meetings, distribute a written notice of each meeting in advance of the meeting date, make physical arrangements for the meetings, preside at the meetings, and record the minutes, including all significant proceedings and decisions. The Contractor will then reproduce and distribute copies of the minutes promptly after each meeting, to all participants in the meeting, to all parties affected by decisions made at the meeting.
- B. Representatives of all Prime Contractors, Subcontractors, and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents.

1.4 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor will schedule the pre-construction conference at a mutually agreeable time before the beginning of construction and after contract award. The purpose of the meeting is to coordinate permits, utilities, lay out area, traffic, and any other items that may affect Owner or the Contractors.
- B. In attendance shall be the Architect, Engineer, all Prime Contractors, major Subcontractors, major suppliers, and others as requested by the parties.

1.5 PROGRESS MEETINGS

- A. The Contractor will schedule regular meetings as required and will call and hold additional meetings as required by the progress of the work. The location of the meetings shall be the project field office.
- B. In attendance shall be the Architect, Engineer, other representatives of the Owner and their professional consultants as needed. Contractors, Subcontractors as appropriate to the agenda, suppliers as appropriate to the agenda, and others as requested.

1.6 MEETING AGENDA

- A. The following is a sample agenda.
1. Review and approval of the minutes of the previous meeting.
 2. Review of work progress since the previous meeting.
 3. Field observations, problems and conflicts.
 4. Problems that impede the Construction Schedule.
 5. Review of off-site fabrication and delivery schedules.
 6. Corrective measures and procedures to retain the projected schedule.
 7. Revisions to the Construction Schedule.
 8. Planning of progress and schedule during the successive work period.
 9. Coordination of schedules.
 10. Review of submittal schedules; expediting as required.
 11. Maintenance of quality standards.
 12. Review of impact of proposed changes for their effect on the Construction Schedule and on the Completion Date, and their effect on other contracts of the Projects.
 13. Other business.

1.7 SUPERINTENDENCE, SUPERVISION

- A. Each Prime Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site at all times when work of his contract is in progress, including overtime work, except where otherwise approved by the Architect.
- B. Important communications shall be confirmed in writing by the Contractor. Other communications shall be so confirmed on written request in each case.

END OF SECTION

SCHEDULE OF REQUIRED SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements and schedule tabulating submittals required under the individual Trade Sections.
- B. Related Work: The following submittals are described under other Sections of these Specifications:
 - 1. Division 1 Section "Electronic Submittal Procedures" for shop drawings.
 - 2. Division 1 Section "Electronic Project Record Documents" for project record documents.
 - 3. Division 1 Section "Warranties" for warranties and warranty services.

1.2 SUBMITTALS

- A. Submittals schedule is for reference only and is not necessarily complete. Specific requirements are included in the respective Trade Sections.
- B. Description of submittals and definitions of terms are included under other Sections of Division 1.
- C. Submittal of Materials for Approval:
 - 1. See Division 1 "Product Requirements" for requirements for materials submittals.
 - 2. All materials requiring Manufacturer Services or Warranty shall be submitted in the form specified under "Warranties".
 - 3. Standard materials may be submitted in tabular form. Where necessary to clarify proposed use, submit as a Shop Drawing a schedule of applications or a drawing showing proposed locations.

1.3 SCHEDULE

- A. The Contractor shall prepare a schedule relating and conforming to the Approved Construction Schedule. Said Schedule shall recognize and allow for lead time, including lead time required by Subcontractors and Manufacturers, and time required for Architect's review in compliance with the Contract Documents for all submittals.
- B. This Schedule shall be submitted to the Owner and the Architect for approval prior to the second Request for Payment.
- C. Exact procedures and time schedules for submittals will be determined at the time Job Progress Schedule is established. Time schedule for submittals shall be periodically revised and adjusted to coordinate with job progress.

1.4 EQUIPMENT ROOM LAYOUT DRAWINGS

- A. Each Contractor shall prepare and submit equipment room layout drawings, as called for under "Shop Drawings and Samples," for all equipment furnished under its Contract.

- B. Scale (Minimum): 1/4 inch equals 1 foot.

1.5 CERTIFICATE OF COMPLIANCE

- A. Each certificate required for demonstrating proof of compliance of materials with specification requirements, including mill certificates, shall be executed in quadruplicate. It shall be the Contractor's responsibility to review all certificates, before submittal, to ensure compliance with the Contract Documents.
- B. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company and shall contain the name and address of the Contractor, the project name and location and the quantity and date or dates of shipment or delivery to which the certificate applies.
- C. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if after tests are performed on selected samples, the material is found not to meet the specific requirements.

1.6 SPARE PARTS DATA

- A. The Contractor shall furnish spare parts data for each different item of equipment furnished if and as called for in the Trade Sections.

1.7 SAMPLES

- A. After the award of the Contract, the Contractor shall furnish, for approval, samples required by the Specifications. The Contractor shall prepay all shipping charges on samples.
- B. Materials or equipment for which samples are required shall not be used in the work until approved in writing.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Where required by the Specifications, Operation and Maintenance Manuals shall be provided by the Contractor as specified under "Electronic Project Record Documents".
- B. Provide all manuals, parts information and similar data which the Architect may determine to be necessary for proper operation and maintenance.
- C. The manuals shall cover the operation requirements of each item specified to require operational and maintenance manuals, and shall include standard maintenance procedures and recommended schedules for routine service. The manuals shall be submitted to the Architect ten (10) days prior to final tests of mechanical and electrical system.

1.9 TEST PROCEDURES AND TEST RESULTS

- A. Where required by the Technical Specifications test procedures and test results shall be provided by the Contractor in quadruplicate. Test procedures shall cover all items required by the Technical Provisions and as specified under "Laboratory Testing and Inspection."

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 "Electronic Project Record Documents" for project record documents.

1.2 DEFINITIONS

- A. Samples: See General Conditions.
 - 1. Preliminary Samples: Hand made 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 to submit shop drawings and product data in electronic form. Submittals are to be made to the **General Contractor** in the following form.
1. Shop drawing: 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
- B. 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.
- C. Physical Samples must be submitted through the **General Contractor** and must be accompanied by an electronic (PDF) copy of the completed TMP Shop Drawing and Transmittal Form.
- D. **General Contractor** 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 **General Contractor** 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.

SECTION 013300
ELECTRONIC
SUBMITTAL
PROCEDURES

- 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.
 - 2. Brochures and other pre-printed data, clearly mark PDF information as follows:
 - a. 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 **General Contractor**, in electronic file PDF except where otherwise specified. The **General Contractor** 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 **General Contractor** 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 General Contractor**. The other contractors shall review in order and sequence as directed by **General Contractor**.
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 **General Contractor** 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 **General Contractor**, 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 **General Contractor** 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, **General Contractor** or the Architect's acceptance or Shop Drawings, Product Data or Samples, unless the Contractor has informed the Owner, **General Contractor** 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 **General Contractor** 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 **General Contractor** 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 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 31, 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 Sections of Division 3, "Concrete" including all cast-in-place 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 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 overlying 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.

AABC - Associated Air Balance Council; www.aabc.com.

AAMA - American Architectural Manufacturers Association; www.aamanet.org.

AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.

AASHTO - American Association of State Highway and Transportation Officials;
www.transportation.org.

AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.

ABMA - American Bearing Manufacturers Association; www.americanbearings.org.

ABMA - American Boiler Manufacturers Association; www.abma.com.

ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org

ACPA - American Concrete Pipe Association; www.concrete-pipe.org.

AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.

AF&PA - American Forest & Paper Association; www.afandpa.org.

AGA - American Gas Association; www.aga.org.

AHAM - Association of Home Appliance Manufacturers; www.aham.org.

AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.

AI - Asphalt Institute; www.asphaltinstitute.org.

AIA - American Institute of Architects (The); www.aia.org.

AISC - American Institute of Steel Construction; www.aisc.org.

AISI - American Iron and Steel Institute; www.steel.org.

AITC - American Institute of Timber Construction; www.aitc-glulam.org.

AMCA - Air Movement and Control Association International, Inc.; www.amca.org.

ANSI - American National Standards Institute; www.ansi.org.

AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.

APA - APA - The Engineered Wood Association; www.apawood.org.

APA - Architectural Precast Association; www.archprecast.org.
API - American Petroleum Institute; www.api.org.
ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
ARI - American Refrigeration Institute; (See AHRI).
ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
ASCE - American Society of Civil Engineers; www.asce.org.
ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
ASSE - American Society of Safety Engineers (The); www.asse.org.
ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
ASTM - ASTM International; www.astm.org.
ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
AWEA - American Wind Energy Association; www.awea.org.
AWI - Architectural Woodwork Institute; www.awinet.org.
AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
AWPA - American Wood Protection Association; www.awpa.com.
AWS - American Welding Society; www.aws.org.
AWWA - American Water Works Association; www.awwa.org.
BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
BIA - Brick Industry Association (The); www.gobrick.com.
BICSI - BICSI, Inc.; www.bicsi.org.
BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
CDA - Copper Development Association; www.copper.org.
CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
CEA - Canadian Electricity Association; www.electricity.ca.
CEA - Consumer Electronics Association; www.ce.org.
CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
CGA - Compressed Gas Association; www.cganet.com.
CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
CPA - Composite Panel Association; www.pbmdf.com.
CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
CRRC - Cool Roof Rating Council; www.coolroofs.org.
CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
CSA - CSA Group; www.csa.ca.
CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
CSI - Construction Specifications Institute (The); www.csinet.org.
CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
CWC - Composite Wood Council; (See CPA).
DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
DHI - Door and Hardware Institute; www.dhi.org.
ECA - Electronic Components Association; (See ECIA).
ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
ECIA - Electronic Components Industry Association; www.eciaonline.org.

EIA - Electronic Industries Alliance; (See TIA).
EIMA - EIFS Industry Members Association; www.eima.com.
EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
ESTA - Entertainment Services and Technology Association; (See PLASA).
ETL - Intertek (See Intertek); www.intertek.com.
EVO - Efficiency Valuation Organization; www.evo-world.org.
FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
FM Approvals - FM Approvals LLC; www.fmglobal.com.
FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarooft.com.
FSA - Fluid Sealing Association; www.fluidsealing.com.
FSC - Forest Stewardship Council U.S.; www.fscus.org.
GA - Gypsum Association; www.gypsum.org.
GANA - Glass Association of North America; www.glasswebsite.com.
GS - Green Seal; www.greenseal.org.
HI - Hydraulic Institute; www.pumps.org.
HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
IAS - International Accreditation Service; www.iasonline.org.
IAS - International Approval Services; (See CSA).
ICBO - International Conference of Building Officials; (See ICC).
ICC - International Code Council; www.iccsafe.org.
ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
IEC - International Electrotechnical Commission; www.iec.ch.
IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
IESNA - Illuminating Engineering Society of North America; (See IES).
IEST - Institute of Environmental Sciences and Technology; www.iest.org.
IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
ILI - Indiana Limestone Institute of America, Inc.; www.ili.ai.com.
Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
ISO - International Organization for Standardization; www.iso.org.
ISSFA - International Solid Surface Fabricators Association; (See ISFA).
ITU - International Telecommunication Union; www.itu.int/home.
KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
LMA - Laminating Materials Association; (See CPA).
LPI - Lightning Protection Institute; www.lightning.org.

MBMA - Metal Building Manufacturers Association; www.mbma.com.
MCA - Metal Construction Association; www.metalconstruction.org.
MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
MHIA - Material Handling Industry of America; www.mhia.org.
MIA - Marble Institute of America; www.marble-institute.com.
MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
MPI - Master Painters Institute; www.paintinfo.com.
MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.;
www.mss-hq.org.
NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
NACE - NACE International; (National Association of Corrosion Engineers International);
www.nace.org.
NADCA - National Air Duct Cleaners Association; www.nadca.com.
NAIMA - North American Insulation Manufacturers Association; www.naima.org.
NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
NBI - New Buildings Institute; www.newbuildings.org.
NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
NCMA - National Concrete Masonry Association; www.ncma.org.
NEBB - National Environmental Balancing Bureau; www.nebb.org.
NECA - National Electrical Contractors Association; www.necanet.org.
NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
NEMA - National Electrical Manufacturers Association; www.nema.org.
NETA - InterNational Electrical Testing Association; www.netaworld.org.
NFHS - National Federation of State High School Associations; www.nfhs.org.
NFPA - National Fire Protection Association; www.nfpa.org.
NFPA - NFPA International; (See NFPA).
NFRCC - National Fenestration Rating Council; www.nfrc.org.
NHLA - National Hardwood Lumber Association; www.nhla.com.
NLGA - National Lumber Grades Authority; www.nlga.org.
NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
NRCA - National Roofing Contractors Association; www.nrca.net.
NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
NSF - NSF International; www.nsf.org.
NSPE - National Society of Professional Engineers; www.nspe.org.
NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
NWFA - National Wood Flooring Association; www.nwfa.org.
PCI - Precast/Prestressed Concrete Institute; www.pci.org.
PDI - Plumbing & Drainage Institute; www.pdionline.org.
PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association);
<http://www.plasa.org>.
RCSC - Research Council on Structural Connections; www.boltcouncil.org.
RFCI - Resilient Floor Covering Institute; www.rfci.com.
RIS - Redwood Inspection Service; www.redwoodinspection.com.
SAE - SAE International; www.sae.org.
SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
SDI - Steel Deck Institute; www.sdi.org.
SDI - Steel Door Institute; www.steeldoor.org.
SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See
ASCE).
SIA - Security Industry Association; www.siaonline.org.
SJI - Steel Joist Institute; www.steeljoist.org.
SMA - Screen Manufacturers Association; www.smainfo.org.

SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.

SMPTE - Society of Motion Picture and Television Engineers; www.smppte.org.

SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.

SPIB - Southern Pine Inspection Bureau; www.spib.org.

SPRI - Single Ply Roofing Industry; www.spri.org.

SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.

SSINA - Specialty Steel Industry of North America; www.ssina.com.

SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.

STI - Steel Tank Institute; www.steeltank.com.

SWI - Steel Window Institute; www.steelwindows.com.

SWPA - Submersible Wastewater Pump Association; www.swpa.org.

TCA - Tilt-Up Concrete Association; www.tilt-up.org.

TCNA - Tile Council of North America, Inc.; www.tileusa.com.

TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.

TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.

TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).

TMS - The Masonry Society; www.masonrysociety.org.

TPI - Truss Plate Institute; www.tpinst.org.

TPI - Turfgrass Producers International; www.turfgrasssod.org.

TRI - Tile Roofing Institute; www.tilerroofing.org.

UL - Underwriters Laboratories Inc.; <http://www.ul.com>.

UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.

USAV - USA Volleyball; www.usavolleyball.org.

USGBC - U.S. Green Building Council; www.usgbc.org.

USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.

WA - Wallcoverings Association; www.wallcoverings.org.

WASTEC - Waste Equipment Technology Association; www.wastec.org.

WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.

WCMA - Window Covering Manufacturers Association; www.wcmanet.org.

WDMA - Window & Door Manufacturers Association; www.wdma.com.

WI - Woodwork Institute; www.wicnet.org.

WSRCA - Western States Roofing Contractors Association; www.wsrca.com.

WWPA - Western Wood Products Association; www.wwpa.org.

- G. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

DIN - Deutsches Institut für Normung e.V.; www.din.de.
IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
ICC - International Code Council; www.iccsafe.org.
ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

- H. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

COE - Army Corps of Engineers; www.usace.army.mil.
CPSC - Consumer Product Safety Commission; www.cpsc.gov.
DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
DOD - Department of Defense; www.quicksearch.dla.mil.
DOE - Department of Energy; www.energy.gov.
EPA - Environmental Protection Agency; www.epa.gov.
FAA - Federal Aviation Administration; www.faa.gov.
FG - Federal Government Publications; www.gpo.gov/fdsys.
GSA - General Services Administration; www.gsa.gov.
HUD - Department of Housing and Urban Development; www.hud.gov.
LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
OSHA - Occupational Safety & Health Administration; www.osha.gov.
SD - Department of State; www.state.gov.
TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
USP - U.S. Pharmacopeial Convention; www.usp.org.
USPS - United States Postal Service; www.usps.com.

- I. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
DSCC - Defense Supply Center Columbus; (See FS).
FED-STD - Federal Standard; (See FS).
FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

Available from Defense Standardization Program; www.dsp.dla.mil.
Available from General Services Administration; www.gsa.gov.

Available from National Institute of Building Sciences/Whole Building Design Guide;
www.wbdg.org/ccb.

MILSPEC - Military Specification and Standards; (See DOD).

USAB - United States Access Board; www.access-board.gov.

USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

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 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.	B/B	CAB.
A.F.F.	B.F.P.	C.U.H.
ABR.	B.D.D.	CAP.
ABS.	B.F.	CPT.
ACC.	B.B.R.	CSMT.
A.C.C.		CSWRK.
	B.PL.	CSG.
ACC.PNL.	BSMT.	C.I.
A.V.	B.	C.I.F.
A.W.	BM.	C.I.P.
AC.	BRG	CSTG.
AC.T.	BR.	CAT.NO.
AC.INSUL.	B.M.	C.B.
A.D.A.	BT.	CLG.
	BETW.	C.D.
ADD.	BEV.	CLG.HT.
ADDN.	BIT.	CEM.
ADDNL.	B.I.	CEM.PLAS.
ADH.	BLK.	CTR.
ADJ.	BD.	C.L.
AGGR.	BLR.	C/C
A.C.B.	BLR.F.	CER.
A/C	BLR.H.	CER.T.
A.C.	B.S.	CBD.
A.C.C.	B.W.	CHAM.
	BOT.	CHG.
A.C.U.	B.O.D.	C/CHAN.
A.H.U.	B.O.P.	CHKD. PL.
ALT.	BOT.EL.	CH.W.R.
ALUM./AL.	BLVD.	CH.W.S.
AMT.	BDRY.	CHD.
AMP.	BRKT.	CIRCUM.
AMPL.	B.HP.	CIR.
ANCH.	BR.	CIRC.
A.B.	BRKR.	CIRC.
&	BRK.	C.BR.
L/AN.	B.T.U.	C-
ANOD.	BRZ.	
APT.	BLDG.	CL.
APR.	B.L.	CLRM.
APPR.	B.M.S.	C.O.
ARCH.		CLR.
	B.U.R.	CLR. GL.
A-	BN.	CLR. W.GL.
	BLKHD.	COEF.
A.T.	BULL.	C.W.
ASPH.	B.A.	COL.
ASSY.	BUZZ.	CO.
@		COMPT.
AUTO.		COMPO.
A.S.R.		C.A.
		COMPR.
AUX.		CONC.
AVG.		C.M.U.
		Unit

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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

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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
L.F. Linear Feet/Foot
LIQ. Liquid
L.L. Live Load
L.R. Living Room
LOC. Location
LKR. Locker
LG. Long
L.L.H. Long Leg Horizontal
L.L.V. Long Leg Vertical
LVR. Louver
L.O. Louver Opening
L.P. Low Point
L.PR. Low Pressure
LBR. Lumber
LBS. Pounds

M

MACH. Machine
M.B. Machine Bolt
MACH.RM. Machine Room
M.U.A. Make-Up Air
M.A.U. Make-up Air Unit
M.D.P. Main Distribution Panel
M.S.B. Main Switch Board
MAINT. Maintenance
MH. Manhole
M.V.D. Manual Volume Damper
MFR. Manufacturer
MAR. Marble
MK. Mark
MAS. Masonry
M.O. Masonry Opening
MATL. Material
MAX. Maximum
MECH. Mechanical
M- Mechanical Drawing Number
M.C. Medicine Cabinet
MED. Medium
MEMB. Membrane
MET. Metal/ Metallic
M.C.S. Metal Carpet Strip
M.D.S. Metal Divider Strip
M.E.S. Metal Edge Strip
M.L. Metal Lath
M.L. & PLAS. Metal Lath And Plaster
MET.W.P. Metallic Waterproofing
MEZZ. Mezzanine
M.D.O.T. Michigan Department of Transportation
MWK. Millwork
MIN. Minimum
MIR. Mirror
M. & S. Mirror And Shelf
MISC. Miscellaneous

M.I. Miscellaneous Iron
MOD. Model
MON. Monument
M.S. & S. Mop Strip And Shelf
M.O. Motor Operated
M.O.D. Motor Operated Damper
MLDG. Molding
MTD. Mounted
MTG. Meeting/Mounting
MTD. Mounted
MOV. Moveable
MOV. Moveable Partition
PARTN.
MULL. Mullion
M Thousand
MBH 1000BTU/Hour

N

NAT. Natural
N.S. Near Side
NK. Neck
NEUT. Neutral
N.R.C. Noise Reduction Coefficient
NOM. Nominal
N.C. Non-Corrosive
NOR. Normal
N.C. Normally Closed
N.O. Normally Open
N North
NOS. Nosing
N.I.C. Not In Contract
N.T.S. Not To Scale
NO. or # Number

O

OBS. Obscure
OBS.GL. Obscure Glass
OFF. Office
O.C. On Center
OPQ. Opaque
OPG. Opening
OPER. Operator
O.B.V.D. Opposed Blade Volume Damper
OPP. Opposite
OPP.HD Opposite Hand
ORIG. Original
ORN. Ornamental
OZ. Ounce
O/O Out-to-Out
O.A. Outside Air
O.D. Outside Diameter
O.F. Outside Face
O.H.S. Oval Head Screw
OA. Overall
OHD. Overhead

OHD.DR. Overhead Door
OXY. Oxygen

P

PRD. Painted
PR. Pair
PNL. Panel
P.T.D. Paper Towel Dispenser
P.T.W.R. Paper Towel Waste Receptacle
PARA. Paragraph
PRL. Parallel
PGK. Parking
P.BD. Particle Board
PRTN. Partition
PASS. Passage
PAT. Patent
PVMT. Pavement
PVG. Paving
PED. Pedestal
PERF. Perforated
PERIM. Perimeter
PERM. Permanent
PERP. Perpendicular
PHOTO. Photograph
P.H. Physically Handicapped
PC. Piece
PCS. Pieces
PLAS. Plaster
PL.LAM. Plastic Laminate
PL. Plate
PL.GL. Plate Glass
PLAT. Platform
PLBG. Plumbing
PLYWD. Plywood
PT. Point
P.T. Point of Tangency
P.C. Point of Curvature
POL. Polish/ Polished
PVC. Polyvinylchloride
PORC. Porcelain
PORC. ENAM. Porcelain Enamel
POR. Porous
PORT. Portable
POS. Position
P.I.V. Post Indicator Valve
LBS. or # Pounds
P.L.F. Pounds Per Linear Foot
P.S.F. Pounds Per Square Foot
P.S.I. Pounds Per Square Inch
P.C.F. Pounds Per Cubic Foot
P.P. Power Panel
P/C Precast

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.		
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. 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.
- C. Furnish: Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
- D. 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.
- E. Provide: Furnish and install, complete and ready for intended use, as applicable in each instance.
- F. 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****

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: Miscellaneous Contractor assigned items of work or services necessary to all construction, but which will be assigned to particular trades.
- B. The General Contractor shall perform preparatory and temporary work with its own forces or reassign to the appropriate trade.

1.2 DIVISION OF RESPONSIBILITIES

- A. General: Each prime contractor is specifically assigned certain responsibilities for temporary services and facilities to be used by other prime contractors, and other entities at the site. The Contractor for General Work is responsible for providing temporary services and facilities that are not related to other prime contractors' normal work and are not specifically assigned otherwise by the Architect/Engineer.
- B. Except as otherwise indicated, each prime contractor is responsible for the following:
 - 1. Installation, operation, maintenance and removal of each temporary service or facility usually recognized as related to its own normal scope of work, and the costs and use charges associated with each such service or facility.
 - 2. Plug-in electric power cords and extension cords, and supplementary plug-in task lighting and special lighting necessary exclusively for its own work.
 - 3. Its own field office, complete with necessary utilities and telephone service.
 - 4. Storage and fabrication sheds necessary for its own work.
 - 5. Temporary heat, ventilation, humidity control and enclosure of the building where these utilities are necessary for its work, but have not yet been installed by the responsible prime contractor.
 - 6. Specialized or unusual hoisting requirements, including hoisting weights in excess of 2-ton, hoisting work into spaces below grade and hoisting requirements outside the building enclosure.
 - 7. Collection and disposal of its own hazardous, dangerous, unsanitary or otherwise harmful waste material.
 - 8. Construction aids and miscellaneous services and facilities necessary for its own work.
- C. Each prime contractor is responsible for providing adequate utility capacity at each stage of construction. Prior to availability of temporary utility services at the site, provide trucked-in services for start-up of construction operations.
- D. Obtain and pay for temporary easements required to bring temporary utilities to the project site, where the Owner's permanent easement cannot be utilized for that purpose.

1.3 QUALITY ASSURANCE

- A. Regulations: Each prime contractor shall comply with local laws and regulations governing construction and local industry standards, in the installation and maintenance of temporary services and facilities.
- B. Each prime contractor shall comply with "Environmental Impact" commitments the Owner or previous Owners of the site have made to secure local approval to proceed with construction of the project.
- C. Inspections: Inspect and test each service before placing temporary utilities in use. Arrange for required inspections and tests by governing authorities. Obtain required certifications and permits for use.
- D. During the progress of the Work, each prime contractor shall submit copies of reports and permits required by governing authorities, or necessary for the installation and efficient operation of temporary services and facilities.

1.4 CONSTRUCTION FACILITIES AND PROTECTION

- A. Site Protection:
 - 1. The General Contractor shall, in areas where so required and as indicated on the drawings, furnish and erect a construction fence around the perimeter of designated portions of the construction site. The fence shall be 8 feet high, 11 gauge chain link, mounted on 2 inch steel posts set in concrete and braced at corners and at gates. All gates will be secured with chains and key locks. In areas where fence is not called for, site protection will be by Excavation Contractor. Fence will be left in place upon completion of demolition for eventual removal specified below.
 - 2. The Excavation Contractor shall maintain construction fences, if any, and it shall furnish and install all straw bale barricades, filters and similar devices as required by code and additional items as indicated. It shall promptly replace all portions of fences or barricades removed or damaged, and shall be responsible for site security units moving off the site.
 - 3. The Safety and Clean-Up Contract Work includes site security and maintenance of fences and barricades as well as removal of the fencing and barricade materials and disposal of all related materials. Fences and barricades are to be replaced as directed by the Architect.
- B. General Site Protection:
 - 1. Each Contractor shall:
 - a. Assume full responsibility for prevention of damage to perimeter barricade and shall provide all other barricades as required by law as a result of its operations and shall take action necessary to provide that hazardous conditions are relieved as soon as possible.

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- b. Provide protection for the public, visitors and for other non-employees of the contractor on the site similar to that legally required for protection of employees.
 - c. Take all necessary precautions to prevent trespass and limit access to authorized visitors, employees and others having business at the site.
 - d. Make all necessary arrangements with subcontractors to provide prompt compliance with the above requirements and upon completion of the work of such contract make arrangements to continue the protection until no longer required.
2. All Contractors, suppliers and others performing work at the Site shall have the right to the use and benefit of protective devices in place or otherwise required to be furnished under the various contracts.
 3. Design, construct, and maintain construction aids and miscellaneous services and facilities as needed to accommodate performance of work. Construction aids and miscellaneous services and facilities include, but are not limited to the following:
 - a. Temporary stairs and ladders.
 - b. Guardrails and barriers.
 - c. Walkways.
 4. Additional protections required by the nature of special hazards in connection with the work of the contractors will be the responsibility of the contractor performing such work.
- C. Field Office and Storage:
1. Each contractor shall provide and erect its own field office.
 - a. Provide suitable construction sheds of sizes and arrangements sufficient for offices and work area for all staff including administrative clerical, and engineering job personnel.
 - b. Location, layout and type shall be as directed by the Architect. Field office may be a trailer on wheels or other portable type as approved.
 - c. Attention is called to the requirement that all temporary enclosures within ten (10) feet of new or existing construction must conform to OSHA requirements. These shall be of fireproof construction and contain a two (2) gallon fire extinguisher. A 50-gallon refuse container shall be placed immediately outside the door.
 - d. Temporary offices and similar construction: For temporary offices, fabrication shops, storage sheds and similar construction, provide standard prefabricated or mobile units or the equivalent job-build construction. Provide insulated, weathertight units, that are heated or air-conditioned where indicated, with lockable entrances, operable windows, roofing, foundations adequate for normal loading, including wind loads, serviceable finishes, and mechanical and electrical equipment necessary to achieve ambient conditions indicated.
 2. The General Trades Contractor shall provide and equip a separate room for the Owner and the Architect's sole use:
 - a. Area: 150 square feet, total.

- b. Furnishings: 1 desk; 3 chairs, 1 - 4 drawer file cabinets; plan rack; one sample rack; one plan reference table.
3. Build such structures of neat and orderly, weathertight materials and construction, comfortably heated and ventilated and adequately provided with electric lighting and toilet facilities.
4. Provide telephone service as required and include costs for service and dial 1 calls. Long distance calls will be paid by user.
- D. Each contractor shall assume full responsibility for building security during construction. As soon as building is enclosed, provide and maintain temporary doors, locked against unauthorized trespass. See "Hardware" for temporary key control.
- E. Each contractor shall repair and replace all structures, including curbing, walks, paving or street road surfaces that is damaged or destroyed by its construction operations.
- F. Delivery, Storage, handling all contractors and sub contractors:
 1. The contractor shall be responsible for the cost of delivery of all materials and equipment pertaining to the work. Location of contractor's items of plant and tools such as booms, hoist towers, mixers, cutters, etc. shall be approved in advance by the Architect.
 2. All materials shall be carefully handled and protected during loading, delivery, unloading, storage, etc., until installed in place. Material shall be stored as directed and located by the Architect. No materials, apparatus, plant or vehicles shall be stored or parked on sidewalks, roadways, parking areas beyond the limits specified on the drawings or as directed by the opportunity for the introduction and storage or their materials and equipment and the execution of their work.
 3. Any movement of stored materials necessitated by progress of the work, as directed by the Architect, will be accomplished promptly by the appropriate contractor at no extra cost to the Owner.
 4. The contractors shall be responsible for cost of expediting all fabrication and delivery of its materials.
 5. Deliveries of materials to the site by the contractors, their sub-contractors, or their suppliers shall be coordinated in advance by the Contractor with the crane or hoist contractor to prevent conflicts with work or deliveries of other contractors.
 6. Any materials which cannot be received on site will be stored off site per the above paragraphs in a place paid for by the appropriate contractor at no extra cost to the Owner, until they can be received on the site for storage or installation.

1.5 CONSTRUCTION OPERATIONS

A. Safety Program:

1. In order to protect the lives and health of its employees under the contract, each contractor shall comply with all pertinent provisions of the construction safety act applicable at the place of performance of that portion of the work as it pertains to health and safety standards; and shall maintain an accurate record of all cases of death,

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occupational disease, and injury requiring medical attention or loss of time from work, arising out of an in the course of employment on work under the contract. Each contractor alone shall be responsible for the safety, efficiency, and adequacy of its plant, appliances, and methods and for all damage which may result from their failure or their improper construction, maintenance, or operation.

2. Comply with all safety requirements specified in other sections of these specifications.
 3. The Superintendent on the work for the contractor shall be in charge of, and be responsible for, complying with all safety regulations.
 4. The contractor shall hold weekly safety meetings with its workmen and submit minutes to the Architect.
 5. Provide in the field office all articles necessary for first aid treatment.
 6. Make arrangements with the nearest hospital for treatment of anyone seriously injured at the site.
- B. Dewatering:
1. Dewatering, as required, to allow the work to proceed uninterrupted will be the responsibility of the Contractor. All required dewatering will continue until completion of the contract.
- C. Parking:
1. There will be parking provided for construction personnel at the job site. This parking will be provided and maintained by the Contractor with allowances for reasonable dislocation to permit installation or permanent parking lots.
- D. Protection:
1. Each contractor will take appropriate precautions to prevent any damage to the work of any other contractor.
 2. All damage which may be caused to another contractor's work, will be repaired at the damaging contractor's own expense. The Owner shall not be held liable for any acts or omissions of any contractor involved in the construction program.
 3. Each contractor shall be responsible for protection of its own work against vandalism, theft and weather, for materials and apparatus under this contract.
 4. If any contractor considers it necessary to have watchman service for its own interest, then it shall provide such service at its own expense.
 5. The contractor performing work which gave rise to the necessity shall provide and maintain guard lights at all barricades, railings, obstructions in the streets or sidewalks or similar protective devices.
 6. Fire Protection:
 - a. Secure approval of the local fire department as required.

- b. The Superintendent of Construction for the contractor shall be responsible for the prevention of fire and shall formulate plans and instruct all workmen in emergency action.
 - 7. Each contractor shall remove all snow and ice as may be required for the proper protection and execution of its work.
 - E. Supervision and Coordination of Work:
 - 1. Each contractor is required to provide a superintendent on site during the period of time it is working on the job. This superintendent will be empowered to make decisions and to make commitments for the contractor regarding the conduct of the work.
 - 2. Each superintendent will be experienced in similar work and be capable of scheduling and coordinating the contract work.
 - F. Daily Construction Reports:
 - 1. All contractors will be required to submit a daily construction report by 12:00 noon or the following day on a form designated by the Architect. Report shall indicate number of workers by trade or craft, type and location of work. It will include subcontractors, and other information, as requested by the Architect.
 - 2. Each contractor shall furnish its own forms and submit two copies of each report.
 - G. Temporary Telephones:
 - 1. Temporary phones will be provided by each contractor for use by its personnel. No temporary telephones will be permitted within the new building without prior approval.
 - H. Each contractor shall prevent an accumulation of mud on wheels of vehicles from being deposited on any street or roadway. Any contractor violating the requirement shall clean the streets and roadways, at its own expense, as directed.
- 1.6 TEMPORARY ROADS AND PAVING
- A. General: To the fullest extent possible, locate temporary roads and paving for storage areas and temporary parking, in the same locations as permanent facilities for similar uses. To incorporate temporary paving provisions, review significant modifications of permanent paving requirements with the Architect/Engineer for acceptance of the proposed improvements.
 - 1. Coordinate development of temporary roads and paved areas with grading and the compaction of the subgrade, installation and stabilization of the subbase and installation of the base and finish courses of permanent paving. Coordinate development in a manner that will minimize exposure of incomplete work to deterioration and the need to rework installations, that will provide adequate temporary roads and paving during the course of the work, and that will result in completion of permanent roads and paved areas in a manner that will be new in appearance and without damage or deterioration at the time of the Owner's occupancy.
 - 2. Delay installation of the final course of permanent asphalt concrete paving in areas exposed to temporary use, until immediately before substantial completion. Coordinate with normal weather conditions to avoid unsatisfactory results.

3. Extend temporary paving in and around the site construction area as necessary to accommodate the following:
 - a. Delivery and storage of materials.
 - b. Fabrication operations.
 - c. Use of equipment, including truck cranes.
 - d. Mock-ups.
 - e. Testing operations.
 - f. Administration and supervision.
 - g. Safety and protection activities.
 4. Provide temporary traffic control facilities at the junction of temporary roads with public roads, including warning signs for public traffic and "STOP" signs for the access road entrance onto public roads. Comply with requirements and recommendations of local traffic authorities.
- B. Paving: Construct and maintain temporary roads and paving to support indicated loading and to withstand exposure to traffic during construction period.
1. Provide a reasonably level, graded and well drained subgrade of satisfactory soil material, as defined in Division 2 sections, well compacted to not less than 95% of maximum dry density in the top 6".
 2. Provide gravel paving course of a well graded subbase material not less than 3" thick, roller compacted to a level, smooth, dense surface.
 3. Provide a dust control treatment consisting of a "Road Oil" or other petro-chemical compound known to be non-polluting and non-tracking.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Unless, and until, otherwise provided, each contractor shall:
1. Provide temporary water, electrical service, telephone, and sanitary facilities immediately after starting work and maintain until use of corresponding permanent services are authorized.
 - a. With the establishment of the job progress schedule, each prime contractor shall establish a schedule for implementation and termination of service for each temporary utility. At the earliest feasible time, and when acceptable to the owner and Architect/Engineer, change over from use of temporary utility service to use of the permanent service, to enable removal of temporary utilities and to eliminate possible interference with completion of the work.
 - b. Self-contained toilet units: Provide single occupant, self contained toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with glass fiber reinforced polyester shell or similar non-absorbent material.

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2. Be responsible for the proper operation, maintenance and protection of all utility systems on the project.
 - a. Temporary use of permanent facilities: Regardless of previously assigned responsibilities for temporary services and facilities, the installer of each permanent service or facility shall assume responsibility for its operation, maintenance and protection during use as a construction service of facility prior to the Owner's acceptance and operation of the facility.
 3. Provide the amount and type of temporary utilities and facilities required by law.
 4. The count of employees estimated to be on the site shall include a reasonable allowance for others performing independent services of the Owner. Facilities shall be available to all persons.
 5. Conditions of use: Operate temporary services and facilities in a safe and efficient manner. Do not overload, and do not permit temporary services and facilities to interfere with the progress of work. Do not allow unsanitary conditions, public nuisances or hazardous conditions to develop or persist on the site.
 6. Provide daily janitorial services for temporary offices, first aid stations, toilets, wash facilities, lunchrooms and similar areas. Require users of other temporary facilities to help maintain a clean and orderly premises.
- B. Light and Power:
1. The Electrical Contractor shall, as soon as possible after the notice to proceed, provide temporary light and power for construction purposes for all trades for the duration of the work, including the cost of running temporary service from the utility supply. The Electrical Contractor shall provide temporary poles and transformer and make arrangements for and make the connection to the existing power source. The installation, maintenance, relocation, and removal of these services and the cost of all related materials, and meters will be included. Electrical contract will also include the cost of any service and transformers supplied by the local Electric Company to provide temporary light and power.
 2. The Electrical Contractor shall install an electric meter arranged to meter all current being supplied for construction work. The Electrical Contractor's responsibility for the cost of temporary services will terminate only upon the date of Owner approval and acceptance of the permanent systems and the acceptance of the building.
 3. The electrical requirements for all temporary heating and ventilating systems shall be connected directly to the project temporary power system by the Electrical Contractor.
 4. The electrical work for construction purposes shall conform to all Federal and State Safety Requirements, as well as requirements of the National Electric Code. The Electrical Contractor shall obtain and pay for required applications, permits, and inspection pertaining to this work. This cost shall also be included in the contractor's price.
 5. Service shall consist of distribution systems, panelboards, grounding, branch circuits, switches, receptacle outlets and all other labor and materials necessary to provide a complete operating system.

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6. Temporary wiring shall be laid out, balanced, and sized so as to produce a voltage drop of no more than five percent at the extreme end of the line when operating at full load.
 7. Temporary power shall include 480 volts, 3 phase for distribution motors up to 7-1/2 HP and welding machines. Use transformers and panelboard to convert the power of 120/108 volt, 1 phase for lighting. There will be a minimum of one step-down station.
 8. Temporary lighting distribution will be made from the temporary panels indicated above. From the panel, circuit wiring with "pigtail" medium base lamps will distribute lighting on the basis of 1/4 watt per square foot average for the construction area. Each circuit will consist of ten "pigtail" receptacles on 20 foot centers, and 100 watt lamps will be installed in every other receptacle leaving the alternate receptacle for added concentration of lighting as needed. Fixtures shall be wired with #8 AWG wire and suspended not less than 7 feet 6 inches above the floor.
 9. As interior partitions are erected, this contractor shall revise the temporary lighting arrangements so that not less than one lamp is provided in each space over one hundred square feet in area.
 10. In addition to the specific requirements indicated herein, provide both 240 volt and 120 volt power receptacles. Provide four 20 amp duplex outlets for 120 volt service, and two 30 amp duplex outlets for 240 volt, 3 phase service.
 11. Each trade shall provide and pay for its own extensions for lights or power tools beyond the receptacle outlets provided above.
 12. The Electrical Contractor shall furnish and install 100 watt lamps for general circuit lighting and all fuses as may be required for a complete job. Replacement of lamps, fuses, including theft, will be the responsibility of the Electrical Contractor throughout the life of the project.
 13. Provide local switching of temporary lighting, spaced to allow lighting to be turned off in patterns to conserve energy, retain light suitable for work-in-progress, access traffic, security check and project lock-up.
- C. Temporary Water:
1. Water Service Use Charges: The Contractor for general work shall pay water service use charges, whether metered or otherwise, for water used by all entities authorized to be at or to perform work at the project site. The Contractor for General Work shall exercise control over water use in an effort to conserve water.
 2. Initially, temporary water for personnel and construction purposes will be provided by the individual contractors requiring this water. The Owner will not furnish any water. Any water necessary for construction purposes must be provided by the contractor.
 3. The Plumbing Contractor shall immediately at the start of its contract furnish and install a pump of sufficient capacity to maintain between 45 and 60 lb. pressure. Pump shall be located as directed and shall be maintained throughout the construction time until removal is ordered.
 4. As soon as the structural slabs are in place the Plumbing Contractor shall furnish and install temporary flushing toilets. These toilets will replace portable toilets. Each water closet shall be in an individual compartment with a door.

5. The fixed temporary toilets are cleaned and maintained by the Contractor, but plumbing maintenance such as stoppages, leaks or freeze-ups shall be the responsibility of the Plumbing Contractor.

3.2 WEATHER PROTECTION AND ENCLOSING THE BUILDING

A. Definitions:

1. Weather Protection: Protective covers and enclosures required for protection against extremes of hot or cold temperatures and precipitation, for protection from wind blown water, sand, dust, other foreign material; shelter from sun or rapid drying; portable heaters to prevent freezing of materials, work in place, and the subgrade below building structures.
2. After excavation, the Contractor shall provide weather protection including supplementary heat as necessary to prevent freezing of concrete and masonry until cured, and to prevent freezing of sub-grade within the building limits until Temporary Heat is in operation.
3. Whenever mean daily temperature is less than 40 degrees F., the Concrete Contractor and the Masonry Contractor shall provide temporary measures to permit respective scheduled work to continue. Provide portable heaters to maintain temperatures above 50 degrees F., during working hours, and not less than 40 degrees F. outside of working hours, or during times when no work is performed. Provide fuel, service and attendance for portable heaters.
4. Heating devices shall be properly shielded and vented to protect adjacent work from excessive heat. Open fires or salamanders are not permitted with enclosures.
5. The same requirements apply for the protection of finished work in vacant enclosed areas as would be required by law if workmen were present.

B. Enclosing the Building:

1. As the schedule permits and as each portion of the building becomes enclosed, each contractor shall be responsible to remove its temporary weather protection enclosures.
2. Weather protection for the work prior to the building being permanently enclosed with cold weather protection is each contractor's responsibility. Each contractor shall provide at its own expense all cold weather protection as required to carry on its work expeditiously during inclement weather and to protect all its work and materials from damage by the weather.

- #### C. Fuel and Maintenance:
- Prior to installation of temporary heat each contractor shall take all necessary precautions to ensure that heat will be maintained as specified without undue loss of heat and that all equipment and fuel is provided and stored in a legal manner.

3.3 TEMPORARY HEAT AFTER ENCLOSING THE BUILDING

A. General:

1. The term "Temporary Heat After Enclosing Building" shall mean all heating required in any portion of the building after it has been enclosed.

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2. Temporary heat after enclosing building shall be provided and maintained, as set forth herein, to properly protect all parts of the building against damage for the duration of each heating season occurring during the entire construction period until the date of Substantial Completion.
 3. The HVAC Contractor shall be responsible for continuously maintaining temporary heat after enclosing the new buildings or portions hereof, in accordance with the stipulations and the requirements called for hereinafter, at the temperatures noted:
 - a. Areas which are not ready for the installation of Interior Finishes and Millwork, as set forth below, shall be continuously maintained at not less than 50 degrees F.
 - b. Areas which are ready for installation of interior finishes, such as resilient flooring, plastic floors, ceramic and quarry tile, lathing and plastering and other finishes as specified shall be continuously maintained at the temperature and for the period called for in the applicable Specification Section.
 - c. Areas which are ready for the installation of millwork and other finish materials that are affected by unstable humidity and temperature conditions, such as wood doors, architectural woodwork items, and acoustical tile, shall be continuously maintained at a temperature of not less than 65°F., and relative humidity of not more than 55 percent, for a period commencing 10 calendar days prior to the start of the installation of such millwork and other finish material and terminating at the date of Substantial Completion.
 4. All equipment and fuel shall be provided and stored in a legal manner. Maintain ventilation at not less than legal minimum condition in all accessible areas including times when workmen are not present.
 5. Gas Service Use Charges: The Contractor for General Work shall pay gas service use charges for gas used by entities authorized to be at or to perform work at the project site. The Contractor for General Work shall exercise control over gas use in an effort to conserve energy.
- B. The HVAC Contractor shall:
1. Provide, maintain and operate the "temporary heat" system in accordance with stipulations called for herein after the building, or portions thereof, have been enclosed and continue to do so for the entire term of the Contract.
 2. Provide all materials, labor, equipment, maintenance, permits, inspections, special operators, both on and off the site, and assume responsibility for damages to the mechanical work due to heat resulting from the operation of the temporary heating system. The mechanical work affected by the above shall be removed and replaced by the HVAC Contractor to the satisfaction of the Architect and at no cost to the Owner.
 3. Provide an attendant of proper trade or trades 7 days a week and provide normal and emergency service 7 days a week, 24 hours a day, whenever required to maintain "temporary heat" after the buildings, or portions thereof, are enclosed. Such service shall continue throughout each heating season until the date of Substantial Completion.
 4. Assume full responsibility for the temporary heating system and for its proper operation and maintenance, including portions of the permanent heating system approved by the Architect for use as temporary heat.

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5. Exercise complete control over the adequacy of heat, ventilation and proper drying out of the work in the new buildings or any portion thereof, for the entire construction period until date of Substantial Completion. All of the Work damaged by dirt, abuses, cold or dampness, or by insufficient or abnormal heat, shall be removed and replaced to restore a new condition as specified.
6. Provide supplementary ventilation as required to reduce humidity and to provide proper drying and prevent damage to materials from excess moisture.
7. The temporary heating and ventilation units shall be arranged to bring in sufficient outdoor air (minimum 1 to 1-1/2 air changes per hour) to ventilate the building, to prevent build-up of harmful dust and fumes, and to remove excess moisture, dust, and fumes from paints solvents, or adhesives in tightly enclosed areas where natural ventilation will not be sufficient.
8. Heat and air shall be supplied in a manner which shall avoid the rapid drying of material but thoroughly dry to such an extent that no remaining moisture will affect finish material.
9. All costs attributable to providing temporary heat as herein described shall be borne by the HVAC Contractor, including costs of providing and installing all valves, traps, space heating units used temporarily, including wages of all required operating personnel and all costs for any temporary electrical controls and connections required, including costs for maintenance, operation and supervision of same.
10. When the permanent ventilating system is used in the final stages of construction for supplemental temporary ventilating, the HVAC Contractor shall assume full responsibility for maintaining such equipment, during and after use in no less than first class condition. Heating Contractor shall pay for any electrical wiring connections for by-passing permanent power service and for making connections or reconnections to temporary power circuits.

C. Responsibilities:

1. The Owner will provide fuel and electrical energy from the time of Substantial Completion to Final Completion.
2. The Heating, Ventilating and Air Conditioning Contractor shall arrange for the fuel billing to be in the name of, and shall have the bill sent to, the General Contractor.

3.4 PROJECT SIGN

- A. The design for the project sign will be provided by the Architect.
- B. Upon completion of the project, the Safety and Clean-up Contractor shall remove and dispose of sign.
- C. Except for warning and other signs required by law and ordinances, place no other signs or advertisement on the construction site.
- D. Allow \$2,500.00 for 8 ft. by 12 ft. sign.

3.5 DUST CONTROL

- A. Each contractor, as applicable, for the duration of the Contract, shall maintain all excavations, embankments, haul roads, access roads, plant sites, waste disposal areas, borrow areas, and all other work areas free from dust, as determined by the Architect.
- B. Industry-accepted methods of dust control suitable to the area involved, such as sprinkling, chemical treatment, light bituminous treatment or similar methods are acceptable.
- C. All temporary partitions, bulkheads and similar enclosures at finish areas shall be dust tight.

3.6 WATER POLLUTION

- A. Each contractor shall provide satisfactory facilities to prevent the introduction of any substances or materials into any body of water including ground water which may pollute the water or constitute substances or materials deleterious to life.

3.7 AIR POLLUTION

- A. Each contractor shall perform its work as not to discharge into the atmosphere from any source whatever smoke, dust, or other air contaminants in violation of the laws, rules, and regulations of the governmental entities having jurisdiction.

3.8 ELECTRONIC PHOTOGRAPHS

- A. The Contractor shall provide a complete photographic record of the project. Each photograph shall be in digital format with the name of the view clearly identified in the lower right hand corner. Identification shall include the contractor's name, project name, project number, diagrammatic orientation of the view to the project layout, the date, etc.
- B. The initial submittal shall contain four (4) or more views of the site of the work adequately depicting its condition and any special conditions pertinent to the contract at the time the contractor is awarded custody and control of the premises or any part thereof. Provide subsequent photographs when they are requested by the Architect as it deems necessary to record the progress of the various parts of the work, special conditions which could lead to litigation, other significant conditions affecting the project, notable construction details, damages.
- C. Electronic photographs shall be submitted with each invoice, and shall include four (4) or more views of the work sufficient to depict clearly the progress of the work being represented by the invoice including interior views as appropriate. These photographs shall have been taken within five (5) days of the first of each month. At completion of the work, and prior to final payment, furnish photographs of all the principle views of the work, including both exterior and interior.
- D. No other photographs will be permitted.
- E. Provide complete photographic survey of adjacent structures. Photographs shall be dated and recorded in sufficient detail to determine exact detail and accurate time record of all alleged damage.

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.

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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

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 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 23 thru 26 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 and retaining walls.
 - c. Structural concrete.
 - d. Structural steel.
 - e. Lintels.
 - f. Timber and primary wood framing.
 - g. Structural decking.
 - h. Miscellaneous structural metals.
 - i. Shoring, bracing and sheeting.
 - j. Structural systems of special construction in Division 13 Sections.
- 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 results 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.
 - g. Operating systems of special construction in Division 13 Sections.
- 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 results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain-wall 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. Processed concrete finishes.
 - b. Roofing.
 - c. Firestopping.
 - d. Window wall system.
 - e. Swimming pool finishes.
- 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.

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.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 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.

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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 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.

END OF SECTION

CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for Cleaning Up during construction and upon completion of the Work.

1.2 CLEANING UP - GENERAL MAINTENANCE

- A. During the entire construction period, each Contractor, Subcontractor, and other persons at the site when performing any work with their own forces, shall collect and deposit trash such as waste materials, packaging materials, and other rubbish accumulated in connection with the execution of their work to locations and containers located by the General Contractor shall remove trash daily from those locations and shall be responsible for removal of trash from the site and legal disposal thereof. No rubbish shall be allowed to remain on the floors overnight.
- B. Additional responsibilities:
 - 1. Maintain the Site and all of the Work in an orderly and clean condition at all times.
 - 2. Keep all floors, roads, sidewalks, pavements and parking areas free from accumulation of dirt, rubbish, general refuse, water, snow and ice at all times.
 - 3. Keep all roof areas clean and free from accumulation of dirt, rubbish, and general refuse at all times.
 - 4. Broom clean the floors of dirt, rubbish, and general refuse in the interior of structures when necessary and practicable, or as directed by the Architect, and take all precautions to avoid dust accumulation on completed Work.
- C. Other contractors and other persons at the site shall cooperate with the contractor and each shall use reasonable diligence and shall make every effort, in connection with their Work, to avoid excessive dirt, rubbish and general refuse thereof required herein of the Contractor.
- D. Other contractors and subcontractors shall keep their materials in proper storage arrangement at all times; otherwise the Contractor, when cleaning the interior of structures or the Site as required herein shall have the right to remove scattered material at such contractor or subcontractor's expense.
- E. No charges shall be made by the Contractor to the Owner for any cleaning work required herein, unless done pursuant to a prior written order. All charges against other contractors require prior approval by the Architect.
- F. Each contractor and his subcontractors shall remove from the Site all tools, scaffolding, surplus materials and all temporary work and structures upon completion of the Work and shall leave the Work and the Site clean and acceptable to the Architect.
- G. Upon completion of installation of each portion of the work, and with the approval of the Architect, each contractor shall remove all temporary protective coverings from all exposed surfaces of its portion of the Work and clean these surfaces of all soil and discoloration ready for acceptance.

1.3 CLEANING UP - GENERAL BUILDING AND GLASS CLEANING

- A. Immediately before turning completed portion of the Work over to Owner, the Contractor shall have all glass cleaned by professional window washers. Care shall be taken not to scratch glass or to use any acid or any other material which could injure or mar the glass surface or adjacent work. All damage shall be made good, including the replacement of glass and other work damaged or disturbed, in accordance with Contract Documents.
- B. Mortar deposits or cement runoff shall not be allowed to remain on glass during construction.
- C. The Safety and Clean-Up Contractor shall:
 - 1. Wash glass at least monthly during construction or otherwise protect as required to prevent etching by alkali or other chemicals, in accordance with published recommendations of glass manufacturer.
 - 2. Clean metal, masonry, and glass using procedures and materials recommended by the manufacturer of the particular material being cleaned. Do all cleaning immediately before application of sealers or coatings where specified.
 - 3. Submit to the Architect, for approval, list of major chemical components of all cleaning compounds used for building cleaning or finish cleaning of any portion of the work. If the chemical formulation is not available, submit a written warranty that the material will not damage building or paving.
 - 4. Ensure that run-off and salts from cleaning materials shall be directed away and not permitted to accumulate in planting areas. Coordinated work so that cleaning work is completed before topsoil is placed in planters adjacent to the building.
- D. Each Contractor will be required to supply his drum containers for the depositing of miscellaneous trash generated within the Contractor's office and shanty areas. This includes any space used by a Contractor's personnel within the building for coffee breaks and meals. Each Contractor will also be responsible for keeping these areas clean and sanitary. The containers shall be emptied by the Contractor as required.
- E. All waste material which can be broken down (i.e., cardboard cartons, wooden boxes, discarded shipping containers) shall be broken down and neatly stacked by the responsible Contractor, in a location as directed for pick-up by the Contractor.
- F. The offices of the Owner and the Architect shall be maintained in a clean and orderly condition at all times by the Contractor

1.4 RESTORATION OF SITE

- A. At completion of the work, all areas adjacent to the actual work which have been disturbed due to these operations, and the alteration or restoration of which is not specifically included in any section of the specifications, shall be restored to the original condition by the Contractor(s) and Subcontractors whose operations caused the disturbance. This shall include removal and replacement of damaged paving, sidewalks, curbs, lawn areas, shrubbery and plantings and any other incidental items.
- B. At completion, all temporary utility poles, under or above ground utility lines and similar items shall be removed and the areas restored as above.

- C. Restoration work shall be in accordance with the requirements of these specifications for similar or adjacent work where such exist, otherwise work shall be as directed by the Architect.

1.5 ADJACENT MUNICIPAL OR PRIVATE PROPERTY

- A. At completion of the work any areas of adjacent municipal or private property which are damaged or disturbed as a result of the operations under this contract shall be corrected or replaced.
- B. Corrective work on municipal property shall be in accordance with requirements of the Architect and municipal authority having jurisdiction.
- C. Corrective work on private property generally shall be in accordance with requirements of work of a similar nature under this contract, and shall be at least equal to the adjacent undamaged surfaces. All such work shall be carried out to the satisfaction of the Architect, the Owner of the property, and the municipal authority having jurisdiction.

1.6 FINAL CLEAN-UP

- A. Upon completion of the work or of an individual section thereof, the Contractor, immediately prior to turning over the work or the completed portion thereof to the Owner, shall arrange for the proper and complete performance of the following:
 - 1. Removal of paint spillage or overspray, smeared caulking or sealing compounds and similar defects, from all finish surfaces including mechanical and electrical devices and equipment.
 - 2. Removal and replacement of caulking or sealant beads not properly adhering to substrate.
 - 3. Removal of temporary coverings in applied floor finish areas and final, thorough broom cleaning of all finished floors. If final broom cleaning does not, in the opinion of the Development Manager, provide a floor surface which is suitable for moving in of the Owner's equipment, scrub and polish or otherwise refinish areas as directed until acceptable to the Development Manager.
 - 4. Reconditioning of permanent ventilating equipment used for provision of temporary ventilation during construction, including replacement of all filter elements.
 - 5. Restoration of previously finished surfaces damaged due to failure or removal of protective measures.
 - 6. Cleaning by washing of all soiled concrete walls where exposed.
 - 7. Replacement of all burned-out light bulbs, tubes, fuses, etc., related to new construction.
- B. In addition to the above and upon completion of the work, or of an individual section thereof, the Contractor, immediately prior to turning over the work or the completed portions thereof to the Owner, shall arrange for the proper and complete performance of the following:
 - 1. Cleaning and polishing of all glass and mirrors, and replacement of any broken items.

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2. Cleaning and polishing of finish hardware, and adjustment of closers, holders, locksets, etc., as required for proper operation.
3. Removal of fingerprints, soot smudges and similar deposits from finished surface.

****END OF SECTION****

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for Completion of Work prerequisites for Project close-out.

1.2 SUBSTANTIAL COMPLETION

- A. Each Contractor shall submit written certification to the Owner that project or designated portion of project is substantially complete.
- B. The Owner and the Architect will make an inspection within seven days after receipt of certification.
- C. Should the Owner and the Architect consider that work is substantially complete:
1. Contractor shall prepare, and submit to the Architect, a list of items to be corrected, as determined by the inspection.
 2. The Architect will prepare and issue a Certificate of Substantial Completion, AIA Document G704, complete with signatures of Owner and Contractor, accompanied by Contractor's list to items to be completed or corrected as verified and amended by the Architect.
 3. Owner occupancy of project or designated portion of project:
 - a. Contractor shall:
 - 1) Apply for Certification of Occupancy
 - 2) Direct final cleaning
 - b. Owner will occupy Project, under provisions stated in Certificate of Substantial Completion.
 - c. Contractor: Complete work listed for completion or correction, within designated time.
 - d. Should the Architect consider that work is not substantially complete:
 - 1) The Architect shall immediately notify the Contractor, in writing, stating reasons.
 - 2) The Contractor shall complete work, and submit written notice, certifying that the project or designated portion of the project, is substantially complete.
 - 3) The Architect will reinspect work.

1.3 FINAL INSPECTION

- A. The Contractor shall submit written certification that:
1. The Contract Documents have been reviewed.

2. The Work has been completed and inspected in accordance with the Contract Documents.
3. Equipment and systems have been tested in presence of the Contractor and are operational.
4. The Project is completed, and ready for final inspection.
5. The Architect will make final inspection after receipt of certification.
6. Should the Architect consider that work is finally complete in accordance with requirements of Contract Documents they shall request project closeout submittals from the Contractor.
7. Should they consider that work is not finally complete:
 - a. They shall notify Contractor, in writing, stating reasons.
 - b. The Contractor shall take immediate steps to remedy the stated deficiencies, and send second written notice certifying that work is complete.
 - c. The Architect will reinspect work.

1.4 SUBMITTALS

- A. Operation and Maintenance Manuals: As specified in respective sections.
- B. Test Reports: As specified in respective sections.
- C. Guarantees: Written guarantees where specified.

****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 a 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****

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Cast-in-place concrete includes the following:
 - 1. Foundations and footings.
 - 2. Slabs-on-grade.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section "Cement Concrete Pavement" for concrete walks.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for proprietary materials and items, including reinforcement and admixtures, and others if requested by Architect.
- C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.
- D. Laboratory test reports for concrete materials and mix design test.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
 - 4. ACI 302, "Guide for Concrete Floor and Slab Construction".

5. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials".
- B. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 and the following:
 1. At least 35 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to, the following:
 - a. Contractor's superintendent.
 - b. Agency responsible for concrete design mixes.
 - c. Agency responsible for field quality control.
 - d. Ready-mix concrete producer.
 - e. Concrete subcontractor.
 - f. Primary admixture manufacturers.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.
 1. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

- C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
 - 1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.
- B. Fly Ash: ASTM C 618, Type C.
- C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.
 - 1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
- D. Water: Potable.
- E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Air-Mix or Perma-Air, Euclid Chemical Co.
 - b. Darex AEA or Daravair, W.R. Grace & Co.
 - c. MB-VR or Micro-Air, Master Builders, Inc.
 - d. Sealtight AEA, W.R. Meadows, Inc.
- G. Water-Reducing Admixture: ASTM C 494, Type A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eucon WR-91, Euclid Chemical Co.
 - b. Daracem-55 W.R. Grace & Co.
 - c. Pozzololith Normal or Polyheed, Master Builders, Inc.
- H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eucon MR, Euclid Chemical Co.
 - b. WRDA 19 or Daracem, W.R. Grace & Co.
 - c. Rheobuild or Polyheed, Master Builders, Inc.
- I. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Accelguard 80, Euclid Chemical Co.
 - b. Daraset, W.R. Grace & Co.
 - c. Pozzutec 20, Master Builders, Inc.
- J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eucon Retarder 75, Euclid Chemical Co.
 - b. Daratard-17, W.R. Grace & Co.
 - c. Pozzolith R, Master Builders, Inc.
- A. Water Vapor Reducing Admixture: ASTM D5084, ASTM E1643, ASTM E1745.
- 1. Product: Vapor Lock 20/20 manufactured by Speciality Products Group (SPG) 6254 Skyway Road, PO Box 915, Smithville, ON LOR2AO, Canada (877-957-4626), or Barrier One High Performance Admixture (MVRA) as manufactured by Barrier One International.
 - 2. Substitutions will be considered subject to compliance with the requirements of this section.
 - 3. Description: 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 emission by integrally and permanently closing the capillary system in the concrete with the following characteristics:
 - a. Waterproofing: Minimum 1×10^{-8} cm/s in accordance with ASTM D5085.
 - b. Toxicity: None
 - c. Solvent: Water
 - d. Acid Resistance: Excellent
 - e. Hazardous Vapors: None
 - f. Capillary Break: Calcium Hydrate
 - g. VOC Levels: 0

2.4 RELATED MATERIALS

- A. Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:
- 1. Polyethylene sheet not less than 8 mils thick.
- B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
- 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. Polyethylene-coated burlap.
- C. Concrete Sealer: Sealer for interior exposed concrete slabs. Prior to application of sealer, cure concrete according to manufacturer's recommendations.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Day-Chem Sure Hard (J17), Dayton Superior.
 - b. Intraseal, Conspec Marketing and Mfg. Co.

- D. Bonding Agent: Polyvinyl acetate or acrylic base.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Polyvinyl Acetate (Interior Only):
 - 1) Superior Concrete Bonder, (J-41) Dayton Superior Corp.
 - 2) Euco Weld, Euclid Chemical Co.
 - 3) Everweld, L&M Construction Chemicals, Inc.
 - b. Acrylic or Styrene Butadiene:
 - 1) Day-Chem Ad Bond, Dayton Superior Corp.
 - 2) SBR Latex, Euclid Chemical Co.
 - 3) Daraweld C, W.R. Grace & Co.
 - 4) Everbond, L&M Construction Chemicals, Inc.
 - 5) Acryl-Set, Master Builders Inc.
- E. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Resi-Bond (J-58), Dayton Superior.
 - b. Euco Epoxy System #452 or #620, Euclid Chemical Co.
 - c. Epabond, L&M Construction Chemicals, Inc.
 - d. Concesive Standard Liquid, Master Builders, Inc.
 - e. Rezi-Weld 1000, W.R. Meadows, Inc.
- F. Underlayment Compound: Free-flowing, self-leveling, pumpable, cement-based compound for applications from 1 inch thick to feathered edges.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. K-15, Ardex, Inc.
 - b. Levelayer I L&M Construction Chemicals, Inc.
 - c. Underlayment 110, Master Builders, Inc.
- G. Waterstops: Provide a flexible butyl rubber and swellable clay waterproofing compound at all construction joints in concrete walls below grade.
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Waterstop RX-101; Cetco.
 - b. Swellstop Waterstop; Greenstreak.

2.5 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
1. Do not use the same testing agency for field quality control testing.

2. Limit use of fly ash to not exceed 20 percent of cement content by weight.
- B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect.
- C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:
1. 4000-psi, 28-day compressive strength; water-cement ratio, 0.44 (air-entrained).
 2. 3500 psi, 28-day compressive strength; water-cement ratio 0.53. Do not allow air content of troweled finished floors to exceed 3 percent. Provide Water Vapor Reducing Admixture: Vapor Lock 20/20 or Barrier One High Performance Admixture.
 3. 3000-psi, 28-day compressive strength; water-cement ratio, 0.58 maximum (non-air-entrained).
- D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
 2. Reinforced foundation systems: Not less than 2 inches and not more than 4 inches.
 3. Concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site-verified 2-to-4-inch slump concrete.
 4. Other concrete: Not more than 4 inches.
- E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

2.6 ADMIXTURES

- A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
- B. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:
 - a. 5.5 percent for 1-1/2-inch maximum aggregate.
 - b. 6.0 percent for 1-inch maximum aggregate.
 - c. 6.0 percent for 3/4-inch maximum aggregate.
 - d. 7.0 percent for 1/2-inch maximum aggregate.
 2. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.

- C. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.
 - 1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3- EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMS

- A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
 - 1. Provide Class A tolerances for concrete surfaces exposed to view.
 - 2. Provide Class C tolerances for other concrete surfaces.
- B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.
- D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

- F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER/BARRIER INSTALLATION

- A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.
- B. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape.

3.4 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.
 - 1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect.
- D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect.
- B. Provide keyways at least 1-1/2 inches deep in construction joints slabs, Bulkheads designed and accepted for this purpose may be used for slabs.
- C. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

3.6 INSTALLING EMBEDDED ITEMS

- A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.
- B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARING FORM SURFACES

- A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.
- B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.
 - 1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators 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 set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.
- E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
 2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 3. Maintain reinforcing in proper position on chairs during concrete placement.
- F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- G. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C) and not more than 80°F (27°C) at point of placement.
1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90°F (32°C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.
- B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

- C. 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 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.
 - 1. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.
 - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to the following tolerances of F(F) (floor flatness) and F(L) (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
 - a. F (F) 20, local F (F) 15
 - b. F (L) 15, local F (L) 10
- C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.
 - 1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to the following tolerances of F(F) (floor flatness) and F(L) (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.
 - a. Floor slabs to receive wood flooring:
 - 1) F (F) 50, local F (F) 25.
 - 2) F (L) 30, local F (L) 15.
 - b. Typical Floor Slabs:
 - 1) F (F) 30, local F (F) 15.
 - 2) F (L) 20, local F (L) 10.

- D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.
- E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, 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 shown or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.12 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Curing Methods: Cure concrete by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.
- D. Provide moisture curing by the following methods:
 - 1. Keep concrete surface continuously wet by covering with water.
 - 2. Use continuous water-fog spray.
 - 3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.
- E. Provide moisture-retaining cover curing as follows:
 - 1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- F. Curing Formed Surfaces: Cure formed concrete surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

- G. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.
 - 1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.13 REMOVING FORMS

- A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

3.14 REUSING FORMS

- A. 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-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Architect.

3.15 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Architect.
- B. Mix dry-pack mortar, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.
 - 1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
 - 2. For surfaces exposed to view, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas 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.
- C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.
 - 1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

- D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.
1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
 3. Correct low areas in unformed surfaces 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. Proprietary underlayment compounds may be used when acceptable to Architect.
 4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- E. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- F. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.
- G. Repair methods not specified above may be used, subject to acceptance of Architect.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. General: The Owner will employ a testing agency to perform tests and to submit test reports.
- B. Measure floor finish tolerances in accordance with ASTM E1155 Standard Test Method for determining floor flatness and levelness using the F-number system.
- C. Sampling and testing for quality control during concrete placement may include the following, as directed by Architect.
1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

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- b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
 - d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
 3. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.
 4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
- D. Test results will be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- F. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

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. Decorative concrete masonry units.
3. Pre-faced concrete masonry units.
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry-joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.

B. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Division 05 Section "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Division 07 Section "Sheet Metal Flashing and Trim" for **exposed** sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
4. Division 07 Section "Firestop Joint Systems" for head-of-wall joints.
5. Division 08 Section "Standard Steel Doors and Frames" for hollow metal frames in unit masonry openings.
6. Division 09 Section "Painting" for field-applied sealer at all exposed concrete masonry units.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
 - 3. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. [**Show elevations of reinforced walls.**]
 - 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
 - 1. Decorative CMUs, in the form of small-scale units.
 - 2. Pre-faced CMUs.
 - 3. Colored mortar.
- D. Samples for Verification: For each type and color of the following:
 - 1. **Decorative** CMUs.
 - 2. **Pigmented and colored-aggregate** mortar. Make Samples using same sand and mortar ingredients to be used on Project.
 - 3. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.

- C. Material Certificates: For each type and size of the following:
1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing according to ASTM C 67.
 - e. For masonry units **used in structural masonry**, include data and calculations establishing average net-area compressive strength of units.
 2. Integral water repellent used in CMUs.
 3. Cementitious materials. Include name of manufacturer, brand name, and type.
 4. Mortar admixtures.
 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 6. Grout mixes. Include description of type and proportions of ingredients.
 7. Reinforcing bars.
 8. Joint reinforcement.
 9. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar[**and grout**]. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. 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 TMS 602/ACI 530.1/ASCE 6.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for typical exterior wall in sizes approximately **48 inches (1200 mm)** long by **48 inches (1200 mm)** high by full thickness, accessories.
 - a. Include a sealant-filled joint at least **16 inches (400 mm)** long in exterior wall mockup.
2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of **24 inches (600 mm)** down both sides of walls, and hold cover securely in place.
 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of **24 inches (600 mm)** down face next to unconstructed wythe, and hold cover in place.

- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in **TMS 602/ACI 530.1/ASCE 6**.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is **40 deg F (4 deg C)** and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in **TMS 602/ACI 530.1/ASCE 6**.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
 - 2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within **20 feet (6 m)** vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Regional Materials: CMUs shall be manufactured within **500 miles (800 km)** of Project site from aggregates **and cement** that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide 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. Hollow Load bearing or Non-load bearing CMU: ASTM C 90.
 - 1. Manufacturers: Subject to compliance with requirements provide products from one of the following with no substitutions being considered:
 - a. Best Block Company.
 - b. Consumers Concrete Corp.
 - c. Fendt Builder's Supply, Inc.
 - d. Grand Blanc Cement Products.
 - e. Michigan Certified Products.
 - f. National Block Company.
 - 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of **2800 psi (19.3 MPa)**.
 - 3. Density Classification: Medium weight or Normal weight unless otherwise indicated.
 - 4. Size (Width): Manufactured to dimensions **3/8 inch (10 mm)** less than nominal dimensions.

5. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

D. Split Face CMUs: ASTM C 90.

1. Basis-of-Design Products: The design for decorative CMU 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.

- a. Type: Standard pattern, split-face finish.
- b. Manufacturer: T.B.D.
- c. Color: T.B.D.
- d. Acceptable manufacturers

- 1) Best Block Company.
- 2) Consumers Concrete Corp.
- 3) Fendt Builder's Supply, Inc.
- 4) Grand Blanc Cement Products.
- 5) Michigan Certified Products.
- 6) National Block Company.
- 7) Trenwyth Industries.

E. Ground Face CMUs: ASTM C 90.

1. Basis-of-Design Products: The design for decorative CMU 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.

- a. Type: ground-face finish.
- b. Manufacturer: T.B.D.
- c. Color: T.B.D.
- d. Acceptable manufacturers

- 1) Best Block Company.
- 2) Consumers Concrete Corp.
- 3) Fendt Builder's Supply, Inc.
- 4) Grand Blanc Cement Products.
- 5) Michigan Certified Products.
- 6) National Block Company.
- 7) Trenwyth Industries.

2.5 Concrete and Masonry LINTELS for Non-Bearing Walls

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.
- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.
- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars

placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- B. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Mortar Cement: ASTM C 1329/C 1329M.
 - 1. [Lafarge North America Inc](#)
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. [Solomon Colors, Inc.](#)
- G. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Colored Portland Cement-Lime Mix:
 - a. [Holcim \(US\) Inc.](#)
 - b. [Lafarge North America Inc](#)
 - 2. Colored Masonry Cement:
 - a. [Holcim \(US\) Inc.](#)
 - b. [Lafarge North America Inc](#)
 - 3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 - 4. Pigments shall not exceed 10 percent of portland cement by weight.
 - 5. Pigments shall not exceed 5 percent of mortar cement by weight.
- H. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

2. For joints less than **1/4 inch (6 mm)** thick, use aggregate graded with 100 percent passing the **No. 16 (1.18-mm)** sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
 - J. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.
 - K. Cold-Weather Admixture: Not allowed.
 - L. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
 1. Grace Construction Products, W. R. Grace & Co. – Conn.; Dry-Block Mortar Admixture.
 - M. Water: Potable.
- 2.7 REINFORCEMENT
- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M.
 - B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from **0.148-inch (3.77-mm)** steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
 1. Interior Walls: Hot-dip galvanized carbon steel.
 2. Exterior Walls: Hot-dip galvanized carbon steel.
 3. Wire Size for Side Rods:**0.148-inch (3.77-mm)** diameter.
 4. Wire Size for Cross Rods:**0.148-inch (3.77-mm)** diameter.
 5. Wire Size for Veneer Ties:**0.148-inch (3.77-mm)** diameter.
 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than **16 inches (407 mm)** o.c.
 7. Provide in lengths of not less than **10 feet (3 m)**.
 - D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least **1-1/2 inches (38 mm)** into veneer but with at least a **5/8-inch (16-mm)** cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
- Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
- C. Corrugated-Metal Ties: Metal strips not less than **7/8 inch (22 mm)** wide with corrugations having a wavelength of **0.3 to 0.5 inch (7.6 to 12.7 mm)** and an amplitude of **0.06 to 0.10 inch (1.5 to 2.5 mm)** made from **0.030-inch- (0.76-mm-)** thick steel sheet, galvanized after fabrication.
- D. Individual Wire Ties: Rectangular units with closed ends and not less than **4 inches (100 mm)** wide.
- Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of **1-1/4 inches (32 mm)**.
 - Wire: Fabricate from **3/16-inch- (4.76-mm-)** diameter, hot-dip galvanized steel wire.
- E. Partition Top Anchors: **0.105-inch- (2.66-mm-)** thick metal plate with a **3/8-inch- (9.5-mm-)** diameter metal rod **6 inches (152 mm)** long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel bars **1-1/2 inches (38 mm)** wide by **1/4 inch (6.35 mm)** thick by **24 inches (610 mm)** long, with ends turned up **2 inches (51 mm)** or with cross pins unless otherwise indicated.
- Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- G. Adjustable Masonry-Veneer Anchors:
- General: Provide anchors that allow vertical adjustment but resist a **100-lbf (445-N)** load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of **1/16 inch (1.5 mm)**.
 - Fabricate sheet metal anchor sections and other sheet metal parts from **0.075-inch- (1.90-mm-)** thick steel sheet, galvanized after fabrication.
 - Fabricate wire ties from **0.187-inch- (4.76-mm-)** diameter, hot-dip galvanized-steel wire unless otherwise indicated.
 - Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
 - Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom.
 - Products: Subject to compliance with requirements, provide the following:

"HCL-711", Wire-Bond
Slotted Rap-Tie system, Fero Corporation
HB-213-HS, Hohmann & Barnard, Inc.

6. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, **No. 10 (4.83-mm)** diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B 117.

2.9 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.
- 2.10 MISCELLANEOUS MASONRY ACCESSORIES
- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or PVC.
 - B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
 - C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
 - D. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:
 - 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Advanced Building Products.
 - 2) Mortar Net USA, Ltd.
 - E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. MortarNet, Mortar Net Solutions.
 - b. Mortar Maze, Advanced Building Products.

2. Configuration: Provide one of the following:
 - a. Strips, not less than 1-1/2 inches (38 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.

2.11 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 1. 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.

2.12 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
 1. Provide Spec Mix/Quikrete factory pre-blended mortar mix, colored mortar mix, and integral water repellent mortar mix as manufactured instead of field prepared mortars NO SUBSTITUTION Pre-blended mortar shall include manufacturer's standard silo system for mixing and delivery of mortar mixes.
 2. Pre-blended mortar and grout mixes shall be mixed with potable water in strict compliance with manufacturer's standard silo system for mixing and delivery system of mortar mixes or 80lb bags of pre-blended as governed.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 1. For masonry below grade or in contact with earth, use Type M.
 2. For reinforced masonry, use Type S.
- D. Pigmented Mortar: Use colored cement.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
- F. 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 TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than **2000 psi (14 MPa)**.
 3. Provide grout with a slump of **8 to 11 inches (200 to 280 mm)** as measured according to ASTM C 143/C 143M.
- G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
1. Application: Use epoxy pointing mortar for exposed mortar joints with the following units:
 - a. Pre-faced CMUs.
 - b. Glazed brick.
 - c. Glazed structural clay facing tile.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m).
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m).
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet ((6 mm in 3 m) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).

3. For head and collar joints, do not vary from thickness indicated by more than plus **3/8 inch (9 mm)** or minus **1/4 inch (6 mm)**.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus **1/8 inch (3 mm)**. Do not vary from adjacent bed-joint and head-joint thicknesses by more than **1/8 inch (3 mm)**.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than **1/16 inch (1.5 mm)** from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in **running bond**; do not use units with less-than-nominal **4-inch (100-mm)** horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than **4 inches (100 mm)**. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal **4-inch (100-mm)** horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout **24 inches (600 mm)** under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide **1/2-inch (13-mm)** clearance between end of anchor rod and end of tube. Space anchors **48 inches (1200 mm)** o.c. unless otherwise indicated.
 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Lay structural clay tile as follows:

1. Lay vertical-cell units with full head joints unless otherwise indicated. Provide bed joints with full mortar coverage on face shells and webs.
2. Lay horizontal-cell units with full bed joints unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.
3. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with **1/4- to 3/8-inch- (6- to 10-mm-)** thick joints.

D. Install clay flue liners to comply with ASTM C 1283. Install flue liners ahead of surrounding masonry. Set clay flue liners in full bed of refractory mortar **1/16 to 1/8 inch (1.6 to 3 mm)** thick. Strike joints flush on inside of flue to provide smooth surface. Maintain expansion space between flue liner and surrounding masonry except where surrounding masonry is required to provide lateral support for flue liners.

E. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

- F. Rake out mortar joints at glazed brick and glazed structural clay tile to a uniform depth of **1/4 inch (6 mm)** and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- G. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 - 1. For glazed masonry units, use a nonmetallic jointer **3/4 inch (19 mm)** or more in width.
- H. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- I. Cut joints flush where indicated to receive waterproofing, cavity wall insulation and air barriers unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of **5/8 inch (16 mm)** on exterior side of walls, **1/2 inch (13 mm)** elsewhere. Lap reinforcement a minimum of **6 inches (150 mm)**.
 - 1. Space reinforcement not more than **16 inches (406 mm)** o.c.
 - 2. Space reinforcement not more than **8 inches (203 mm)** o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than **8 inches (203 mm)** above and below wall openings and extending **12 inches (305 mm)** beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at [**corners,**] returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
- C. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint **4 inches (100 mm)** in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
 3. Build in compressible joint fillers where indicated.
 4. Form open joint full depth of block wythe and of width indicated, but not less than **3/8 inch (10 mm)** for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than **3/8 inch (10 mm)**.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

- A. Install steel lintels where indicated.
- B. Provide concrete or masonry lintels where shown and where openings of more than **12 inches (305 mm)** for brick-size units and **24 inches (610 mm)** for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of **8 inches (200 mm)** at each jamb unless otherwise indicated.

3.9 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than **60 inches (1520 mm)**.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- J. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.11 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.12 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. 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 Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fabrication and erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.
 - 1. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 03 Section "Cast-in-Place Concrete" for anchor bolt installation in concrete.
 - 2. Division 04 Section "Unit Masonry" for anchor bolt installation in masonry.
 - 3. Division 05 Section "Metal Fabrication" for miscellaneous metal fabrications.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
 - 1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
 - 2. High-strength bolts (each type), including nuts and washers.
 - a. Include Direct Tension Indicators if used.
 - 3. Structural steel primer paint.
 - 4. Shrinkage-resistant grout.
- C. Shop drawings prepared under supervision of a licensed Structural Engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.
 - 1. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.

2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.
- D. Test reports conducted on shop- and field-bolted and welded connections. Include data on type(s) of tests conducted and test results.
- E. Certified copies of each survey conducted by a licensed Land Surveyor, showing elevations and locations of base plates and anchor bolts to receive structural steel and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.
- 1.4 QUALITY ASSURANCE
- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges."
 - a. Paragraph 4.4 of the above code is hereby modified to allot 15 business days for Shop Drawing review in accordance with Specification Section 01330.
 - b. Paragraph 4.4.1(b) of the above code is hereby modified as follows:

“Confirmation that the Owner’s designated representative for Design has reviewed the Connection details shown on the Shop and Erection Drawings and submitted in accordance with Section 3.1.2, if applicable.”
 2. AISC "Specifications for Structural Steel Buildings," including "Commentary."
 3. AISC "Specifications for the Design of Steel Hollow Structural Sections."
 4. "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections.
 5. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel."
 6. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."
- B. Qualifications for Welding Work: Qualify welding procedures and welding operators in accordance with AWS "Qualification" requirements.
1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
 2. If recertification of welders is required, retesting will be Contractor's responsibility.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not to delay work.

- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. If bolts and nuts become dry or rusty, clean and relubricate before use.
 - 1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Metal Surfaces, General: For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.
- B. Structural Steel Wide Flange Shapes: ASTM A992, Grade 50; ASTM A572, Grade 50.
- C. Angles, Channels, Plates and Bars: ASTM A36.
- D. Cold-Formed HSS Square and Rectangular: ASTM A 500, Grade B.
- E. Hot-Formed Round HSS: ASTM A 501.
- F. Round HSS: ASTM A 53, Type E or S, Grade B.
 - 1. Finish: Black, except where indicated to be galvanized.
- G. Anchor Bolts: ASTM A 307, nonheaded type unless otherwise indicated.
- H. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.
 - 1. Provide hexagonal heads and nuts for all connections.
 - 2. Provide either hexagonal or square heads and nuts, except use only hexagonal units for exposed connections.
- I. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:
 - 1. Quenched and tempered medium-carbon steel bolts, nuts, and washers, complying with ASTM A 325.
 - 2. Where indicated as galvanized, provide units that are zinc coated, either mechanically deposited complying with ASTM B 695, Class 50, or hot-dip galvanized complying with ASTM A 153.
 - 3. Quenched and tempered alloy steel bolts, nuts, and washers, complying with ASTM A 490.
- J. Electrodes for Welding: Comply with AWS Code.

K. Nonmetallic Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with CE-CRD-C621.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Euco N.S.; Euclid Chemical Co.
- b. Crystex; L & M Construction Chemicals, Inc.
- c. Masterflow 713; Master Builders.
- d. Sealtight 588 Grout; W.R. Meadows.

2.2 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections.

C. Bolt field connections, except where welded connections or other connections are indicated.

1. Provide high-strength threaded fasteners for all bolted connections.

D. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts."

E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

F. Assemble and weld built-up sections by methods that will produce true alignment of axes without warp.

G. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

H. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

I. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 SHOP PAINTING

A. General:

1. Shop-paint exposed structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.
 - a. Do not paint surfaces to be welded or high-strength bolted with friction-type connections.
 - b. Do not paint surfaces scheduled to receive sprayed-on fireproofing.
 - c. Apply two (2) coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
 - d. Interior steel not exposed to view may be left unpainted.
2. No coatings shall be applied until approved by the Architect and Owner's Representative.
3. Intermediate and finish coats shall be applied by the painting contractor per Division 9 Section "Painting."
4. Inspection and Testing: During the shop painting process and prior to shipping steel, the fabricator shall have the primer manufacturer representative inspect structural steel for proper dry film thickness in accordance with specifications.
 - a. Fabricator shall use testex tape to keep a permanent and verifiable record of the surface profile. A minimum of three (3) random tests shall be taken per ton of steel.

B. Exterior – Exposed:

1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning removing mill scale, rust, paint and other foreign matter except for staining, by use of abrasives. All surfaces must be clean, dry and free of oil, grease, dust, dirt or contaminants detrimental to the coating system.
2. Primer:
 - a. TNE MEC: One (1) coat TNE MEC Series 90-97 Tneme-Zinc @ 2.5 to 3.5 mil DFT.
 - b. Wasser: One (1) coat of Wasser MC-Zinc @ 3.0-5.0 mils DFT.
3. For warranty purposes, the Contractor shall insure that the intermediate and finish coats specified in Division 9 "Painting" and the applied primer specified above are from the same manufacturer.

C. Preparation and Coating over Galvanized Steel:

1. Preparation: All galvanized metal receiving additional coats shall be tested by use of a copper sulfate test. This includes using a 10% solution of copper sulfate dissolved in water and applied to the galvanized surface. The reaction time between the copper sulfate and zinc should result in turning the galvanized area black within 15 seconds or less. If the reaction takes longer than 15 seconds, further cleaning is required as follows:

- a. Preparation for TNEMEC paints: Apply Great Lakes Clean and Etch or SSPC-SP16.
 - b. Preparation for Wasser paints: Apply Great Lakes Clean and Etch or Oakite 747 as recommended by manufacturer followed by a thorough rinse.
2. Primer:
 - a. TNEMEC: One (1) coat TNEMEC Series 27 F.C. Typoxy @ 2.0 to 4.0 mil DFT.
 - b. Wasser: One (1) coat of Wasser MC-CR @ 3.0-4.0 mils DFT.
 3. For warranty purposes, the Contractor shall insure that the intermediate and finish coats specified in Division 9 "Painting" and the applied primer specified above are from the same manufacturer.
- D. Pool Environment:
1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning, removing mill scale, rust, paint and other foreign matter except for staining, by use of abrasives. All surfaces must be clean, dry and free of oil, grease, dust, dirt or contaminants detrimental to the coating system.
 2. Primer:
 - a. TNEMEC: One (1) coat TNEMEC Series 90-97 Tneme-Zinc @ 2.5 to 3.5 mil DFT.
 - b. Wasser: One (1) coat of Waaer MC-Zinc @ 3.0-5.0mils DFT.
 3. For warranty purposes, the Contractor shall insure that the intermediate and finish coats specified in Division 9 "Painting" and the applied primer specified above are from the same manufacturer.
- E. Interior – Exposed:
1. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
 - a. SP-1 "Solvent Cleaning".
 - b. SP-2 "Hand Tool Cleaning".
 - c. SP-3 "Power Tool Cleaning".
 2. Primer: Manufacturer's standard rust-inhibiting primer.
- 2.4 SOURCE QUALITY CONTROL
- A. General: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
1. Promptly remove and replace materials or fabricated components that do not comply.

- B. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.
 - 1. Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated.

PART 3- EXECUTION

3.1 ERECTION

- A. Surveys: Employ a licensed land surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made or until compensating adjustments to structural steel work have been agreed upon with Architect.
- B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.
- D. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 - 1. Set leveling plates for structural columns on a bed of shrinkage resistant grout and level to proper elevation.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed.
 - 3. For proprietary grout materials, comply with manufacturer's instructions.
- E. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- F. Level and plumb individual members of structure within specified AISC tolerances.
- G. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- H. Splice members only where indicated and accepted on shop drawings.
- I. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.
 - 1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Do not enlarge unfair holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- J. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Architect. Finish gas-cut sections equal to a sheared appearance when permitted.
- K. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.2 QUALITY CONTROL

- A. Owner will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
- B. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.
- C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.
- D. Testing agency may inspect structural steel at plant before shipment.
- E. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.
- F. Shop-Bolted Connections: Inspect or test in accordance with AISC specifications.
- G. Field-Bolted Connections: Inspect in accordance with AISC specifications.
- H. Field Welding: Inspect and test during erection of structural steel as follows:
1. Conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 2. Perform visual inspection of all welds.
 3. Perform tests of welds as follows:
 - 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 not acceptable.
 - c. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 - d. Ultrasonic Inspection: ASTM E 164.

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. Ladders.
- 3. Loose steel lintels.
- 4. 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."
- 4. Section 129300 "Site Furnishings" for bicycle racks.

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 Guard 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. 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 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.
- 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. Mount handrails only on gypsum board assemblies reinforced 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 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.
- D. 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.
- E. 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.
- F. 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.

- G. 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.
- H. Gray Iron Castings: ASTM A 48, Class 30.
- I. Malleable Iron Castings: ASTM A 47, grade 32510.
- J. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- K. 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.
- L. Welding Rods and Bare Electrodes: Select in accordance with AWS

2.2 STAINLESS STEEL

- A. Bar Stock: ASTM A 276, Type 302 or 304.
- B. Plate: ASTM A 167, Type 302 or 304.

2.3 ALUMINUM

- A. Extruded Bars and Shapes: ASTM B 221, alloys as follows:
 - 1. 6061-T6 or 6063-T6 for bearing bars of gratings and shapes.
 - 2. 6061-T1 for grating cross bars.
- B. Aluminum-Alloy Rolled Tread Plate: ASTM B 632, alloys as follows:
 - 1. 6061-T6 for platforms.
 - 2. 6061-T4 for treads.
- C. Aluminum Rivets: ASTM B 316, alloy 6053-T4 or 6061-T6.
- D. Aluminum Sheet for Expanded Aluminum Grating: ASTM B 209, alloy 5052-H32.
- E. Fasteners for Aluminum Gratings: Use fasteners made of same basic metal as fastened metal except use galvanized fasteners complying with ASTM A 153 for exterior aluminum

units, unless otherwise indicated. Do not use metals that are corrosive or incompatible with metals joined.

2.4 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.

2.5 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.

2.6 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.

2.7 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.

2.8 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.
- 2.9 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.

2.10 STEEL LADDERS

- A. General: Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as indicated. Comply with requirements of ANSI A14.3.
- B. Siderails: Continuous steel flat bars, 1/2 inch x 2-1/2 inches, with eased edges, spaced 18 inches apart.
- C. Bar Rungs: Round steel bars, 3/4-inch diameter, spaced 12 inches o.c.
- D. Bar Rungs: Square steel bars, 3/4 inch, spaced 12 inches o.c.
- E. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
- F. Support each ladder at top and bottom and at intermediate points spaced not more than 5'-0" o.c. by means of welded or bolted steel brackets.
 - 1. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.
 - 2. Extend side rails 42 inches above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, gooseneck the extended rails back to the structure to provide secure ladder access.
- G. Provide non-slip surface on top of each rung, either by coating the rung with aluminum oxide granules set in epoxy resin adhesive, or by using a type of manufactured rung which is filled with aluminum oxide grout.
- H. Galvanize ladders, including brackets and fasteners, in the following locations:
 - 1. Exterior locations.
 - 2. Interior locations where indicated.

2.11 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 where 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 where indicated or required, and not included with structural steel, shall be as follows: (Galvanize loose steel lintels located in exterior walls.)
 - a. Openings up to 4'-0": One angle 3-1/2" x 3-1/2" x 5/16" for each 4" width of masonry.
 - b. Openings 4'-1" to 7'-0": One angle 5" x 3-1/2" x 5/16" for each 4" width of masonry.
 - c. Openings 7'-1" to 10'-0": One beam W8x10 plus 5/16" thick plate; 1/2" narrower than up to 12" thick wall.
 - d. Openings 10'-1" to 12'-0": One beam W8x18 plus 5/16" thick plate; 1/2" narrower than up to 12" thick wall.

2.12 MISCELLANEOUS STEEL TRIM

- A. Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.
- B. Galvanize miscellaneous framing and supports in the following locations:
 - 1. Exterior locations.
 - 2. Interior locations where indicated.

2.13 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.

2.14 FINISHES, GENERAL

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

2.15 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.

2.16 ALUMINUM FINISHES

- A. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- B. As Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. 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.

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. Center nosings on tread widths with noses flush with riser faces and tread surfaces.
- C. 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. Roof sheathing
 - 4. Composite Decking
 - 5. Framing with dimension lumber.
 - 6. 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.
 - 2. Division 07 Section "Interior/Exterior Finish System" for interior/exterior finish system.

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. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

5. 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. Fire-retardant-treated wood.
 3. Engineered wood products.
 4. Shear panels.
 5. Power-driven fasteners.
 6. Powder-actuated fasteners.
 7. Expansion anchors.
 8. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Single source responsibility for Fire-Retardant-Treated wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

1.7 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.

1.8 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. Fire-Retardant-Treated Materials, Interior Type A
 - a. Baxter: J.H. Baxter Co.
 - b. Chemical Specialties, Inc.
 - c. Continental Wood Preservers, Inc.
 - d. Hickson Corp.
 - e. Hoover Treated Wood Products, Inc.
3. Fire-Retardant-Treated Materials, Exterior Type:
 - a. American Wood Treaters, Inc.
 - b. Hoover Treated Wood Products, Inc.
4. Gypsum Sheathing Board:
 - a. BPB America Inc.
 - b. Georgia-Pacific Corp.
 - c. National Gypsum Co.; Gold Bond Building Products Division
 - d. United States Gypsum Co.
5. 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"
 - b. Glass-Fiber-Embedded Gypsum Sheathing Board:
 - 1) BPB America Inc., "GlasRoc Brand Sheathing"
 - c. Cellulose-Fiber-Embedded Gypsum Sheathing Board:
 - 1) United States Gypsum Co., "Fiberock Brand Aqua-Tough 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 AND PLYWOOD:
- 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.
 - D. Plywood Grade: APA C-D PLUGGED EXTERIOR, with minimum space rating to suit support spacing and plywood thickness indicated.
 - E. Particle Boards: Particle Board Standard: Manufacture and factory-mark each particle board panel to comply with ANSI A208.01 "Mat-Formed Wood Particle Board" for grade indicated.
- 2.4 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).

2.5 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 AWP 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 AWP M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.6 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS:

- A. General: Where fire-retardant-treated wood is indicated, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWP C20 and C27, respectively, for treatment type indicated; identify "fire-retardant-treated wood" with appropriate classification marking of Underwriters Laboratories, Inc. (UL), U.S. Testing, Timber Products Inspection, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Current Evaluation/Research Reports: Provide fire-retardant- treated wood for which a current model code evaluation/research report exists that is acceptable to authorities having jurisdiction and that evidences compliance of fire-retardant- treated wood for application indicated.
- B. Interior Type A: For interior locations use fire-retardant chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
 1. No reduction takes place in bending strength, stiffness, and fastener holding capacities below values published by manufacturer of chemical formulation that are based on tests by a qualified independent testing laboratory of treated wood products identical to those indicated for this Project under elevated temperature and humidity conditions simulating installed conditions.
 2. No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.
 3. No corrosion of metal fasteners results from their contact with treated wood.
- C. Exterior Type: Use for exterior locations and where indicated.

- D. Inspect each piece of treated 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: Construction, Stud, or No.3
 - 2. Species:
 - a. Douglas fir-larch; WCLIB or WWPA
 - b. Hem-fir; WCLIB or WWPA
 - c. Southern Pine; SPIB
 - d. Douglas fir south; WWPA
 - 1) Any species above

2.8 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.

2.9 COMPOSITE DECKING

- A. Basis of Design: "Good Life"; as manufactured by Fiber Composites, LLC.
1. Envision Expression manufactured by TAMKO Building Products
 2. Select Composite Decking manufactured by Trex Company, Inc.
- B. Composition: Polyethylene (PE) composite core with a PE capping material. Manufactured through a continuous co-extrusion process with capping material on three sides (no capstock on bottom).
- C. Performance Criteria:
1. Surface Burning Characteristics: Maximum 125 FSI and 300 SDI; ASTM E84 and UL 723. CAPPED COMPOSITE DECKING 067316 - 12
 2. Self-Ignition Temperature: 743 deg F; ASTM D1929.
 3. Flash-Ignition Temperature: 698 deg F; ASTM D1929.
 4. Specific Gravity: 1.10; ASTM D792.
 5. Coefficient of Thermal Expansion: 1.67×10^{-5} in/in/deg F; ASTM D6341.
 6. Modulus of Elasticity: 404,400 psi; ASTM D6109.
 7. Modulus of Rupture: 2,845 psi; ASTM D6109.
 8. Creep Recovery: Passes for minimum 75 percent recovery; ASTM D7032.
 9. Maximum Load Deflection: Less than 0.120 inch; ASTM D7032.
 10. UV Resistance: Successfully passed after 2000 hours of Xenon-Arc exposure. Tested according to ASTM D2565 Cycle 1.
 11. Fungus Decay Resistance: No significant decay; AWWA E10 and ASTM D1413.
 12. Formosan Termite Resistance: Passes; AWWA E1.
- D. Board Dimensions: 5.25 inches wide by 0.93 inch total thickness; 0.015 inch capping material thickness.
- E. Board Length: 20 feet
- F. Board Profiles: Non-reversible pattern. 1/8 inch radius for board edges.
1. Square Edge Boards: For face-fastening only. Provide for the following applications: Seating and Accessory items.
- G. Gapping: The following open joint dimensions are required:
1. 1. Butted Boards: 1/4 inch to 1/32 inch open joints, depending on temperature.
 2. 2. Edge-to-Edge Boards: 3/16 inch open joints.
- H. Color: As selected by Architect from manufacturer's standard color line.

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 AWWA M4 to cut surfaces of preservative treated lumber and plywood.

3.2 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.

3.3 WOOD FURRING:

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

3.4 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.

3.5 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 plane 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.

****END OF SECTION****

WOOD ROOF DECKING

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 solid-sawn wood roof decking
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for dimension lumber items associated with wood roof decking.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For preservative-treated wood products, include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
- B. Samples: 24 inches (600 mm) long, showing the range of variation to be expected in appearance of wood roof decking.

1.4 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of wood roof decking to avoid extended on-site storage and to avoid delaying the Work.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood roof decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

PART 2 - PRODUCTS

2.1 WOOD ROOF DECKING, GENERAL

- A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

2.2 SOLID-SAWN WOOD ROOF DECKING

- A. Standard for Solid-Sawn Wood Roof Decking: Comply with AITC 112.
- B. Roof Decking Species: southern pine.
- C. Roof Decking Nominal Size: 3 by 6.
- D. Roof Decking Grade: Select Decking.
- E. Grade Stamps: Factory mark each item with grade stamp of grading agency. Apply grade stamp to surfaces that are not exposed to view.
- F. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.
- G. Face Surface: Smooth.
- H. Edge Pattern: Vee grooved.

2.3 PRESERVATIVE TREATMENT

- A. Pressure treat wood roof decking according to AWPA U1; Use Category UC2.
 - 1. For laminated roof decking, treat lumber before gluing.
- B. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 1. For exposed items indicated to receive a stained or natural finish, use products that do not contain colorants, bleed through, or otherwise adversely affect finishes.
- C. Use process that includes water-repellent treatment.
- D. Use process that does not include water repellents or other substances that might interfere with application of indicated finishes.
- E. After treatment, redry materials to 15 percent maximum moisture content.
- F. After dressing and fabricating roof decking, apply preservative chemical acceptable to authorities having jurisdiction and containing no arsenic or chromium according to AWPA M4 to surfaces cut to a depth of more than **1/16 inch (1.5 mm)**.

2.4 ACCESSORY MATERIALS

- A. Fasteners for Solid-Sawn Roof Decking: Provide fastener size and type complying with AITC 112 for thickness of deck used.
- B. Fasteners for Glued-Laminated Roof Decking: Provide fastener size and type complying with requirements in "Installation" Article for installing laminated roof decking.
- C. Nails: Common; complying with ASTM F 1667, Type I, Style 10.
- D. Spikes: Round; complying with ASTM F 1667, Type III, Style 3.
- E. Fastener Material: Hot-dip galvanized steel.
- F. Bolts for Anchoring Roof Decking to Walls: Carbon steel; complying with **ASTM A 307** with **ASTM A 563** hex nuts and, where indicated, flat washers, all hot-dip zinc coated.
- G. Sealants: Latex, complying with applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.
- H. Penetrating Sealer: Clear sanding sealer complying with Section 099300 "Staining and Transparent Finishing" and compatible with topcoats specified for use over it.

2.5 FABRICATION

- A. Shop Fabrication: Where preservative-treated roof decking is indicated, complete cutting, trimming, surfacing, and sanding before treating.
- B. Predrill roof decking for lateral spiking to adjacent units to comply with AITC 112.
- C. Seal Coat: After fabricating and surfacing roof decking, apply a saturation coat of penetrating sealer in fabrication shop.
- D. Apply indicated finish materials to comply with Section 099100 "Painting" in fabrication shop.

PART 3- EXECUTION

3.1 EXAMINATION

- A. Examine walls and support framing in areas to receive wood roof decking for compliance with installation tolerances and other conditions affecting performance of wood roof decking.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install solid-sawn wood roof decking to comply with AITC 112.
 - 1. Locate end joints for combination simple and two-span continuous lay-up.
- B. Anchor wood roof decking, where supported on walls, with bolts as indicated.

- C. Where preservative-treated roof decking must be cut during erection, apply a field-treatment preservative chemical acceptable to authorities having jurisdiction and containing no arsenic or chromium to comply with AWPA M4.
- D. Apply joint sealant to seal roof decking at exterior walls at the following locations:
 - 1. Between roof decking and supports located at exterior walls.
 - 2. Between roof decking and exterior walls that butt against underside of roof decking.
 - 3. Between tongues and grooves of roof decking over exterior walls and supports at exterior walls.

3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged roof decking if repairs are not approved by Architect.

3.4 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.
- B. If, despite protection, inorganic boron (SBX)-treated roof decking becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

****END OF SECTION****

SHOP-FABRICATED WOOD TRUSSES

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. Wood roof trusses.
 - 2. Wood girder trusses.
- B. Related Requirements:

1.3 ALLOWANCES

- A. Provide wood truss bracing under the Metal-Plate-Connected Truss Bracing Allowance as specified in Section 012100 "Allowances."

1.4 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For wood-preservative-treated lumber metal-plate connectors, metal truss accessories, and fasteners.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from 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 truss fabricator.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.

4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data, truss shop drawing and layout drawings signed and sealed by the qualified professional engineer registered in the State of Michigan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For metal connector-plate manufacturer, professional engineer, and fabricator.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
 1. Wood-preservative-treated lumber.
 2. Metal-plate connectors.
 3. Metal truss accessories.

1.7 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated.
 - 2. Maximum Deflection under Design Loads:
 - a. Roof Trusses: Vertical deflection of **1/360** of span.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S.
 - 4. Provide dry lumber with **15** percent maximum moisture content at time of dressing.
- B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry"

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. For exposed trusses indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all trusses unless otherwise indicated in storage and filtration room areas.

2.4 METAL CONNECTOR PLATES

- A. General: Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304 and not less than 0.035 inch (0.88 mm) thick.
 - 1. Use at pool filtration room.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 - 2. Where trusses are exposed to weather, made from pressure-preservative treated wood, or in area of high relative humidity (pool filtration room), provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.

2.6 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Allowable design loads, as published by manufacturer, shall comply with or exceed those **indicated**. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, **G60 (Z180)** coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); **G185 (Z550)** coating designation; and not less than **0.036 inch (0.9 mm)** thick.
 - 1. Use for wood-preserved-treated lumber and where indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Use for exterior locations and where indicated.
- E. Truss Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening roof trusses to wall below, **as noted on drawings**.
- F. Roof Truss Bracing/Spacers: U-shaped channels, **1-1/2 inches (38 mm)** wide by **1 inch (25 mm)** deep by **0.040 inch (1.0 mm)** thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.
- G. Drag Strut Connectors: Angle clip with one leg extended for fastening to the side of girder truss.
 - 1. Angle clip is **3 by 3 by 0.179 by 8 inches (76 by 76 by 4.55 by 203 mm)** with extended leg **8 inches (203 mm)** long. Connector has galvanized finish.
 - 2. Angle clip is **3 by 3 by 0.239 by 10-1/2 inches (76 by 76 by 6.07 by 267 mm)** with extended leg **10-1/2 inches (267 mm)** long. Connector has painted finish.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.8 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.9 SOURCE QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.
 1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
 2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate do not comply with the Contract Documents.

PART 3- EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

- L. Replace wood trusses that are damaged or do not comply with requirements.
 - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces according to ASTM A 780/A 780M and manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION

GLUED-LAMINATED CONSTRUCTION

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 framing using structural glued-laminated timber.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.
 - 2. Section 061516 "Wood Roof Decking" for glued-laminated wood roof decking.

1.3 DEFINITIONS

- A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on lumber, adhesives, fabrication, and protection.
 - 2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 3. For connectors. Include installation instructions.
- B. Sustainable Design Submittals:
- C. Shop Drawings:
 - 1. Show layout of structural glued-laminated timber system and full dimensions of each member.
 - 2. Indicate species and laminating combination.
 - 3. Include large-scale details of connections.
 - 4. Glulam Trusses and connections shall be designed by supplier. Supplier shall submit signed and sealed shop drawings and calculations by a Registered Engineer in the State of Michigan. Shop drawings shall indicate all designed loads.
- D. Samples: Full width and depth, 24 inches long, showing the range of variation to be expected in appearance of structural glued-laminated timber including variations due to specified treatment.

1. Apply specified factory finish to three sides of half length of each Sample.
2. Delegated-Design Submittal: For structural glued-laminated timber and timber connectors. Supplier shall submit signed and sealed shop drawings and calculations by a Registered Engineer in the State of Michigan.

1.5 INFORMATIONAL SUBMITTALS

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.
- B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.
- C. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design structural glued-laminated timber and connectors.
- B. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D 3737 and acceptable to authorities having jurisdiction.
- C. Seismic Performance: Structural glued-laminated timber and connectors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7-10.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
 2. Provide structural glued-laminated timber made from single species.
 3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.

4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
- B. Species and Grades for Structural Glued-Laminated Timber: Any species.
 - C. Species and Grades for Structural Glued-Laminated Timber: Southern pine that complies with structural properties indicated.
 - D. Species and Grades for Beams:
 1. Species and Beam Stress Classification: Southern pine. See design drawings for required values.
 2. Lay-up: Either balanced or unbalanced.
 3. Species and Combination Symbol: Southern pine. See design drawings for required values.
 - E. Species and Grades for Truss Members:
 1. Species and Combination Symbol: Southern pine. See design drawings for required design values.
 - F. Appearance Grade: Architectural, complying with AITC 110.
 1. For Premium and Architectural appearance grades, fill voids as required by AITC 110. For Premium appearance grade, use clear wood inserts, of matching grain and color, for filling voids and knot holes more than 1/4 inch wide.

2.3 PRESERVATIVE TREATMENT

- A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category UC1 interior, and UC3 for exterior use.
 1. Use preservative solution without substances that might interfere with application of indicated finishes.
 2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.
- B. Preservative:
 1. Pentachlorophenol in light petroleum solvent.
- C. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWPA M4 to surfaces cut to a depth of more than 1/16 inch.

2.4 TIMBER CONNECTORS

- A. [Simpson Strong-Tie](#)
- B. Fabricate beam seats from steel with 3/8-inch (9.5-mm) bearing plates, 3/4-inch diameter-by-12-inch long deformed bar anchors, and 0.239-inch side plates.
- C. Fabricate arch base shoes from steel with 1-inch baseplates and 3/8-inch side plates.

- D. Fabricate beam hangers from steel with 0.179-inch stirrups and 0.239-inch top plates.
- E. Fabricate hinge connectors from steel with 0.179-inch side plates and 3/4-inch top and bottom plates.
- F. Fabricate strap ties from steel 2-1/2 inches wide by 0.179 thick.
- G. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A 668/A 668M.
- H. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A 307, Grade A; nuts complying with ASTM A 563; and, where indicated, flat washers.
- I. Provide shear plates, complying with ASTM D 5933.
- J. Materials: Unless otherwise indicated, fabricate from the following materials:
 - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
 - 2. Round steel bars complying with ASTM A 575, Grade M 1020.
 - 3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
- K. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.
- L. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

2.5 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.6 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
 - 1. Dress exposed surfaces as needed to remove planing and surfacing marks.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWPA M4.
 - 1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.

2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

D. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit except for preservative-treated wood where treatment included a water repellent.

2.7 FACTORY FINISHING

A. Wiped Stain Finish: Manufacturer's standard, dry-appearance, penetrating acrylic stain and sealer; oven dried and resistant to mildew and fungus.

1. Color: As selected by Architect from manufacturer's full range.

B. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Framing Built into Masonry: Provide 1/2-inch clearance at tops, sides, and ends of members built into masonry; and do not embed more than 4 inches unless otherwise indicated.

C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

D. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.

1. Predrill for fasteners using timber connectors as templates.

2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
3. Coat cross cuts with end sealer.
4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWWA M4.
 - a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
 - b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

E. Install timber connectors as indicated.

1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.

1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

****END OF SECTION****

INTERIOR ARCHITECTURAL WOODWORK

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. Wood cabinets.
 - 2. Plastic-laminate cabinets.
 - 3. Plastic-laminate countertops.
 - 4. Solid-surfacing-material countertops.
 - 5. Shop finishing of interior woodwork
 - 6. FRP Wall Panels and Trim.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors 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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
 - 2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
 - 4. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.

- B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
- C. Samples for Verification:
 - 1. For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.
- B. Sample Warranty: For manufacturer's warranty.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance
- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and wood doors with face veneers that are sequence matched with woodwork.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 - 1. Provide AWI Quality Certification Program labels indicating that woodwork complies with requirements of grades specified.
- D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- E. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria."
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and ventilation system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

1.10 WARRANTY

- A. Manufacturer's Warranty for Columns: Manufacturer agrees to repair or replace columns that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Columns: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by a firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work:

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

- B. Grade: Premium AA
- C. Wood Species for Opaque Finish: Any closed-grain hardwood
- D. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2
 - 4. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - 5. Softwood Plywood: DOC PS 1
 - 6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1 , made with adhesive containing no urea formaldehyde .
- E. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
 - 1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a. Formica Corporation.
 - b. Nevamar Company, LLC; Decorative Products Div.
 - c. Pionite Industries.
 - d. Wilsonart International; Div. of Premark International, Inc.
- G. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avonite, Inc.
 - b. E. I. du Pont de Nemours and Company.
 - c. Formica Corporation.
 - d. Wilsonart International; Div. of Premark International, Inc.
 - e. L.G. Hi'Macs Co.
 - 2. Type: Standard type unless Special Purpose type is indicated.
 - 3. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Lumber: AWPA C2 Kiln dry after treatment to a maximum moisture content of 19 percent.

- B. Plywood: AWPA C9. Kiln dry after treatment to a maximum moisture content of 18 percent.
- C. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- D. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
- E. Do not use material that is warped or does not comply with requirements for untreated material.
- F. Mark lumber with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- G. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
 - 1. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
- H. Application: Where indicated.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.
 - 1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:
 - 1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
 - 2. Interior Type A: Low-hygroscopic formulation.
 - 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking plant certified by testing and inspecting agency.
 - 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from

drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

5. Kiln-dry materials before and after treatment to levels required for untreated materials.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.
 2. For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.
 3. Product: Subject to compliance with requirements, provide "Duraflake FR" by Weyerhaeuser.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
1. Product: Subject to compliance with requirements, provide "Medite FR" by SierraPine Ltd.; Medite Div.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
 2. Contact Adhesive: 250 g/L.
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement
1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).
 - 2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
 - 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).
- E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

2.7 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Grade: Custom
- B. Wood Species: Any closed-grain hardwood.
- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- D. Assemble casings in plant except where limitations of access to place of installation require field assembly.

- E. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

2.8 PLASTIC-LAMINATE CABINETS

- A. Grade: Premium
- B. AWI Type of Cabinet Construction: As indicated .
- C. WI Door and Drawer Front Style: Flush overlay
- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: Grade HGS
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Edges: Grade HGS or matching PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
- E. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - a. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
- F. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- G. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As selected by Architect from laminate manufacturer's full.
- H. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.9 PLASTIC-LAMINATE COUNTERTOPS

- A. Grade: Premium
- B. High-Pressure Decorative Laminate Grade: HGS
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As selected by Architect from manufacturer's full range.
- D. Grain Direction: Parallel to cabinet fronts.
- E. Edge Treatment:
 - 1. Postformed Surfaces: PF-42 (0.042 inch nominal thickness).

2. Edges: GP-50 (0.050 inch nominal thickness).
 3. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
- F. Core Material: Particleboard made with exterior glue.
- G. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

2.10 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Grade: Premium Price Group "C"
- B. Solid-Surfacing-Material Thickness: 1/2 inch (12.7 mm) .
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
1. As selected by Architect from manufacturer's full range.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
1. Fabricate tops with loose backsplashes for field application.

2.11 FRP PROTECTIVE WALL PANELS (PWP1)

- A. Basis of Design: Provide and install FRP ceiling panel system equal to Crane Composites Inc. "Glasbord" panel system.
1. Fire-Test-Response Characteristics: Provide impact-resistant wall protection system components with the following surface-burning characteristics, as determined by testing materials identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify impact-resistant wall protection system components with appropriate markings of applicable testing and inspection agency.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 450 or less.
 2. Acceptable Manufacturers
 - a. Panolam
 - b. Construction Specialties, Inc.
 - c. Crane Composites Inc.
 - d. Marlite
 - e. IPC Door and Wall Protection Systems, Inc.
 3. Extruded Rigid Plastic: Textured, chemical-and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic; thickness as indicated; with a minimum impact resistance of 25.4 ft-lbf/in. (1356 J/m) of width when tested according to ASTM D 256, Test Method A. Panels shall have a wear side with a pebble-like embossed finish.
 - a. Color and Texture: As selected by Architect from manufacturer's full range.

- b. Thickness: 1/8"
- c. Length: 8' or as required for conditions.
- d. Panels shall be trimmed with manufacturer's recommended trim pieces in color to match panels and adhesively applied to wall surface

2.12 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 9 painting Sections for finishing opaque-finished architectural woodwork.
- D. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Division 9 painting Sections for finishing architectural woodwork not indicated to be shop finished.
- E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- F. Transparent Finish:
 - 1. Grade: Premium
 - 2. WI Finish System 4: Conversion varnish or WI Finish System 5: Catalyzed polyurethane.
 - 3. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c.] [and] [to walls with adhesive .
 - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- I. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- J. Refer to Division 9 Sections for final finishing of installed architectural woodwork not indicated to be shop finished .

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

****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 HOT-APPLIED ASPHALT DAMPPROOFING

- A. Asphalt Primer: Asphalt cut-back type; ASTM D 41.

2.2 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.

2.3 MANUFACTURERS

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

2.4 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.

2.5 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. Glass Fiber Mat: Manufacturer's standard nonwoven fabric of continuous filament or jack-straw filament/yarn pattern of glass fiber, impregnated and bound together with type of organic/ synthetic binder which is compatible with type of bituminous compound indicated to be reinforced, weighing 1.0 to 1.5 lbs. per 100 sq. ft., 36" wide rolls.
- C. Bituminous Grout: ASTM D 147.
- D. Protection Course, Board Type: Asphalt impregnated and coated organic fiberboard, 1/4" thick.

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.

SECTION 071113
BITUMINOUS
DAMPPROOFING

- E. Install 2 x 2 cant strip of bituminous grout at base of vertical dampproofing where it meets horizontal surface.
 - F. Install lapped course of glass fiber mat in first coat of dampproofing compound where shown as "Reinforced".
 - G. Fill voids, seal joints, and apply bond breakers (if any) as recommended by prime materials manufacturer, with particular attention at construction joints.
 - H. 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.
- 3.3 GENERAL
- A. Where indicated, install protection course of type indicated, over completed-and-cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attachment of protection materials. Support with spot-application of plastic cement where not otherwise indicated.

END OF SECTION

INTERIOR FINISH SYSTEM

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. Interior finish systems applied over a substrate of cementitious backer units.
 - a. Locations: Shower ceilings and as indicated on Drawings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 09 Section "Gypsum Board" for cementitious backer units for interior substrates.

1.3 DEFINITIONS

- A. Interior 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. General: Provide systems that comply with the following performance requirements:
 - 1. Bond Integrity: Free from bond failure within system 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 system and assemblies behind it or through them into interior of building that results in deterioration or degradation of system and assemblies behind it, including substrates, supporting wall construction, and interior finish.
- B. Physical Properties Finish System: Provide system whose physical properties and structural performance comply with the following when tested per methods referenced:
 - 1. Abrasion Resistance: Showing no cracking, checking, or loss of film integrity after exposure to 528 quarts (500 L) of sand when tested per ASTM D 968, Method A.
 - 2. 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.

3. Mildew Resistance: Showing no growth when tested per ASTM D 3273 after 28 days.
4. Salt-Spray Resistance: Showing no cracking, checking, crazing, erosion, blistering, peeling, or delamination after testing for 300 hours per ASTM B 117.
5. Tensile Adhesion: No failure in the adhesive, base coat, or finish coat. Minimum 5-psi (34.5-kPa) tensile strength before and after freeze-thaw and accelerated weathering tests per EIMA 101.03.
6. Water Resistance: Showing no cracking, checking, crazing, erosion, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type and component of IFS indicated.
- B. Shop Drawings: For IFS. Include plans, elevations, sections, details of components, details of penetration and termination, flashing details, joint locations and configurations, fastening and anchorage details including mechanical fasteners, and connections and attachments to other work.
- C. Samples for Initial Selection: For each type of finish-coat color and texture indicated.
 1. Include similar Samples of joint sealants and exposed accessories involving color selection.
- D. 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 EIFS and joint sealants comply with requirements.
- C. Material or Product Certificates: For[cementitious materials and aggregates and for each joint sealant, from manufacturer.
- 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 IFS to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is certified in writing by system manufacturer as qualified to install manufacturer's system.
- 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 Finish System manufacturer as compatible with other system components.
- E. Fire-Test-Response Characteristics: Provide system 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.
- F. Mockups: Before installing system, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed Work:
 - 1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting fabrication of work.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1

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. Manufacturers: Subject to compliance with requirements, provide interior / exterior finish systems by one of the following:
 - 1. Dryvit Systems, Inc.
 - 2. Parex Incorporated.
 - 3. Senergy Div.; of Harris Specialty Chemicals, Inc.
 - 4. Sto Corp.; Sto Finish Systems Div.

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 system 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: System 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 system 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).
- E. Base-Coat Materials: System 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. Finish-Coat Materials: System 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.
- G. Water: Potable.
- H. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with system manufacturer's written requirements, manufactured from vinyl plastic and complying with ASTM C 1063.
 - 1. Special aluminum trim modified "R" Extrusion shall be as manufactured by AFS Specialty Metal Products in profile as indicated on Drawings.

2.3 ELASTOMERIC SEALANTS

- A. Elastomeric Sealant Products: Provide system 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 "EIMA Guide for Use of Sealants with Exterior Insulation and Finish Systems, Class PB" and with requirements in Division 7 Section "Joint Sealants" for products corresponding to description indicated below:
 - 1. Low-modulus silicone sealant.

- 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.

2.4 MIXING

- A. General: Comply with system manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by system manufacturer. Mix materials in clean containers. Use materials within time period specified by system 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 system. Proceed with installation of system only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling caused by application of systems. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- B. Protect system, substrates, and wall construction behind them from inclement weather during installation. Prevent infiltration of moisture behind system and deterioration of substrates.
- C. Prepare and clean substrates to comply with system 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 INSTALLATION

- A. Comply with ASTM PS 49 and system manufacturer's written instructions for installation of system as applicable to each type of substrate indicated.
- B. Install trim accessories at locations indicated according to system manufacturer's written instructions.
- C. Apply base coat to substrate in minimum thickness recommended in writing by system manufacturer, but not less than 1/16-inch (1.6-mm) dry-coat thickness.
- D. Embed reinforcing mesh of 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 (64 mm) or otherwise treated at joints to comply with ASTM PS 49 and system manufacturer's written requirements. Do not lap reinforcing mesh within 8 inches (204 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
 - 1. Standard reinforcing mesh, unless otherwise indicated.

- E. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-305-mm) strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- (200-mm-) wide strip reinforcing mesh at both inside and outside corners, unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.
 - 1. At aesthetic reveals, apply strip reinforcing mesh not less than 8 inches (200 mm) wide.
 - 2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.
- F. Shapes: Fully embed reinforcing mesh in base coat.
- G. Apply finish coat over dry base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by system manufacturer to produce a uniform finish of color and texture matching approved sample.

3.4 INSTALLATION OF JOINT SEALANTS

- A. Prepare joints and apply sealants, of type and at locations indicated, to comply with applicable requirements in Division 7 Section "Joint Sealants" and in "EIMA Guide for Use of Sealants with Exterior Insulation and Finish Systems."
 - 1. Clean surfaces to receive sealants to comply with indicated requirements and system manufacturer's written instructions.
 - 2. Apply primer recommended in writing by sealant manufacturer for surfaces to be sealed.
 - 3. Install sealant backing to control depth and configuration of sealant joint and to prevent sealant from adhering to back of joint.
 - 4. Apply masking tape to protect areas adjacent to sealant joints. Remove tape immediately after tooling joints, without disturbing joint seal.
 - 5. Recess sealant sufficiently from surface of system so an additional sealant application, including backing rod, can be installed without protruding beyond system surface.
 - 6. Apply joint sealants after base coat has cured but before applying finish coat.

3.5 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

METAL ROOF PANELS

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. Factory-formed and field-assembled, standing-seam metal roof panels.

- B. Related Sections include the following:

- 1. Division 06 Section "Wood Roof Decking" for wood decking supporting metal roof panels
- 2. Division 06 Section "Rough Carpentry" for wood sheathing supporting metal roof panels.
- 3. Division 06 Section "Shop Fabricated Wood Trusses" and "Glued-Laminated Construction" for wood trusses supporting metal roof panels.
- 4. Division 06 Section "Sheet Metal Flashing and Trim" for flashings and other sheet metal work not part of metal roof panel assemblies.
- 5. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft. (75 Pa).
 - 2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.

3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.
- C. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
1. Test-Pressure Difference: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12.0 lbf/sq. ft. (575 Pa).
 2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
 3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.
- D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift resistance class indicated.
- E. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
1. Fire/Windstorm Classification: Class 1A-90.
 2. Hail Resistance: MH.
- F. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
1. Wind Loads: As indicated on Drawings.
 2. Snow Loads: As indicated on Drawings.
 3. Deflection Limits: Engineer metal roof panel assemblies to withstand design loads with vertical deflections no greater than 1/180 of the span.
- G. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- 1.5 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 roofing.

1. Include plans, elevations, sections, and attachment details.
 2. Detail fabrication and installation layouts, expansion joint locations, fixed points, and keyed details. Distinguish between shop- and field-assembled work.
 3. Include details for forming, including seams and dimensions.
 4. Include details for joining and securing, including layout and spacing of fasteners, cleats, and other attachments. Include pattern of seams.
 5. Include details of termination points and assemblies.
 6. Include details of expansion joints, including showing direction of expansion and contraction from fixed points.
 7. Include details of roof penetrations.
 8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings.
 9. Include details of special conditions.
 10. Include details of connections to adjoining work.
 11. Detail the following accessory items, at scale of not less than **1-1/2 inches per 12 inches**
 - a. Flashing and trim.
 - b. Gutters and downspouts as they relate to adjacent sheet metal roofing.
 - c. Roof curbs.
 - d. Attachment of snow guards.
- C. Samples for Initial Selection: For each type of sheet metal with factory-applied finishes.
1. Include Samples of trim and accessories involving finish or color selection.
- D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Roofing: **12 inches (300 mm)** long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, and other attachments.
 2. Trim and Metal Closures: **12 inches (300 mm)** long and in required profile. Include fasteners and other exposed accessories.
 3. Other Accessories: **12-inch- (300-mm-)** long Samples for each type of other accessory.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Roof 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. Sheet metal roofing, seam locations, and attachments.
 2. Equipment supports, pipe supports, and penetrations.
 3. Snow guards.
 4. Details for penetrations.

- B. Qualification Data: For Installer.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing sheet metals and accessories to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An installer with not less than five (5) years of successful experience in installing metal roof panels similar to those required for this project and which is trained and approved by manufacturer.
 - 1. Engineering Responsibility: Preparation of data for metal roof panels, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal roof panels 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. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, deck Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
 - 4. Examine deck substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 5. Review structural loading limitations of deck during and after roofing.
 - 6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.

7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
8. Review temporary protection requirements for metal roof panel assembly during and after installation.
9. Review roof observation and repair procedures after metal roof panel installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.
 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal roof panels without field measurements, or allow for field-trimming of panels. Coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.11 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations, which are specified in Division 7 Section "Roof Accessories."
- B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer 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 PERFORMANCE REQUIREMENTS

- A. General Performance: Sheet metal roofing system including, but not limited to, metal roof panels, cleats, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, fascia panels, trim, underlayment, and accessories, shall comply with requirements without failure due to defective manufacture, fabrication, or installation, or due to other defects in construction. Sheet metal roofing shall remain watertight.
- B. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or indicated on Drawings.
- C. Recycled Content of Steel-Sheet Roofing: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 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 metal roof panel 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.

2.3 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
 2. Surface: Smooth, flat finish.
 3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings.
 - a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Fluoropolymer Three-Coat System: Manufacturer's standard three-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 physical properties and coating performance requirements of AAMA 2605, except as modified below:
 - a) Humidity Resistance: 1000 hours.
 - b) Salt-Spray Resistance: 1000 hours.
- B. Panel Sealants:
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 UNDERLAYMENT MATERIALS

- A. Self-Adhering, Polyethylene-Faced Sheet: ASTM D 1970, 40 mils (1.0 mm) thick minimum, consisting of slip-resisting polyethylene-film reinforcing and top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.
1. Products:
 - a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "A."
 - b. Grace, W. R. & Co.; Grace Ice and Water Shield.
 - c. Owens Corning; WeatherLock.
- B. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft. (0.24 kg/sq. m), rosin sized.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.
1. Fasteners for Roof Panels: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal roof panels.
 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- B. 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.

2.6 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and snapping panels together.
1. Basis-of-Design Product: Snap-Seam panels as manufactured by AEP-Span or a comparable product of one of the following:
 - a. ATAS International, Inc.
 - b. Berridge Manufacturing Company.
 - c. CENTRIA Architectural Systems.
 - d. Fabral, Inc.

- e. Morin Corporation; a Metecno Group Company.
- 2. Material: Aluminum-zinc alloy-coated steel sheet, 0.0329 inch (0.85 mm) thick.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: Custom color to match Architect's samples.
- 3. Clips: Floating to accommodate thermal movement.
 - a. Material: 0.0428-inch (1.06-mm-) thick, zinc-coated (galvanized) steel sheet.
- 4. Panel Coverage: 18 inches (457 mm).
- 5. Panel Height: 1.5 inches (38 mm).
- 6. Uplift Rating: UL 90.

2.7 ACCESSORIES

- A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.0179-inch- (0.45-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.
- C. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, clamps, or hooks for anchoring.
 - 1. Seam-Mounted, Bar-Type Snow Guards: stainless-steel rods or bars held in place by stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.
 - a. Stainless-Steel Finish: Enamel or Fluoropolymer.
 - 1) Color to match metal roof panels.
 - b. Products:
 - 1) Alpine Snow Guards, Div. Of Vermont Slate & Copper Services, Inc.; Model No. 05-98.
 - 2) LMCurbs; S-5! SnoFence.

- 3) Riddell & Company, Inc.; Snobar
- 4) Snow Management Systems, a division of Contek, Inc.; Vermont Snowguard.

D. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.8 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

2.9 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 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, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.
 - 1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - 2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
- C. Install fasciae and copings to comply with requirements specified in Division 7 Section "Manufactured Roof Specialties."

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.
 - 1. Apply self-adhering sheet underlayment over entire roof.
- B. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal roofing and related flashing.
- C. Install flashings to cover underlayment according to requirements in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cutting of metal roof panels by torch is not permitted.
 2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels.
 3. Provide metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.
 4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 5. Locate and space fastenings in uniform vertical and horizontal alignment.
 6. Install ridge and hip caps as metal roof panel work proceeds.
 7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.
- B. Fasteners:
1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.
1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.5 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
1. Install clips to supports with self-tapping fasteners.

2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (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 weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- C. Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam metal roof panels with clamps or set screws. Do not use fasteners that will penetrate metal roof panels.
 1. Number of rows, spacing and starting point above roof edge shall be according to manufacturer's recommendation subject to approval by Architect.
- D. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

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. Metal gutters and downspouts, including splash blocks.
 2. Roof sheet metal flashings and fabrications.
 3. Miscellaneous sheet metal flashing.
 4. Exposed trim and miscellaneous sheet metal.
 5. Manufactured reglets.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 3 Section "Cast-in-Place Concrete" for installing reglets.
 2. Division 4 Section "Unit Masonry Assemblies" for through-wall flashing, reglets, and other integral masonry flashings specified as part of masonry work.
 3. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
 4. Division 7 Roofing Sections for flashing and roofing accessories installed integral with roofing membrane as part of roofing-system work.
 5. Division 7 Section "Metal Roof Panels" for factory-formed metal roof panels and flashing and trim not part of sheet metal flashing and trim.
 6. Division 7 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 **1-1/2 inches per 12 inches (1:10)**.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. 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.
- C. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

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. Solder for Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
 - E. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
 - F. 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."
 - G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
 - H. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
 - I. 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.
 - J. 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 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
 - 1. Gutter Style: Half Round
 - 2. Expansion Joints: Lap type.
 - 3. Accessories:
 - a. Continuous removable leaf screen with sheet metal frame and hardware cloth screen.
 - b. Valley baffles.
 - 4. Fabricate gutters from the following material:
 - a. Aluminum: 0.050 inch (1.2 mm) thick.
- B. Downspouts: Fabricate rectangular downspouts to cross section indicated complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
 - 1. Fabricate downspouts from the following material:
 - a. Aluminum: 0.050 inch (1.2 mm) thick
 - 2. Splash Blocks: Fabricated from concrete if downspout spills to grade.

2.6 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.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following material:
 - 1. Aluminum: 0.0320 inch (0.8 mm) thick.
 - 2. Stainless Steel: 0.0156 inch (0.4 mm) thick.
- B. Valley Flashing: Fabricate from the following material:
 - 1. Aluminum: 0.0320 inch (0.8 mm) thick.
- C. Drip Edges: Fabricate from the following material:
 - 1. Aluminum: 0.0320 inch (0.8 mm) thick.
- D. Eave and Rake Flashing: Fabricate from the following material:
 - 1. Aluminum: 0.0320 inch (0.8 mm) thick.

2.8 UNDERLAYMENT MATERIALS

- A. 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.

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

2.9 MANUFACTURED REGLETS

A. General: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces and compatible with flashing indicated.

1. Material:

- a. Stainless steel, 0.0187 inch (0.5 mm) thick
- b. Aluminum, 0.024 inch (0.6 mm) thick.

B. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

C. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.

D. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

E. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.

F. Flexible Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.

G. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of the counterflashing lower edge.

1. Material: Stainless steel, 0.0187 inch (0.5 mm) thick.

2. Material: Aluminum, 0.024 inch (0.6 mm) thick.

H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Fry Reglet Corporation.
2. Hickman: W.P. Hickman Co.
3. Keystone Flashing Company.
4. MM Systems Corporation

2.10 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. Pretinning is not required for lead.
 - 3. 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.
 - 4. 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. Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with elastomeric sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets or straps spaced not more than 36 inches (900 mm) apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.24 m) apart. Install expansion joint caps.
 - 2. Install continuous gutter screens on gutters with noncorrosive fasteners, removable or hinged to swing open for cleaning gutters.
- C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
 - 1. Provide elbows at base of downspout to direct water away from building.
 - 2. Connect downspouts to underground drainage system if indicated.

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.

- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 4 Section "Unit Masonry Assemblies."
- C. Reglets: Installation of reglets is specified in Division 3 Section "Cast-in-Place Concrete" and Division 4 Section "Unit Masonry Assemblies."

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****

ROOF 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. Equipment supports.

- B. Related Sections include the following:

- 1. Division 5 Section "Metal Fabrications" for ladders and miscellaneous metal framing and supports.
 - 2. Division 6 Section "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.
 - 3. Division 7 Section "Sheet Metal Flashing and Trim" for shop and field fabricated metal flashing, counterflashing, gutters and downspouts.
 - 4. Division 7 Sections for roofing accessories included as part of roofing Work.
 - 5. Division 9 Section "Painting" for shop primers and field painting.
 - 6. Division 23 Section "Power Ventilators" for power roof-mounted ventilators.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.
- C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples in manufacturer's standard sizes, and of same thickness and material indicated for the Work. If

finishes involve normal color or shade variations, include sample sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Roof Curbs and Equipment Supports:
 - a. Babcock-Davis Hatchways, Inc.
 - b. Colony Custom Curbs.
 - c. Custom Curb, Inc.
 - d. LMCurbs.
 - e. Metallic Products Corporation.
 - f. Pate Co.(The).
 - g. ThyCurb, Inc.

2.2 MATERIALS, GENERAL

A. Galvanized Steel Sheet: ASTM A 653/A 653M with G90 (Z275) coating designation; commercial quality, unless otherwise indicated.

1. Structural Quality: Grade 40 (Grade 275), where indicated or as required for strength.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M with Class AZ-50 (AZ-150) coating, structural quality, Grade 40 (Grade 275), or as required for strength.

C. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.

D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

- G. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coating.
- H. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- I. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.
- J. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.3 EQUIPMENT SUPPORTS

- A. General: Provide equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
- B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch- (1.9-mm-) thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.
 - 1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
 - 2. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 3. Fabricate units to minimum height of 8 inches (200 mm), unless otherwise indicated.
 - 4. Sloping Roofs: Where slope of roof deck exceeds 1/4 inch per foot (1:48), fabricate support units with height tapered to match slope to level tops of units.

2.4 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. 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.

2.5 GALVANIZED STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.
- B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated.
- C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.
- D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.
- E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.
- F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.2 CLEANING AND PROTECTION

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

****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 Assemblies" for joint fillers for non-fire-resistive-rated masonry construction.
 - 3. Division 7 Section "Joint Sealants" for non-fire-resistive-rated joint sealants.
 - 4. Division 23 Sections specifying ducts and piping penetrations.
 - 5. Division 26 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.
- B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
 - 1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

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 Project site.

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
- 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****

STAINLESS-STEEL DOORS AND FRAMES

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 stainless-steel doors and frames.
- B. Related Requirements:
 - 1. Division 08 Section "Door Hardware" for door hardware for stainless-steel doors.

1.3 COORDINATION

- A. Coordinate anchorage installation for stainless-steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.4 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 electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 7. Details of anchorages, joints, field splices, and connections.
 - 8. Details of accessories.
 - 9. Details of moldings, removable stops, and glazing.

- C. Samples:
 - 1. Finishes: For each type of exposed finish required, prepared on Samples of not less than **3 by 5 inches (75 by 125 mm)**.
- D. Product Schedule: For stainless-steel doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of stainless-steel door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver stainless-steel doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store stainless-steel doors and frames under cover at Project site with head up. Place units on minimum **4-inch- (100-mm-)** high wood blocking.
- D. Provide minimum **1/4-inch (6-mm)** space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide stainless steel doors and frames by one of the following:
 - 1. Stainless Steel Doors and Frames:
 - a. Amweld Building Products, LLC.
 - b. Ceco Door Products; an ASSA ABLOY Group Company.
 - c. CURRIES Company; an ASSA ABLOY Group Company.
 - d. Fleming Door Products Ltd.; an ASSA ABLOY Group Company.
 - e. Pioneer Industries, Inc.
 - f. Republic Doors and Frames; a Windsor Republic Door Company
 - g. Steelcraft; an Ingersoll-Rand Company.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency, acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard

construction requirements for tested and labeled fire-rated door assemblies except for size.

2. Temperature-Rise Limit: Where indicated, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

- B. Smoke- and Draft-Control Door Assemblies: Provide assemblies with gaskets listed and labeled for some and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 STAINLESS-STEEL DOORS AND FRAMES

- A. Construct stainless-steel door and frame assemblies to comply with NAAMM-HMMA 866 for the application indicated, including materials, fabrication methods, hardware reinforcement, tolerances, and clearances, and as specified. Comply with SDI A250.4, for Physical Performance Level A.

- B. Doors and Frames for Highly Corrosive Environments: (For doors and frames exposed to pool environment.)

1. Stainless-Steel Doors:

- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches (44.5 mm).
- c. Face Sheets: Type 316 stainless-steel sheet, minimum thickness 0.062 inch (1.59 mm).
- d. Edge Construction: Continuously welded with no visible seam.
- e. Top and Bottom Edges: Closed with continuous stainless-steel channels with minimum thickness of 0.062 inch (1.27 mm), adhesive laminated to face sheets.
- f. Core Construction: Polyisocyanurate, polystyrene, or polyurethane laminated to face sheets.
- g. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors

2. Stainless-Steel Frames:

- a. Materials: Type 316 stainless-steel sheet.
- b. Door Frames for Openings 48 Inches (1219 mm) Wide or Less: Fabricate from stainless-steel sheet, minimum thickness 0.062 inch (1.59 mm).
- c. Construction: Full profile welded.

3. Hardware Reinforcement: Stainless-steel sheet.

4. Finish: No. 4, Directional Satin

2.4 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless-steel, Type 316.
- B. Foam-Plastic Insulation: Manufacturer's standard polystyrene or urethane board insulation with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within door.

- C. Inserts, Bolts, and Anchor Fasteners: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 for bolts and nuts.

2.5 FRAME ANCHORS

- A. Provide anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
- B. Postinstalled Expansion Anchor: Minimum **3/8-inch- (9.5-mm-)** diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- C. Number and Spacing:
 - 1. Masonry Type: Locate anchors not more than **18 inches (457 mm)** from top and bottom of frame. Space anchors not more than **32 inches (813 mm)** o.c.
 - 2. Stud-Wall Type: Locate anchors not more than **18 inches (457 mm)** from top and bottom of frame. Space anchors not more than **32 inches (813 mm)** o.c. Two anchors per head for frames more than **42 inches (1066 mm)** wide and mounted in metal-stud partitions.
 - 3. Compression Type: Not less than two anchors in each jamb.
 - 4. Postinstalled Expansion Type: Locate anchors not more than **6 inches (152 mm)** from top and bottom of frame. Space anchors not more than **26 inches (660 mm)** o.c.
- D. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- E. Material: Stainless-steel sheet. Same type as door face.

2.6 FABRICATION

- A. Stainless-Steel Door Fabrication: Provide doors rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.
 - 1. Tolerances: Fabricate doors to tolerances indicated in NAAMM-HMMA 866.
 - 2. Stops and Moldings: Factory cut openings in doors. Provide minimum **0.038-inch- (0.95-mm-)** thick, stainless-steel stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.
 - a. Glazed Lites: Provide fixed stops and moldings welded on secure side of door.
 - b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
- B. Stainless-Steel Frame Fabrication: Provide stainless-steel frames rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.
 - 1. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 866.
 - 2. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

3. Provide countersunk, flat-, or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 4. Door Silencers: Except on weather-stripped and gasketed frames, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
 5. Grouted Frames:
 - a. Plaster Guards: Weld guards to frame at back of hardware mortises and mounting holes in frames to be grouted.
 - b. Head Reinforcement: For frames more than 48 inches (1219 mm) wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
- C. Hardware Preparation: Factory prepare stainless-steel doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule, and templates.
1. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.7 FINISHES

- A. Stainless-Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Grain Direction: For finishes exhibiting grain, run grain vertically on door faces and frame jambs.

2.8 ACCESSORIES

- A. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches (102 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace stainless-steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb, and perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install stainless-steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with approved Shop Drawings and with manufacturer's written instructions.

B. Stainless-Steel Frames:

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable glazing stops located on secure side of opening.
2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
4. Solidly pack mineral-fiber insulation inside frames.
5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors.
6. Installation Tolerances: Adjust stainless-steel frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb, and perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.

C. Stainless-Steel Doors: Fit and adjust stainless-steel doors accurately in frames within clearances specified below:

1. Non-Fire-Rated Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA 866.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3. Smoke-Control Doors: Install doors according to NFPA 105.

3.3 ADJUSTING AND CLEANING

- A. Clean grout and other bonding material off stainless-steel doors and frames immediately after installation.
- B. Stainless-Steel Touchup: Immediately after erection, smooth any scratched or damaged areas of stainless steel; polish to match undamaged finish.

****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 01 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: 10 years from date of shipment. In addition, a limited lifetime (while the door is in its specified application in its original installation) warranty covering: failure of corner joinery, core deterioration, delamination or bubbling of door skin.

- B. Provide written warranty signed by Manufacturer guaranteeing hardware attachment of factory installed finish hardware.

- 1. Time Period: 10 years from date of shipment.

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, SpecLite 3, 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. Sweep: Provide manufacturer's **adjustable** sweep.
- G. 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 are to 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 to be tubular shape to accept hardware as specified.
 4. Top and bottom rails to be extruded with internal legs for interlocking rigid weather bar.
 5. Face Sheets to be secured with extruded interlocking edges. (No snap-on trim will be accepted).
 6. Joinery to 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 5 pounds per cubic ft. density. All doors are to be properly reinforced for hardware prior to Urethane core foaming in door.
 8. Face Sheets:
 - a. Fiberglass Reinforced Plastic Sheets to be polyester SpecLite 3, 0.120" thick, with pebble-like finish.
 9. Pairs of Doors: Meeting stiles to 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 to 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 to be Urethane of 5 pounds per cubic foot density.
 4. Face Skins to be as follows:
 - a. Fiberglass Reinforced polyester panel faces to be SpecLite 3, 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 to 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.
- C. Stops: Provide applied door stops at single acting doors. Stops to be caulked and weathertight by installer in field.
- D. Fabrication: Fabricate tubular frame assemblies as shown. Vertical frame members are to be the full height of the entrance opening. Joints are to 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 are to 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 08710 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 08710, 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 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.

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- 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 07900 "Joint Sealants."

****END OF SECTION****

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing 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. Wall access doors and frames.
2. Ceiling access doors and frames.
3. Fire-rated ceiling access doors and frames.

- B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for blocking out openings for access doors and frames in concrete.
2. Division 04 Section "Unit Masonry" for anchoring and grouting access door frames set in masonry construction.
3. Division 08 Section "Door Hardware" for mortise or rim cylinder locks and master keying.
4. Division 23 Section "Air Duct Accessories" for ventilation duct access doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.
- B. Shop Drawings: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.
- D. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.
- E. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
1. Method of attaching door frames to surrounding construction.

2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction:
 1. NFPA 252 or UL 10B for vertical access doors.
 2. ASTM E 119, UBC Standard 7.1 or UL 263 for horizontal access doors and frames.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cesco Products.
 2. Jensen Industries.
 3. J. L. Industries, Inc.
 4. Karp Associates, Inc.
 5. Larsen's Manufacturing Company.
 6. Milcor Limited Partnership.
 7. Nystrom Building Products Co.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M. Electrolytic zinc-coated steel sheet, complying with ASTM A 591/A 591M, Class C coating, may be substituted at fabricator's option.

- C. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M for uncoated base metal.
- D. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.3 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- B. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.4 ACCESS DOORS AND FRAMES

- A. Flush, Uninsulated, Fire-Rated Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
 - 1. Locations: Masonry walls.
 - 2. Fire-Resistance Rating: As indicated.
 - 3. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
 - 4. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, flush construction.
 - 5. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with 1-inch- (25-mm-) wide, surface-mounted trim.
 - 6. Hinges: Continuous piano hinge.
 - 7. Automatic Closer: Spring type.
 - 8. Latch: Self-latching bolt operated by key with interior release.
- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
 - 1. Locations: Masonry wall surfaces.
 - 2. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with exposed face flange of frame.
 - 3. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with 1-inch- (25-mm-) wide, surface-mounted trim.
 - 4. Hinges: Continuous piano hinge.

5. Latch: Screwdriver-operated cam latch.

2.5 FABRICATION

- A. General: Provide access door assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 1. Exposed Flanges: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame.
 2. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
 3. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction. Furnish adjustable metal masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.7 STEEL FINISHES

- A. Surface Preparation: 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. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install access doors with trimless frames flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

****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. Section Includes:

1. Exterior and interior storefront framing.
2. Storefront framing for punched openings.
3. Exterior and interior manual-swing entrance doors and door-frame units.

B. Related Sections:

1. Division 08 Section "Glazed Aluminum Curtain Walls" for curtain-wall systems that mechanically retain glazing on four sides.
2. 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.

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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.

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 judgment, 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 Kawneer Co. "451T" System or approved equal from one of the following:
 - 1. Tube Lite.
 - 2. EFCO.
 - 3. Special Lite.

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.

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- B. Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, or other materials warranted by the manufacturer to be non-corrosive 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 non-corrosive 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 "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 pre-assemble 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. 0.125" minimum wall thickness and type 6063-T5 aluminum alloy. 0.625" x 1.25" applied door stops with screws and weatherstripping.
 - 2. Where wide strikes or electric strikes are used, a 0.625" 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 0.5" pilot hole on the door side of the frame, and anchoring the frame from the wall side of the frame.

C. Stile-and-Rail Type Aluminum Doors:

1. Frame: Provide tubular frame members, fabricated with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts.
2. Design:
 - a. Provide 1-3/4" thick doors of design indicated with door skins a minimum of 0.125" thick.
 - b. Wide Stile.
3. Glazing: Fabricate doors to facilitate replacement of glass or panels, without disassembly of stiles and rails. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for non-removal.

2.4 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.

2.5 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. Pre-glaze 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. Minimum 5/8" high x minimum 1¼" 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 (i.e., 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.

2.6 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, pre-treat, 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: Custom color to match Architect's sample.

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 Division 8 Section "Glazing" for installation of glass and other panels indicated to be glazed into doors and framing, and not pre-glazed 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 "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

GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes curtain wall and related work.
- B. Primary Components of the glazed curtain wall system include:
 - 1. Aluminum curtain wall framing system
 - 2. Internal steel reinforcement.
 - 3. Glazing gaskets.
 - 4. Column covers, soffits, sills, copings, trim and similar border and filler items.
 - 5. Anchors, shims, fasteners, inserts, accessories, and support brackets.
 - 6. Insulation and firestopping within the curtain wall system.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Joint Sealants" for joint sealing within the curtain wall system.
 - 2. Division 8 Section "Aluminum Entrances and Storefronts" for operable aluminum windows included as part of the curtain wall system.
 - 3. Division 8 Section "Glazing" for glass and glazing included as part of the curtain wall system.

1.3 SYSTEM DESCRIPTION

- A. Self-supporting 7½" and 6" as indicated on drawings overall depth curtain wall, with pressure plate and covers attached to the tongue of back member. Glass is captured both vertically and horizontally on all 4 sides with no exposed fasteners used to the greatest extent possible. Site line dimensions to be no less than 2 ½" (635 mm). Glass to be supported at the exterior of the system with the exterior face of glass no more than ¾".
- B. Verticals and horizontals shall have a silicone compatible elastomer thermal break separator which will adhere to silicone sealant. Framing intersections to incorporate silicone compatible "zone dams". All horizontal glazing pockets will provide weep holes to drain all accumulated water to exterior.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide the manufacturer's stock curtain wall system, adapted to the application indicated, that complies with performance requirements specified as demonstrated by testing the manufacturers corresponding stock systems according to test methods indicated.

1. Design wind velocity at the project site is 80 mph, must comply with BOCA and other applicable codes.
- B. Air and Water Infiltration: Design and install the glazed curtain wall system for permanent resistance to air and water leakage through the system in accordance with the following:
1. Air Infiltration: Air leakage through the curtain wall system shall not exceed 0.06 cfm per sq. ft. of wall area when tested in accordance with ASTM E 283 at a minimum static air pressure differential of 6.24 lbf per sq. ft.
 2. Water Penetration: There shall be no uncontrolled water leakage through the curtain wall system, as defined in AAMA 501, when tested in accordance with ASTM E 331 at a minimum differential pressure of 20 percent of inward design wind load but not less than 6.24 lbf per sq. ft. or more than 15 lbf per sq. ft.
- C. Structural Performance: Design, engineer, fabricate, and install the glazed aluminum curtain wall system to withstand the effects of a wind load of 25 psf acting inward and 20 psf acting outward, normal to the plane of the wall, when tested in accordance with ASTM E 330, with no material failures or permanent deformation of structural members.
1. Structural test pressure shall be equal to 150 percent of the inward and outward acting design wind pressures.
- D. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (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 smaller.
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
 3. Cantilever Deflection: Where framing members overhang an anchor point, limited to 2 times the length of cantilevered member, divided by 175.
- E. Thermal Movements: The glazed aluminum curtain wall system shall be capable of withstanding thermal movements resulting from an ambient temperature differential of 120 deg F (67 deg C), which may result in a metal surface temperature range of 180 deg F (100 deg C) within the curtain wall framing without causing buckling, stresses on glass, failure of joint sealants, damaging loads on fasteners, or other detrimental effects.
- F. Condensation Requirements: The glazed aluminum curtain wall system shall be of thermal-break construction that has been tested in accordance with AAMA 1502.7 and certified by the manufacturer to provide a condensation resistance factor (CRF) of at least 70.
- G. Sound Transmission: The average sound transmission loss through the glazed aluminum curtain wall system shall be a minimum of 30 db for the standard frequency range of 125 to 4000 Hz when tested in accordance with ASTM E 90 with the glass type indicated.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product data: Include manufacturer's specifications for materials and fabrication, installation instructions, and recommendations for maintenance. Include test reports showing compliance with project requirements where test method is indicated.
- C. Shop Drawings: Show adaptation of manufacturer's standard glazed aluminum curtain wall system to the project; include typical unit elevations at 1/2-inch scale and details at 3-inch scale. Show dimensions, profiles of members, anchorage system, interface with building construction, and glazing.
 - 1. Include setting drawings, templates, and directions for the installation of anchor bolts and other anchorages installed as a unit of work under other sections.
 - 2. Indicate where and how the system deviates from contract drawings and specifications. Show section moduli of wind-load-bearing members and calculations of stresses and deflections. Provide material properties and other information needed for structural analysis including computations, prepared, signed, or sealed by a professional engineer licensed to practice in the jurisdiction where the project is located.
- D. Samples: Provide pairs of samples of each aluminum finish type and color on 12-inch-long sections of extrusions of formed shapes and on 6-inch squared of aluminum sheet or plate. Include 2 or more units in each sample set showing the extreme limits of variations expected in color and texture of finish.
 - 1. The Architect reserves the right to require fabrication samples showing the following:
 - a. Prime members.
 - b. Joinery.
 - c. Anchorage.
 - d. Expansion provisions.
 - e. Glazing and similar details.
 - f. Profiles.
 - g. Intersections.
- E. Installer certificates signed by the manufacturer certifying that the Installers of the glazed aluminum curtain wall system comply with requirements indicated.
- F. Test Reports: Provide test reports from a qualified independent testing laboratory that show compliance of the glazed aluminum curtain wall system with performance requirements indicated based on comprehensive testing of the system by the laboratory.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has successfully completed installation of glazed curtain wall systems similar in material, design, and extent to that indicated for the Project and who is acceptable to the curtain wall manufacturer.
- B. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to the Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying the progress of the Work.

- C. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or referenced standards.
- D. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or on one component pane of units with the appropriate certification label of inspecting and testing organization indicated below.
 - 1. Insulating Glass Certification Council (IGCC).
 - 2. Associated Laboratories Inc. (ALI).
- E. Single-Source Responsibility: Provide glazed aluminum curtain wall system for the project from one source from a single manufacturer.
- F. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of the curtain wall system and are based on the specific type and model indicated. Curtain wall systems by other manufacturers having equal performance characteristics may be considered provided deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the Architect.
 - 1. The burden of proof for equality of the curtain wall systems is on the proposer.
- G. Pre-installation Conference: Before beginning curtain wall installation, conduct a pre-installation conference at the Project site with the curtain wall system manufacturer, installer, and other interested parties to review procedures, schedules, and coordination of the curtain wall installation with other elements of the Work.
 - 1. Comply with requirements of Division 1 Section: Project Meetings."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.8 SEQUENCING AND SCHEDULING

- A. Schedule installation of the glazed aluminum curtain wall system in sequence with related elements of the Work specified in other Sections to ensure that wall assemblies, including flashing, trim, and joint sealers, are protected against damage from effects of weather, age, corrosion, and other causes.

1.9 WARRANTY

- A. General: Submit a written warranty signed by authorized representatives of the Contractor and installer warranting that portions of the Work involving glazed aluminum curtain wall are of good quality, free from defects, and in conformance with the requirements of the Contract Documents and further promising to repair or replace defective Work during a 5-year period following completion of that portion of the Work.
 - 1. Defective is defined to include the following:
 - a. Glass breakage.
 - b. Failure of operational parts to function normally.
 - c. Deterioration or discoloration of finishes.

- d. Failure of the system to meet performance requirements.
- B. The Warranty submitted under this Section shall not deprive the Owner of other rights or remedies that the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide 1600 Wall System as manufactured by Kawneer or equal products of one of the following:
 - 1. Tubelite Division of Indal Inc.
 - 2. Efco Corporation
 - 3. Vistawall Architectural Products

2.2 MATERIALS

- A. Aluminum: Provide alloy, temper, and thickness recommended by the manufacturer for the type of use and finish indicated and with not less than the strength and durability properties of the alloy and temper designated below for each aluminum form required.
 - 1. Extruded Bar and Shapes: Comply with requirements of ASTM B 221.
 - 2. Plate and Sheet: Comply with requirements of ASTM B 209.
 - 3. Rounded pressure plate cover - 2 ½" dia. where indicated.
- B. Glass: Provide glass of types and thicknesses indicated. Fabricate glass to sizes required for openings indicated with edge clearances and tolerances complying with manufacturer's recommendations. Refer to Division 8 Section "Glass and Glazing" for requirements.
- C. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing or wedge-lock dry glazing system of black, resilient elastomeric glazing gaskets, setting blocks and shims or spacers as required, hardness as selected by manufacturer.
 - 1. Gasket Material: Extruded polyvinyl chloride gaskets complying with requirements of ASTM D 2287.
- D. Structural Rubber Glazing Gaskets: Provide the manufacturer's standard configuration of black lockstrip gaskets, complying with applicable requirements of ASTM C 542 and ASTM C 716.
- E. Glazing sealants and fillers: Comply with requirements in the "Glass and Glazing" section.
- F. Framing System Gaskets and Joint Fillers: Manufacturer's standard permanent framing system gaskets and joint fillers, depending on joint movement and sealing requirements, such as sliding joints, compression joint translation, or nonmoving joints.
- G. Sealants and joint fillers, both for joints within the curtain wall construction and for joints at the interface of curtain wall construction and other work, shall comply with requirements specified in the "Joint Sealers" Section.

- H. Concealed Flashing: Dead-soft 26-gage stainless steel concealed flashing of type selected for compatibility by the manufacturer.
- I. Firestopping Materials: Provide mineral fiber insulation or other noncombustible materials suitable for permanent placement and that comply with governing regulations.

2.3 COMPONENTS

- A. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum units.
 - 1. Brackets not exposed to weather or abrasion may be hot-dip galvanized steel complying with ASTM A 386.
 - 2. Provide nonstaining, nonferrous shims for installation and alignment of curtain wall work.
- B. Fasteners and Accessories: Provide manufacturer's standard non-corrosive fasteners and accessories compatible with materials used in the framing system and with exposed portions that match finish of the curtain wall system. Where movement is expected, provide slip-joint linings of sheets, pads, shims, or washers of fluorocarbon resin or a similar material recommended by the manufacturer.
 - 1. Where fasteners anchor into aluminum less than 0.125-inch thick, provide noncorrosive pressed-in splined grommet nuts or other type reinforcement to receive fastener threads.
- C. Concrete or Masonry Inserts: Cast-iron, malleable iron or hot-dip galvanized steel inserts complying with ASTM A 386.
- D. Stile-and-Rail Type Aluminum Doors:
 - 1. Frame: Provide tubular frame members, fabricated with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts.
 - 2. Design: Provide 1-3/4" thick doors of design indicated with door skins a minimum of 0.125 inch thick.
 - 3. Glazing: Fabricate doors to facilitate replacement of glass or panels, without disassembly of stiles and rails. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for non-removal.

2.4 FABRICATION

- A. General: Fabricate curtain wall system at the manufacturer's shop to the fullest extent possible and before applying finishes. Provide concealed fasteners. Make provisions to weep penetrating water and condensation to the exterior.
 - 1. Match exposed work to produce continuity of line. Fit joints accurately and secure rigidly.
 - 2. Where feasible, install nonglazed panels in prefabricated frames at the manufacturer's shop.
 - 3. Where feasible and at the Contractor's option, install glass in prefabricated frames at the manufacturer's shop.

2.5 FINISHES

- A. General: Comply with the 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. 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 instructions.
 - 1. Fluorocarbon 2-Coating System, Equal to PPG Duranar®: Manufacturer's standard 2-coat thermocured system, composed of specially formulated inhibitive primer and fluorocarbon color topcoat containing no less than 70 percent polyvinylidene fluoride resin by weight: comply with AAMA 605.2.
 - 2. Color and Gloss: Custom as selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Furnish inserts at proper times for setting in concrete formwork, masonry, and similar work indicated to support curtain wall work.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions for protecting, handling, and installing fabricated curtain wall components, with particular care and attention to preservation of applied finishes. Discard or remove and replace damaged members.
- B. Anchor components securely in place in the manner indicated. Shim and allow for movement resulting from changes in thermal conditions. Provide separators and isolators to prevent corrosion, electrolytic deterioration, and freeze-up of moving joints.
- C. Firestopping: Clean debris from behind curtain wall during erection and provide temporary closures to prevent accumulation of debris. Install firestopping to comply with governing regulations and AAMA TIR-A3. Install firestopping with securely anchored metal flanges or make equivalent provisions to prevent dislocation. Comply with requirements of Division 7 Section "Building Insulation."
- D. Glazing: Comply with requirements specified in "Glazing" sections.
- E. Sealants and joint fillers: Comply with requirements specified in "Joint Sealants" sections.
- F. Erection Tolerances: Install components plumb, level, accurately aligned, and located in reference to column lines and floor levels. Adjust work to conform to the tolerances indicated below. Tolerances indicated below are maximum and are not cumulative.
 - 1. Plumb: 1/8 inch in 10 feet; ¼ inch in 40 feet.
 - 2. Level: 1/8 inch in 20 feet; ¼ inch in 40 feet.

3. Alignment: Limit offset of member alignment to 1/16 inch where surfaces are flush or less than 1/2 inch out of flush and separated by less than 2 inches by a reveal or protruding work; otherwise limit offsets to 1/8 inch.
4. Location: 3/8-inch maximum deviation from the measured theoretical location of any member at any location.

3.3 CLEANING

- A. Clean the completed system, inside and out, promptly after erection and installation of glass and sealants, allowing for nominal curing of liquid sealants. The installer shall advise the Contractor of proper and adequate procedures for protection and cleaning during the remainder of the construction period so that the system will be without damage and deterioration at the time of acceptance.
- B. At the time of Substantial Completion, clean curtain wall system thoroughly and polish glass. Demonstrate proper cleaning methods and materials to the Owner's maintenance personnel.

****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 work specified in other sections:
 - 1. Furnishing and installing of Finish Hardware for the following items:
 - a. Division 06 Section "Interior Architectural Woodwork" for casework.
 - b. Division 26 for electrical general requirements.
 - 2. Electrical trades are responsible for roughing in, providing power and control wiring, and connecting finish hardware requiring electrical connections.
- C. Related Sections include the following:
 - 1. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.

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. 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 Schlage AD400 series wireless locks, 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 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. Numbers listed in sets are Ives 5BB1 series.
 - a. Equal products from any B.H.M.A. member will also be acceptable.

C. Continuous Hinges:

1. Furnish door height less one inch. Numbers specified in sets are Ives.
 - a. Ives
 - b. McKinney
 - c. Pemko
 - d. Select Products

D. Mortise Locksets and Latchsets:

1. Function designations are Schlage L9000 with 17A lever trim. (No substitutions)

E. Push & Pull Plates:

1. Products listed in sets are Ives 8000 series.
 - a. Equal products from any B.H.M.A. member will also be acceptable.

F. Closers:

1. Do not furnish surface closers with through-bolts. Furnish wood and machine screws only.
2. 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. Overhead Holders and Stops:

1. Type, function, fasteners, and quantities of fasteners must be the same as Glynn-Johnson specified. Size: Per manufacturer's sizing chart.
 - a. Equal products from any B.H.M.A. member will also be acceptable.

- H. Wall Stops:
 - 1. Furnish with pictorial installation instructions illustrating downward slope of diagonal side.
 - 2. Numbers listed in sets are Ives model WS33.
 - a. Equal products from any B.H.M.A. member will also be acceptable.
- I. Wall Holders:
 - 1. Numbers listed in sets are Ives model WS45.
 - a. Equal products from any B.H.M.A. member will also be acceptable.
- J. Smoke Seals:
 - 1. Numbers listed in sets are National Guard Products.
 - a. Pemko
 - b. Reese
 - c. Zero
- K. Bottom Sweeps:
 - 1. Surface: Attach to outside faces of doors, to make contact with thresholds.
 - 2. Numbers listed in sets are National Guard Products.
 - a. Pemko
 - b. Reese
 - c. Zero
- L. Weatherstripping:
 - 1. Apply to head and jamb stops with no cutouts for stop-applied hardware.
 - 2. Numbers listed in sets are National Guard Products.
 - a. Pemko
 - b. Reese
 - c. Zero
- M. Thresholds:
 - 1. Numbers specified are National Guard Products. Products from other manufacturers are acceptable if equal in material, shape, thickness, and contain equal bumper gaskets and foot seals.
 - a. Pemko
 - b. Reese
 - c. Zero
 - 2. Thresholds of sufficient width to project beyond faces of doors and frames shall be coped around frame and mullion stops and faces, equal in length to full masonry openings, excluding side lights, when faces of frames are not flush with adjacent walls.

3. When faces of frames are flush with adjacent walls, such thresholds shall be coped similarly at stops and mullions but not in front of faces of frames.
 4. Thresholds without projection shall be equal in length to door openings and coped at frame and mullion stops only.
 5. Furnish one unit or assembly per door openings, at batteries, butted together with only hairline joints.
- N. Cylinders and Keying: All hardware components capable of being locked shall be provided with a cylinder housing as listed below. Cylinder housings shall be mortise or rim type as required by function of locking device. Provide cams or tail pieces as required.
1. Furnish cylinder housings & cores factory keyed per the owner's instructions to the existing key system. Furnish two keys per cylinder.
 2. Supply cylinders with interchangeable construction cores for use during the construction period.
 3. Furnish construction master keys as required by Contractor/Construction Manager.
- O. Miscellaneous:
1. Furnish items not categorized in the above descriptions but specified by manufacturers' names in the Hardware Sets.
- P. 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.
- Q. Finishes:
1. Furnish finish for each item as indicated in sets.
- R. 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

3.1 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.

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.

3.2 HARDWARE SETS:

HW SET: 01

1	EA	CONTINUOUS HINGE	112HD	628	IVE
1	EA	INDICATOR PRIVACY	L9040 17A L583-363 L283-722	626	SCH
1	EA	WALL STOP	WS33	626	IVE

HW SET: 02

2	EA	CONTINUOUS HINGE	112HD	628	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
2	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
1	SET	WEATHER SEAL	BY FRAME SUPPLIER		B/O
1	EA	ASTRAGAL	178A	AL	NGP
2	EA	DOOR SWEEP	C627A	AL	NGP
1	EA	THRESHOLD	4425	AL	NGP

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DOOR HARDWARE

HW SET: 03

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 8" X 16"	630	IVE
1	EA	PULL PLATE	8303-0 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS33	626	IVE

HW SET: 04

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

HW SET: 05

1	EA	CONTINUOUS HINGE	112HD	628	IVE
1	EA	CORRIDOR LOCK	L9456BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
1	SET	WEATHER SEAL	BY FRAME SUPPLIER		B/O
1	EA	DOOR SWEEP	C627A	AL	NGP
1	EA	THRESHOLD	425	AL	NGP

HW SET: 06

1	EA	CONTINUOUS HINGE	112HD	628	IVE
1	EA	OFFICE LOCK	L9050BDC 17A L583-363	626	SCH
1	EA	WALL STOP	WS33	626	IVE

HW SET: 07

1	EA	CONTINUOUS HINGE	112HD	628	IVE
1	EA	CLASSROOM LOCK	L9070BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	WALL STOP & HOLDER	WS45	626	IVE
1	SET	WEATHER SEAL	BY FRAME SUPPLIER		B/O
1	EA	DOOR SWEEP	C627A	AL	NGP
1	EA	THRESHOLD	425	AL	NGP

SECTION 087100
DOOR HARDWARE

HW SET: 08

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	LATCHING FLUSH BOLT	FB61P	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
2	EA	SURFACE CLOSER	4111 SCUSH X ST-1496	689	LCN
1	EA	COORDINATOR	COR X FL	628	IVE
1	EA	ASTRAGAL SEAL	5070CL	CLR	NGP
1	SET	SEALS	2525B	BRN	NGP

HW SET: 09

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	SET	SEALS	2525B	BRN	NGP

HW SET: 10

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17A	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN

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.

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. Glazed curtain walls.
 - 3. Storefront framing.
 - 4. Glazed entrances.
- B. Related Sections:
 - 1. Division 08 Section "Aluminum Entrances and Storefronts"
 - 2. Division 08 Section "Glazed Aluminum Curtain Walls."
- C. 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. Glazing for Fire-Rated Window 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 ratings indicated, based on testing according to NFPA 257.
- F. 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.

- G. 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 GDSG-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."
- H. 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. 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.
- D. 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.
- E. 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.
- F. Spandrel Glass:
- 1. All glass will be fully tempered.
 - 2. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.
 - 3. Opacifier material will be either a ceramic frit or silicone opacicoat.
 - a. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B (spandrel glass, one surface ceramic coated), Type I (transparent flat glass), Quality-Q3, and complying with other requirements specified.
 - b. Coated Spandrel Float Glass: Float glass complying with other requirements specified and with the following:
 - 1) Factory apply manufacturer's standard opacifier of the following material to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA Tempering Division's "Engineering Standards Manual."
 - a) Silicone opacifier material.

2.3 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.

2.4 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.

2.5 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.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: 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.

2.7 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.

2.8 GLASS SCHEDULE

A. Schedule of Glass Types:

- GL-1 Annealed Insulating Glass consisting of:
Exterior Lite: 1/4"
Tint: Clear
Airspace: 1/2"
Interior Lite: 1/4"
Tint: Clear
Low-E Coating: #2 Surface.
- GL-2 Tempered Insulating Glass consisting of:
Exterior Lite: 1/4"
Tint: Clear
Airspace: 1/2"
Interior Lite: 1/4"
Tint: Clear
Low-E Coating: #2 Surface.
- GL-3 Insulating Spandrel Glass consisting of:
Exterior Lite: 1/4" tempered glass. (Type to match typical Exterior Glass)
Airspace: 1/2"
Interior Lite: 1/4" tempered glass.
Frit or Opacicoat: #3 Surface.
Color: Black.

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

LOUVERS AND VENTS

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 louvers and vents is indicated on drawings, including indications of sizes and locations.
- B. Types of louvers and vents include the following:
 - 1. Extruded aluminum louvers
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Joint Sealants" for sealants.
 - 2. Division 23 for air-handling louvers connected to ductwork.

1.3 QUALITY ASSURANCE:

- A. Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details and installation procedures, except as otherwise indicated.
- B. Field measurements: Verify size, location and placement of louver units prior to fabrication, wherever possible.
- C. Shop Assembly: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units. Pre-assemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

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; certified test data, where applicable; and installation instructions for required products, including finishes.
- C. Samples: Submit pairs of samples of each type and color of aluminum finish, on 12" long sections of extrusions or formed shapes or 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.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products equal to Ruskin Manufacturing Co. No. EME220DD drainable blade louver at Curtain Wall assemblies. Provide products equal to Ruskin Manufacturing Co. No. EME820DD at masonry wall construction.
 - 1. The Airlite Co.
 - 2. American Warming and Ventilating Co.
 - 3. Construction Specialties, Inc.

2.2 MATERIALS:

- A. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer to provide required finish.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T52.
- C. Fastenings: Use same material as items fastened, unless otherwise indicated. Fasteners for exterior applications may be hot-dip galvanized, stainless steel or aluminum. Provide types, gages and lengths to suit unit installation conditions. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- D. Anchors and Inserts: Use non-ferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
- E. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2.3 FABRICATION, GENERAL:

- A. Provide louvers and accessories of design, materials, sizes, depth, arrangement, and metal thicknesses indicated, or if not indicated, as required for optimum performance with respect to airflow; water penetration; air leakage, where applicable (for adjustable units, if any); strength; durability; and uniform appearance.
- B. Fabricate frames including integral sills to suit adjacent construction with tolerances for installation, including application of sealants in joints between louvers and adjoining work.
- C. Include supports, anchorages, and accessories required for complete assembly.
- D. Join frame members to one another and to stationary louver blades by welding, except where indicated otherwise or where field bolted connections between frame members are made necessary by size of louvers. Maintain equal blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

2.4 STATIONARY EXTRUDED ALUMINUM WALL LOUVERS:

- A. Horizontal Blade Louvers: Size and depth indicated, with blades of profile, slope and spacing indicated, or if not indicated, to meet performance requirements.
 - 1. Extrusion Thickness: Not less than 0.080" for blades and frames.

2. Continuous Horizontal Blades: Conceal supporting framework from vision on outside face of louver by placing braces, mullions and brackets on inside face; with close fitting, field-made splice joints in blades designed to permit expansion and contraction without deforming blades or framework.
 - a. Exterior Corners: Shop miter and weld blades into prefabricated corner units to align with straight sections. Include concealed bracing.
 - b. Aluminum: Not less than 14 gage.

2.5 LOUVER SCREENS

- A. General: Provide louvers with screens at locations indicated.
 1. Screen Location for Fixed Louvers: Interior face, unless otherwise indicated.
 2. Screening Type: Bird screening, unless otherwise indicated.
- B. Secure screens to louver frames with stainless steel machine screws, spaced at each corner and at 12 inch o.c. between.
- C. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:
 1. Metal: Same kind and form of metal as indicated for louver frames to which screens are attached.
 - a. Reinforce extruded aluminum screen frames at corners with clips.
 - b. Finish: Same finish as louver frames to which louver screens are attached.
 - c. Type: Non-rewireable U-shaped frames for permanently securing screen mesh.
- D. Louver Screening for Aluminum Louvers: Fit aluminum louver screen frames with screening covering louver openings and complying with the following requirements:
 1. Bird Screening: 1/2 inch square mesh formed with 0.063 inch diameter aluminum wire.

2.6 BLANK-OFF PANELS

- A. General: Fabricate blank-off panels from materials and to sizes indicated and to comply with the following requirements:
 1. Finish: Match finish applied to louver with respect to coating type, except for color which shall be as follows:
 - a. Black.
 2. Attach blank-off panels to back of louver frames with stainless steel sheet metal screws.

2.7 METAL FINISHES:

- A. GENERAL: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products are assembled. Protect finishes on exposed surfaces with protective covering, prior to shipment. Remove scratches and blemishes from exposed surfaces which will be visible after completing finishing process.
 1. Provide custom color as selected by Architect.

- B. Aluminum Finishes:
 - 1. High-Performance Coating: AA-C12C42R1x (cleaned with inhibitive chemicals, conversion coated with an acid-chromate-fluoride phosphate treatment and painted with organic coating specified below). Apply where high-performance coating is indicated in strict compliance with coating and resin manufacturer's instructions using a licensed applicator.
 - a. Fluorocarbon Coating: Inhibitive thermo-cured primer, 0.2 mil minimum dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil minimum dry film thickness.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION:

- A. Locate and place louver units plumb, level and in proper alignment with adjacent work.
- B. Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations, and refinish entire unit, or provide new units, at Contractor's option.
- D. Protect galvanized and non-ferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry or dissimilar metals.
- E. Refer to Division-7 sections for sealants in connection with installations of louvers.

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. Tile backing panels.
 - 3. Non-load-bearing steel framing.
- 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 "Interior Finish System" for interior/exterior finish system.
 - 3. 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 5 Finish as described in the current edition of the "Gypsum Construction Handbook" of the United States Gypsum Company.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Research/Evaluation Reports: Evidence of compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction that substantiate required fire-resistance rating for each gypsum board shaft-wall assembly.
- 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. ClarkDietrich Building Systems.
 - b. Marino/Ware.
 - c. Jaimes Industries, Inc.
 - d. Steel Stud Solution.
- 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.
- C. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0454 inch (1.15 mm).
 - 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).
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
 - 2. Depth: As indicated.
- G. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical, with face attached to single flange by a slotted leg (web).

- a. Product: U.S. Gypsum No. RC-1 or equal.
- H. 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.
- I. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Framing and Furring:
 - a. ClarkDietrich Building Systems.
 - b. Marino/Ware.
 - c. Jaimes Industries, Inc.
 - d. Steel Stud Solution.
 - B. Components, General: Comply with ASTM C 754 for conditions indicated.
 - C. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
 - D. Hanger Attachments to Concrete: As follows:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
 - a. Type: Cast-in-place anchor, designed for attachment to concrete forms, postinstalled, chemical anchor, or postinstalled, expansion anchor.
 - 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
 - E. Hangers: As follows:
 - 1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.
 - F. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch (1.37 mm), a minimum 1/2-inch- (12.7-mm-) wide flange, with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
 - 1. Depth: Minimum 2 inches (50.8 mm) unless otherwise indicated.
 - G. 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.

2.4 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:
 - 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. Flexible Gypsum Wallboard: ASTM C 36, manufactured to bend to fit tight radii and to be more flexible than standard regular-type panels of the same thickness.
 1. Thickness: 1/4 inch (6.4 mm).
 2. Long Edges: Tapered.
 3. Location: As indicated and at curved assemblies applied in double layer.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BPB America Inc.
 - b. Georgia-Pacific Corp.
 - c. National Gypsum Company
 - d. United States Gypsum Co.
- D. Abuse-Resistant Gypsum Wallboard: ASTM C 36, manufactured to produce greater resistance to surface indentation and through-penetration than standard gypsum panels.
 1. Abuse-Resistant Gypsum Wallboard: Provide one of the following:
 - a. Gypsum core wall panel surfaced with heavy abrasion-resistant paper on front and a heavy liner paper on back.

- 1) Type: X
 - 2) Thickness: 5/8 inch (15.9 mm).
 - 3) Long Edges: Tapered.
 - 4) Location: As indicated.
 - 5) Products: Subject to compliance with requirements, provide one of the following:
 - a) Georgia-Pacific Corp., ToughRock Abuse-Resistant Gypsum Board.
 - b) National Gypsum Company, Hi-Abuse XP Brand Wallboard.
 - c) United States Gypsum Co., Sheetrock Brand Abuse-Resistant Gypsum Panels.
- b. Gypsum fiber reinforced wall panels with face paper.
- 1) Type: X.
 - 2) Thickness: 5/8 inch (15.9 mm).
 - 3) Long Edges: Tapered.
 - 4) Location: As indicated.
 - 5) Products: Subject to compliance with requirements, provide BPB America Inc., ProRoc Brand - Abuse Resistant.
2. Impact-Resistant Gypsum Wallboard: Provide one of the following:.
- a. Gypsum fiber mesh reinforced wall panels without face paper.
- 1) Type: X.
 - 2) Thickness: 5/8 inch (15.9 mm).
 - 3) Long Edges: Tapered.
 - 4) Location: As indicated.
 - 5) Products: Subject to compliance with requirements, provide United States Gypsum Co., Fiberock Brand Panels – VHI Abuse-Resistant.
- b. 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
- 1) Type: X
 - 2) Thickness: 5/8 inch (15.9 mm).
 - 3) Long Edges: Tapered.
 - 4) Location: As indicated.
 - 5) Products: Subject to compliance with requirements, provide National Gypsum Company, Hi-Impact XP Brand Wallboard.

2.5 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Cementitious Backer Units (Cement Board): ANSI A118.9.
1. Thickness: As indicated.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. National Gypsum Co., PermaBase Cement Board.
 - b. United States Gypsum Co., Durock Cement Board

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - 1) Product: U.S. Gypsum No. 103 Dur-A-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: U.S. Gypsum No. 200-A Metal Trim or equal.
 - c. L-Bead (Casing Bead): L-shaped; exposed long leg receives joint compound; use where indicated.
 - 1) Product: U.S. Gypsum No. 200-B Metal Trim or equal.
 - d. Control Joint: Use at control joint locations in walls, ceilings, bulkheads, fasciae and soffits:
 - e.
 - 1) Product: U.S. Gypsum No. 093 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 as with materials appropriate to conditions of installation.
 - f. 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.

2.7 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, use setting-type, sandable topping compound or drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Cementitious Backer Units: As recommended by manufacturer.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate 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. 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.
- F. Thermal Insulation: As specified in Division 7 Section "Building Insulation."
- G. Polyethylene Vapor Retarder: As specified in Division 7 Section "Building Insulation."

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. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. 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 AND SOFFIT 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.
 3. Cementitious Backer Units: 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. Weld at each intersection.
- 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. Curved Partitions:
1. Cut top and bottom track (runners) through leg and web at 2-inch (50-mm) intervals for arc length. In cutting lengths of track, allow for uncut straight lengths of not less than 12 inches (300 mm) at ends of arcs.
 2. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 3. Support outside (cut) leg of track by clinching steel sheet strip, 1-inch- (25-mm-) high-by-thickness of track metal, to inside of cut legs using metal lock fasteners.
 4. Begin and end each arc with a stud, and space intermediate studs equally along arcs at stud spacing recommended in writing by gypsum board manufacturer for radii indicated. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- 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-Furring 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.
- M. Polyethylene Vapor Retarder: Where indicated install to comply with requirements specified in Division 7 Section "Building Insulation."

3.5 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. All ceiling construction shall be fully "unrestrained". Interrupt main runners, furring, or wallboard ceilings at walls of all full sized rooms as required to accommodate building movement. Use appropriate trim pieces to accomplish the work.
1. Cut furring, reinforce, support, and fit for electric outlet boxes, recessed fixtures, grilles and similar items.
 2. Provide allowance for anticipated building movement between floors and ceilings or soffits.
- B. Suspend ceiling hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - a. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - b. Do not attach hangers to steel deck tabs.
 - c. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - d. Do not connect or suspend steel framing from ducts, pipes, or conduit.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers 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 and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
- C. Tie carrying channels to hangers with single (only) wrap of wire to avoid lifting channel.
- D. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member and transversely between parallel members.
- E. Wire-tie furring channels to supports, as required to comply with requirements for assemblies indicated.
1. Saddle tie furring channels to carrying channels with double strand tie wires.
 2. Screw furring to wood framing.
- F. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
1. Hangers: 48 inches (1219 mm) o.c.
 2. Carrying Channels (Main Runners): 48 inches (1219 mm o.c.
 3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

3.6 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 ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. 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.
- E. 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.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. 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.
- I. Form control and expansion joints with space between edges of adjoining gypsum panels.
- J. 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.
- K. 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.
- L. Hold gypsum panels free from all surfaces subject to condensation or moisture.
- M. Floating Construction: Where feasible, including where recommended in writing by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.

- N. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- O. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
- P. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.7 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. Partitions, or assemblies where finish is a rigid veneer, such as plaster, skim coat, tile or stone work or mounted mirror or any use that would be compromised by vibration or deflection shall be constructed to meet L/360 deflection criteria.
4. Do not proceed with work until temperature and humidity of building meet requirements of manufacturer's standard specifications.
5. Fastening system shall be power driven drywall screws. Where hand driven fasteners are used, double nailing will be required.
6. 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.
7. Repair areas scarified or otherwise damaged by cutting out damaged areas, back blocking set with adhesive, and patching with patching plaster.
8. Grout anchors for door frames. Jamb board into door frame to provide rigidity. Full grout frames at label doors, shaftwall, and elsewhere as indicated.
9. 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 Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
- D. 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.
- E. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- F. 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.
- G. 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.
- H. Curved Partitions:
 1. Install panels horizontally and unbroken, to the extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
 2. Wet gypsum panels on surfaces that will become compressed where curve radius prevents using dry panels. Comply with gypsum board manufacturer's written recommendations for curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
 3. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around curve. On concave side, start fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced 12 inches (300 mm) o.c.
 4. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.
 5. Allow wetted gypsum panels to dry before applying joint treatment.

I. Tile Backing Panels:

1. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
 - a. Where indicated install standard gypsum wallboard panels to produce a flat surface at tiled areas not subject to wetting.
2. Examine framing; verify that framing and furring members to receive cement board has a maximum spacing of 16" o.c. and is minimum 20 gauge with a maximum deflection of L/360.
3. Install cement board in accordance with manufacturer's instructions.
 - a. Install cement board with rough side out.
 - b. Use maximum lengths possible to minimize number of joints.
4. Attach cement board to framing with screws spaced 8" o. c. at perimeter where there are framing supports, and 8" o. c. along intermediate framing in field.
 - a. Drive fasteners to bear tight against and flush with surface of cement board. Do not countersink. Locate fasteners minimum 3/8" from edges and ends of cement board.
5. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.8 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.

3.9 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 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface where indicated or required by Architect.
 - E. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- 3.10 FIRE RATED SHAFT-WALL ASSEMBLIES
- A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
 - B. Shaft wall construction at ventilation shafts shall be sealed airtight to prevent aspiration.
 - C. Fire ratings are as indicated and as required by Code.
- 3.11 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.
 - D. Where bulkheads are built to enclose and shield noisy ducts, no part of the bulkhead structure may touch the duct.
- 3.12 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.

3.13 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****

TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Unglazed ceramic mosaic tile.
 - 2. Glazed wall tile.
 - 3. Synthetic thresholds.
 - 4. Anti-fracture membrane.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
 - 2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 3. Division 9 Section "Gypsum Wallboard Assemblies" for cementitious backer units installed as part of gypsum wallboard systems.

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 tiles or sections of tile showing full range of colors, textures, and patterns available for each type and composition of tile indicated. Include samples of grout and accessories involving color selection.
- D. Samples for verification purposes of each item listed below, prepared on samples of size and construction indicated, products involve color and texture variations, in sets showing full range of variations expected.
 - 1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on plywood or hardboard backing and grouted.
 - 2. Full-size units of each type of trim and accessory for each color required.
 - 3. Synthetic thresholds in 6-inch lengths.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
- C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.
- C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If despite these precautions coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- C. Maintain temperatures at 50°F (10°C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.
- D. Do not install mortar, set or grout tile exterior when inclement weather conditions are expected within 48 hours after work is completed unless properly protected.
- E. Protection: Protect adjacent work surfaces during tile work until mortar and grout has set.

1.7 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tile: Subject to compliance with requirements, provide products as follows:

1. CT1: Floor Tile
American Olean
Unglazed Colorbody Porcelain Mosaics
Size: 2" x 2" Tiles on 12" x 24" sheets
Thickness: 1/4"
Max Grout Joint Width: 1/8"
Color: Storm Gray Speckled
Built-Up Base: MT-6A
Provide all inside/outside corner trim pieces as needed.
OR EQUAL by Daltile Keystones
2. CT2: Wall Tile
American Olean
Bright and Matte Wall Tile
Size: 4-1/4" x 4-1/4"
Thickness: 5/16"
Max Grout Joint Width: 1/16"
Color: Ice White
Provide all bullnose trim pieces as needed.
OR EQUAL by Daltile

2.2 PRODUCTS, GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.
 1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 1. Provide selections made by Architect from manufacturer's full range of colors, textures, and patterns as indicated for each product.
 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TRIM UNITS:

- A. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:
1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
 2. Shapes: As selected by Architect from manufacturer's standard shapes, and as necessary for a complete installation.

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to ½ inch (12.7 mm) or less, and finish bevel to match face of threshold.
- B. Synthetic (Solid Polymer) Thresholds: Made from homogenous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or 6, without precoated finish.
1. Manufacturers: E. I. DuPont De Nemours & Co., Corian Surfaces.
 - a. Color: Dove

2.5 CRACK ISOLATION MATERIALS

- A. Crack Isolation Membrane: ANSI A118.12, composition as follows:
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Laticrete: Blue 92 Anti-Fracture Membrane.
 - b. MAPEI Corporation; Mapelastic AquaDefense Waterproofing and Crack-Isolation Membrane.
 - c. TEC; a subsidiary of H. B. Fuller Company; HydraFlex Waterproofing Crack Isolation Membrane.
 - d. Custom Building Products: RedGuard Waterproofing and Crack Prevention Membrane or 9240 Waterproofing and Anti-Fracture Membrane.
 2. Location: Full membrane at all locations unless indicated otherwise.

2.6 SETTING MATERIALS

- A. Polymer Enhanced Mortars: ANSI A118.4/ANSI A118.15, composition as follows:
1. For TCNA defintied Large Format Tiles, provide medium bed mortar.
 2. For Glass Tiles, provide white mortar.
 3. Provide product that is approved by manufacturer for application thickness of 5/8".

2.7 GROUTING MATERIALS

- A. Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy: ANSI A118.3.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and certified by manufacturer for intended use.
2. Epoxy Grout:
 - a. Epoxy Grout: Epoxy Grout shall be as manufactured by one of the following:
 - 1) MAPEI Corporation, "Kerapoxy"
 - 2) Bostik Findley, Inc. "Hydroment Color-Poxy"
 - 3) TEC Specialty Products Inc. "AccuColor EFX"
 - 4) Custom Building Products "CEG Lite"
 - b. Location: At CT1 and CT2
 - c. Colors: Architect shall select two (2) colors from manufacturer's full line.

2.8 MISCELLANEOUS MATERIALS

- A. Metal Edge Strips: Zinc alloy or stainless steel terrazzo strips, 1/8-inch wide at top edge with integral provision for anchorage to mortar bed or substrate unless otherwise indicated.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.
- B. TCNA Installation Guidelines: TCNA "Handbook for Ceramic, Glass, and Stone Tile Installation"; comply with TCNA installation methods indicated.
- C. Install crack isolation membrane over entire surface to comply with manufacturer's written instructions to produce a membrane of uniform thickness bonded securely to substrate.
- D. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- E. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.
- F. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.
- G. Lay out tile wainscots to dimensions indicated.
- H. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw cut joints after installation of tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
- I. Grout tile to comply with the requirements of the following installation standards:
 - 1. For ceramic tile grouts (and latex-portland cement grouts), comply with ANSI A108.10.
 - 2. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 FLOOR INSTALLATION METHODS

- A. Ceramic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCNA installation methods related to types of subfloor construction, and grout types:
 - 1. Polymer Enhanced Mortars: ANSI A108.5.
 - a. Concrete Subfloors, Interior: TCNA F112, F113 and 125A as indicated on Drawings.
 - 1) Install crack isolation membrane over entire surface at all locations unless indicated otherwise.
 - b. Grout: Epoxy.

B. Thresholds: Install synthetic thresholds at locations indicated; set in same type of setting bed as abutting field tile unless otherwise indicated.

1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane over entire surface to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

3.6 WALL TILE INSTALLATION METHODS

A. Install types of tile designated for wall application to comply with requirements indicated below for setting-bed methods, TCNA installation methods related to subsurface wall conditions, and grout types:

1. Polymer Enhanced Mortars: ANSI A108.5.
 - a. Masonry, Interior: TCNA W202.
 - b. Cementitious Backer Units, Interior: TCNA W244.
 - c. Grout: Latex-portland cement.

- 1) Provide epoxy grout.

3.7 CLEANING AND PROTECTION

A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures that tile is without damage or deterioration at time of Substantial Completion.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

****END OF SECTION****

RESILIENT SHEET FLOORING

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 resilient sheet flooring and accessories is shown on drawings and in schedules.

1.3 QUALITY ASSURANCE:

- A. Manufacturer: Provide resilient sheet flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.
- B. Fire Test Performance: Provide resilient flooring which complies with the following fire test performance criteria as determined by an independent testing laboratory acceptable to authorities having jurisdiction.
 - 1. Flame Spread: Not more than 75 per ASTM E 84.
 - 2. Smoke Developed: Not more than 450 per ASTM E 84.
 - 3. Smoke Density: Not more than 450 per NFPA 258.
- C. Installer's Qualifications: Engage Installer who is certified in writing by resilient flooring manufacturer as qualified for installation of sheet vinyl employing heat welded seams.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for each type of resilient sheet flooring and accessory.
- B. Samples for Initial Selection Purposes: Submit manufacturer's standard color charts in form of actual sections of resilient flooring, including accessories, showing full range of colors and patterns available, for each type of resilient flooring required.
- C. Samples for Verification Purposes: Submit the following samples of each type, color, and pattern of resilient sheet flooring required, showing full-range of color and pattern variations.
 - 1. 6" x 9" samples of sheet flooring.
 - 2. 2-1/2 long samples of resilient flooring accessories.
 - 3. Welding beads for sheet flooring.
 - 4. Other materials as requested.
- D. Certification for Fire Test Performance: Submit certification from an independent testing laboratory acceptable to authorities having jurisdiction that resilient sheet flooring complies with fire test performance requirements.

- E. Maintenance Instructions: Submit 2 copies of manufacturer's recommended maintenance practices for each type of resilient sheet flooring and accessory required.

1.5 PROJECT CONDITIONS:

- A. Maintain minimum temperature of 65°F (18°C) in spaces to receive resilient sheet flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55°F (13°C) in areas where work is completed.
- B. Install resilient sheet flooring and accessories after other finishing operations, including painting, have been completed. Do not install resilient flooring over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by resilient flooring manufacturer's recommended bond and moisture test.

1.6 EXTRA STOCK:

- A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
 - 1. Sheet Flooring: Furnish not less than 5 linear yards for each type, color and pattern installed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide resilient sheet safety flooring products as follows:
 - 1. RSF1
Altro
Aquarius Safety Flooring
Thickness: 2mm
Width: 6'-7"
Warranty: 10 years
Color: Porthole PX2007
Color Matched Weld Rods
Flash cove material using all required trim pieces including but not limited to Cove Former and Cap Strip.
Manufacturer's Representative: Maria Bernock (586)879-7179
- B. Resilient Wall Base: Subject to compliance with requirements provide products as follows:
 - 1. RB1 Provide one of the following:
 - a. Johnsonite
Rubber Wall Base
Height: 4"
Color: Architect shall select one (1) color from manufacturer's full line.
 - b. Roppe
Rubber Wall Base
Height: 4"
Color: Architect shall select one (1) color from manufacturer's full line

2.2 VINYL SHEET FLOORING:

- A. Filled vinyl sheet products are those with a vinyl plastic wearlayer complying with descriptive requirements of FS L-F-475 for wearing surface.
- B. Unfilled vinyl sheet products are those with a vinyl plastic wearlayer complying with descriptive requirements of FS L-F-001641 for wearlayer.
- C. Filled Vinyl Sheet with Backing: Provide vinyl sheet with filled vinyl plastic wearlayer and fibrous backing complying with FS L-F-475, Type II, Grade A requirements, with manufacturer's recommended static load limit of 100 psi, and 72" minimum sheet width.
- D. Filled Vinyl Sheet without Backing: Provide non-layered filled vinyl sheet with pattern and color extending through its full thickness and complying with the following requirements:
 - 1. Federal Standard: Comply with FS L-F-475, Type II, Grade A requirements except for overall thickness, backing and dimensional stability requirements.
 - 2. Static Load Limit: 125 psi minimum as recommended by manufacturer.
 - 3. Static Load Limit: 100 psi minimum as recommended by manufacturer.
- E. Filled Vinyl Sheet with Foam Backing: Provide vinyl sheet with non-layered filled vinyl wearlayer whose pattern and color extending through its full thickness, plastic foam backing, and complying with the following requirements:
 - 1. Static Load Limit: 100 psi as recommended by manufacturer.
 - 2. Static Load Limit: 150 psi as recommended by manufacturer.
- F. Unfilled Vinyl Sheet with Foam Interlayer and Backing: Provide vinyl sheet with translucent vinyl plastic wearlayer, foamed plastic interlayer and backing with a recommended static load limit of 75 psi and complying with the following requirements:
 - 1. Federal Standard: Comply with FS L-F-001641 for Class 1 vinyl sheet with Type II or III backing.
 - 2. RFCI Standard: Comply with SV-1 for Grade A vinyl sheet (0.020" average wearlayer thickness) with Type III, Material II wearlayer, plastic foam interlayer, and Group II or III backing suitable for Use Category I.
 - a. Sheet Width: Manufacturer's standard but not less than 6'-0".
 - b. Sheet Width: 9' minimum.
 - c. Sheet Width: 12' minimum.
- G. Unfilled Vinyl Sheet with Vinyl Backing: Provide vinyl sheet, 0.060" overall thickness, consisting of opaque vinyl wearlayer, 0.020" thick, non-foam vinyl interlayer and opaque vinyl tacking: complying with FS L-F-001641, Type II, Class 1, except for average total thickness, average tacking thickness and dimensional stability; suitable for tension application only, above-, on- and below grade, in commercial, institutional and residential applications; with manufacturer's recommended static load limit of 125 psi at 90oF.
- H. Unfilled Vinyl Sheet with Reinforced Vinyl Interlayer and Backing: Provide vinyl sheet with unfilled non-layered vinyl wearlayer, glass-fiber-reinforced vinyl interlayer and vinyl backing; and complying with the following requirements:

1. Wearlayer/Overall Thickness: 0.024"/0.080" nominal.
 2. Static Load Limit: 75 psi as recommended by manufacturer.
 3. Sheet Width: 6.5' minimum.
- I. Unfilled Vinyl Sheet with Reinforced Vinyl Backing: Provide vinyl sheet composed of unfilled non-layered vinyl wearlayer and backing of glass-fiber-reinforced filled vinyl; complying with the following requirements.
1. Wearlayer/Overall Thickness: 0.020"/0.080" nominal.
 2. Sheet Width: 6.5' minimum.
- J. Unfilled Vinyl Sheet with Reinforced Vinyl Interlayer and Foam Backing: Provide vinyl sheet with unfilled non-layered vinyl wearlayer, glass-fiber-reinforced vinyl interlayer, plastic foam backing, and complying with the following requirements:
1. Wearlayer/Overall Thickness: 0.020"/0.100" nominal.
 2. Sheet Width: 6.5' minimum.
- K. Raised Profile Vinyl Sheet with Backing: Provide vinyl sheet with surface pattern of raised mineral aggregate discs, wearlayer thickness of 0.035", overall thickness of 0.100", minimum sheet width of 6' and manufacturer's recommended static load limit of 125 psi.
- L. Raised Profile Vinyl Sheet without Backing: Provide non-layering filled vinyl sheet with raised profile surface pattern and complying with the following requirements:
1. Static Load Limit: 125 psi as recommended by manufacturer.
 2. Thickness: 0.106" Sheet Width: 6' minimum.
 3. Sheet Width: 6' minimum.
- M. Welding Thread: Vinyl thread or rod as produced by manufacturer of sheet vinyl flooring and intended for heat sealing of joints.
1. Color: Match field color of flooring.
 2. Color: As selected by Architect to contrast with field color of flooring.

2.3 ACCESSORIES:

- A. Rubber Wall Base: Provide rubber base complying with FS SS-W-40, Type I, with matching end stops and preformed or molded corner units, and as follows:
1. Height: 4".
 2. Thickness: 1/8" gage.
 3. Style: Standard top-set cove at resilient tile areas. Straight base without cove at carpeted areas.
 4. Finish: Matte.

- B. Adhesives (Cements): Waterproof, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.
- C. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.
- D. Leveling and Patching Compounds: Latex type as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Require Installer to inspect subfloor surfaces to determine that they are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, ridges, coatings preventing adhesive bond, and other defects impairing performance or appearance.
- B. Perform bond and moisture tests on concrete subfloors to determine if surfaces are sufficiently cured and dry as well as to ascertain presence of curing compounds.
- C. Do not allow resilient flooring work to proceed until subfloor surfaces are satisfactory.

3.2 PREPARATION:

- A. Prepare subfloor surfaces as follows:
 - 1. Use leveling and patching compounds as recommended by resilient flooring manufacturer for filling small cracks, holes and depressions in subfloors.
 - 2. Remove coatings from subfloor surfaces that would prevent adhesive bond, including curing compounds incompatible with resilient flooring adhesives, paint, oils, waxes and sealers.
- B. Broom clean or vacuum surfaces to be covered, and inspect subfloor.
- C. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.3 INSTALLATION:

- A. Where movable partitions are shown, install resilient flooring before partitions are erected.
- B. Install resilient flooring using method indicated in strict compliance with manufacturer's printed instructions. Extend resilient flooring into toe spaces, door reveals, and into closets and similar openings.
- C. Scribe, cut, and fit resilient flooring to permanent fixtures, built-in furniture and cabinets, pipes, outlets and permanent columns, walls and partitions.
- D. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.
- E. Install resilient flooring on covers for telephone and electrical ducts, and similar items occurring within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly cement edges to perimeter of floor around covers and to covers.

- F. Tightly cement resilient flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll resilient flooring at perimeter of each covered area to assure adhesion.

3.4 INSTALLATION OF SHEET FLOORING:

- A. Lay sheet flooring to provide as few seams as possible with economical use of materials. Match edges for color shading and pattern at seams in compliance with manufacturer's recommendations.
- B. Adhere sheet flooring to substrates using method approved by flooring manufacturer for type of sheet flooring and substrate condition indicated.
 - 1. Use conventional full spread adhesive method unless otherwise indicated.
 - 2. Use modified conventional full-spread adhesive method with two-part epoxy adhesive under seams, latex-resin base multi-purpose adhesive elsewhere.
 - 3. Use conventional perimeter bonding adhesive procedures where recommended by flooring manufacturer.
 - 4. Use special perimeter bonding adhesive for unfilled vinyl sheet with vinyl backing.
- C. Prepare seams in vinyl sheet flooring with manufacturer's special routing tool and heat weld with vinyl thread in accordance with manufacturer's instructions.
- D. Prepare seams in vinyl sheet flooring in accordance with manufacturer's instructions for most inconspicuous appearance, sealing continuously with fluid-applied sealant or adhesive as standard with manufacturer.
- E. Provide integral flash cove base, including cove support strip and metal top edge strip. Construct coved base in accordance with manufacturer's instructions.
 - 1. On masonry surfaces or other similar irregular vertical substrates, fill voids between metal top edge strip cove cap and vertical surface with manufacturer's recommended adhesive filler material.

3.5 CLEANING AND PROTECTION:

- A. Perform following operations immediately upon completion of resilient flooring:
 - 1. Sweep or vacuum floor thoroughly.
 - 2. Do not wash floor until time period recommended by resilient flooring manufacturer has elapsed to allow resilient flooring to become well-sealed in adhesive.
 - 3. Damp-mop floor being careful to remove black marks and excessive soil.
 - 4. Remove any excess adhesive or other surface blemishes, using appropriate cleaner recommended by resilient flooring manufacturers.
- B. Protect flooring against damage during construction period to comply with resilient flooring manufacturer's directions.

SECTION 096516
RESILIENT SHEET
FLOORING

1. Apply protective floor polish to resilient flooring surfaces free from soil, excess adhesive or surface blemishes. Use commercial available metal cross-linked acrylic product acceptable to resilient flooring manufacturer.
 2. Protect resilient flooring against damage from rolling loads for initial period following installation by covering with plywood or hardboard. Use dollies to move stationary equipment or furnishings across floors.
 3. Cover resilient flooring with undyed, untreated building paper until inspection for substantial completion.
- C. Clean resilient flooring not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Clean resilient flooring by method recommended by resilient flooring manufacturer.
1. Strip protective floor polish, which was applied after completion of installation, prior to cleaning.
 2. Reapply floor polish after cleaning.

****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. Benjamin Moore: MO4 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - c. PPG Industries: 90-708 Series, Pitt-Tech One-Pack Interior/Exterior Industrial Primer
 - d. Pratt & Lambert: Universal Acrylic Primer Z6631 or Steeltech Acrylic Prime & Finish Z190.
 - e. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
 - 2. Second and Third Coats:
 - a. Benjamin Moore: Moorcraft Latex House and Trim Paint 170 except at railings which shall be Impervex Enamel 309
 - b. Glidden Professional: Devoe Coatings Devflex 4216HP High Performance Waterborne Acrylic Semi-Gloss Enamel.
 - c. PPG Industries: 6-2000 Series, Speedhide Exterior Satin Latex except at railings which shall receive 90-474 Series, Pitt-Tech One Pack Interior/Exterior Satin High Performance Industrial Enamel.
 - d. Pratt & Lambert: DTM Acrylic Gloss Z6841 or Semi-Gloss Z6761 or Satin Z6671.
 - e. 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. Benjamin Moore: Moorcraft Latex House and Trim Paint 170
 - b. Glidden Professional: Ultra-Hide 150 Exterior Satin Paint 2412V Series.
 - c. Pittsburgh Paints: 6-2000 Series, Speedhide Exterior Satin Latex (Provide a prime coat of 4-603, interior/exterior Perma-Crete Acrylic Alkali Resistant Primer.
 - d. Pratt & Lambert: Pro Hide Gold Acrylic Concrete & Stucco Primer Z6300 Finish: Pro Hide Gold Exterior Acrylic Latex Flat Z8400, Eggshell Z8500 or Semi Z8600.
 - e. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series

D. Wood:

1. First Coat:

- a. Benjamin Moore: Moorcraft Latex Exterior Primer 169
- b. Glidden Professional: Hydrosealer Primer Sealer 6001-1200.
- c. Pittsburgh Paints: 6-609, Speedhide Exterior Latex Primer.
- d. Pratt & Lambert: Pro Hide Gold Exterior Latex Primer Z8460
- e. Sherwin Williams: Exterior Latex Wood Primer B42W8041

2. Second and Third Coats:

- a. Benjamin Moore: Moorcraft Latex House and Trim Paint 170
- b. Glidden Professional: Ultra-Hide 150 Exterior Satin Paint 2412V Series.
- c. Pittsburgh Paints: 6-2000 Series, Speedhide Exterior Satin Latex.
- d. Pratt & Lambert: Pro Hide Gold Exterior Acrylic Latex Flat Z8400, Eggshell Z8500 or Semi Z8600
- e. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series

E. 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. Tnemec: One (1) coat TNEMEC Series 27 F.C. Typoxy @ 3.0 to 5.0 mils DFT.
- b. Wasser: One (1) component MC-CR @ 3.0-4.0 mils DFT.
- c. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.

4. Finish Coat:

- a. Tnemec: One (1) coat TNEMEC Series 73 Endura-Shield @ 2.0 to 3.0 mil DFT.
- b. Wasser: One (1) component MC-Luster @ 2.0-4.0 mils DFT.
- c. 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. Benjamin Moore: Moorcraft Vinyl Latex Primer-Sealer 273.
- b. Glidden Professional: High Hide Interior Primer Sealer 1000-1200.
- c. Pittsburgh Paints: 4-603 Permacrete interior/exterior Acrylic Alkali Resistant Primer for plaster; 6-2 Interior Latex Sealer for gypsum board.
- d. Pratt & Lambert: Plaster: Pro Hide Gold Z1001 Gypsum: Pro Hide Gold High Holdout Latex Primer/Sealer Z8165
- e. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600

2. Second Coat:
 - a. Benjamin Moore: Moorcraft Vinyl Latex Flat 275
 - b. Glidden Professional: Ultra-Hide 150 Interior Flat Paint 1210V Series.
 - c. Pittsburgh Paints: Speedhide Latex Flat 6-70 (for all colors)
 - d. Pratt & Lambert: Pro Hide Gold Latex Flat Z8100, Eggshell Z8200, Satin Z9400 or Semi Z8300.
 - e. Sherwin Williams: ProMar 200 Zero VOC Latex Flat B30 Series
 3. Third Coat:
 - a. Benjamin Moore: Moorcraft Vinyl Latex Flat 275
 - b. Glidden Professional: Ultra-Hide 150 Interior Flat Paint 1210V Series.
 - c. Pittsburgh Paints: Speedhide Latex Flat 6-70 (for all colors)
 - d. Pratt & Lambert: Pro Hide Gold Latex Flat Z8100, Eggshell Z8200, Satin Z9400, or Semi Z8300.
 - e. Sherwin Williams: ProMar 200 Zero VOC Latex Flat B30 Series
- B. Plaster and Gypsum Board Walls and Columns - Epoxy:
1. First Coat:
 - a. Benjamin Moore: M08/M09 Waterborne Epoxy Primer
 - b. Glidden Professional: High Hide Interior Primer Sealer 1000-1200.
 - c. Pittsburgh Paints: 4-603 Permacrete interior/exterior Acrylic Alkali Resistant Primer for plaster; 6-2 Interior Latex Sealer for gypsum board.
 - d. Pratt & Lambert: Plaster: Pro Hide Gold Z1001 Gypsum: Pro Hide Gold High Holdout Latex Primer/Sealer Z8165.
 - e. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
 2. Second and Third Coats:
 - a. Benjamin Moore: M43/M44 Acrylic Epoxy Gloss Coating
 - b. Glidden Professional: Devoe Coatings Tru-Glaze-WB Waterborne Epoxy Gloss Coating 4428.
 - c. Pittsburgh Paints: 16-551 Series, Pitt-Glaze High Solids Acrylic-Epoxy.
 - d. Pratt & Lambert: Acrylic Water-Based Epoxy Z7021.
 - e. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
 - f.
- C. 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.
- D. Masonry Block
1. First Coat: Masonry block filler at rate not to exceed 100 sq. ft. per gal.
 - a. Benjamin Moore: Interior and Exterior Block Filler 173
 - b. Glidden Professional: Concrete Coatings Block Filler Interior/Exterior Primer 3010-1200.
 - c. Pittsburgh Paints: Speedhide Latex Block Filler 6-15
 - d. Pratt & Lambert: Pro Hide Silver Block Filler Z8485

- e. 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) Benjamin Moore: Moorcraft Latex Semi Gloss Enamel 276.
 - 2) Glidden Professional: Ultra-Hide 150 Interior Semi-Gloss Paint 1416V Series.
 - 3) Pittsburgh Paints: 6-512 Series, Speedhide Semi-Gloss Latex Enamel.
 - 4) Pratt & Lambert: Pro Hide Gold Latex, Satin Z9400 or Semi Z8300
 - 5) Sherwin Williams: ProMar 200 Zero VOC Latex Semi-Gloss B31 Series
3. Second and Third Coats - Epoxy.
- a. Benjamin Moore: M43/M44 Acrylic Epoxy Gloss Coating
 - b. Glidden Professional: Devoe Coatings Tru-Glaze-WB Waterborne Epoxy Gloss Coating 4428.
 - c. Pittsburgh Paints: 16-551 Series, Pitt-Glaze High Solids Acrylic-Epoxy.
 - d. Pratt & Lambert: Acrylic Water-Based Epoxy Z7021
 - e. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- E. Masonry Block and Concrete at pool environment:
1. Surface preparation: Allow new concrete and mortar to cure a minimum of 14 days for Tnemec products, a minimum of 7 days for Wasser products. Brush-Blast or mechanically abrade removing laitance, curing agents, release compounds or other contaminants leaving surface profile similar to light/medium grit sandpaper. All surfaces must be clean, dry and free of oil, grease, dirt, dust or other foreign matter detrimental to the coating system.
2. Prime (pre-fill) coat:
- a. Tnemec: One (1) coat TNEMEC Series 130 Envirofill at 80-100 sq ft/gallon.
 - b. Glidden Professional: Devoe Coatings One (1) coat Tru-Glaze-WB High Performance Waterborne Epoxy Block Filler 4015 Series @ 75-100 sq. ft/gallon.
 - c. Wasser: Epoxy Block Filler @ 60-80 sq. ft. per gallon.
 - d. Sherwin Williams: Kem Cati-Coat Epoxy Block Filler.
3. Intermediate Coat:
- a. Tnemec: One (1) coat TNEMEC Series 27 F.C. Typoxy @ 3.0 to 5.0 mil DFT.
 - b. Glidden Professional: Devoe Coatings One (1) coat Bar-Rust 231 Multi-Purpose Epoxy Mastic @ 4.0-8.0 mils DFT.
 - c. Wasser: One (1) component MC-CR @ 3.0-4.0 mils DFT.
 - d. Sherwin Williams: Macropoxy 646 FC Epoxy @ 5-10 mils DFT.
4. Finish Coat:
- a. Tnemec: One (1) coat TNEMEC Series 297 Enviro-Glaze @ 2.0 to 3.0 mil DFT.
 - b. Glidden Professional: One (1) Coat Devoe Coatings DETHANE 379H Aliphatic Urethane Enamel @ 2.0 to 3.0 mils DFT.
 - c. Wasser: One (1) component MC-Luster @ 2.0-4.0 mils DFT.
 - d. Sherwin Williams: One (1) coat Acrolon 218 HS Polyurethane @ 3-6 mils DFT.

- F. Concrete Floors – Opaque Sealer:
1. Preparation:
 - a. Surfaces shall be clean and dry.
 - b. Mechanically abrade surface to achieve a texture of medium grade sandpaper.
 - c. Clean surfaces per ASTM Standard Practice D4258-83.
 2. First Coat and Second Coat:
 - a. Sherwin Williams, H&C Concrete Stain Solid Color Water-Based, or PPG Perma-Crete Color Seal WB Interior/Exterior Acrylic Concrete Stain.
 - 1) Apply minimum of 2 coats in strict accordance with manufacturer's written instructions.
- G. Exposed Ceiling Construction - Dry Fall Paint.
1. Preparation: Spot prime any welds, etc.
 2. First Coat:
 - a. Benjamin Moore: M04 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - c. Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - d. Pratt & Lambert: Steel Tech Arcylic Metal Primer, Z190
 - e. 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. Benjamin Moore: Moorcraft Dry Fog Sweep Up 272
 - b. Glidden Professional: Waterborne Interior Dryfall Flat 1280-1200.
 - c. Pittsburgh Paints: 6-715X, Speedhide Flat Latex Dry Fog
 - d. Pratt & Lambert: Enducryl Acrylic Dryfall, Flat Z5900 or Semi Z5910
 - e. Sherwin Williams: Low VOC Waterborne Acrylic Dryfall Flat B42W81
- H. 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) Benjamin Moore: M04 Acrylic Metal Primer

- 2) Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - 3) Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - 4) Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - 5) 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) Benjamin Moore: M04 Acrylic Metal Primer
 - 2) Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - 3) Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - 4) Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - 5) Sherwin Williams: ProCryl Universal Metal Primer B660310 Series
- c. Aluminum:
- 1) Benjamin Moore: M04 Acrylic Metal Primer
 - 2) Glidden Professional; Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - 3) Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - 4) Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - 5) Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
4. Second and Third Coats:
- a. Benjamin Moore: Moorcraft Latex Semi Gloss Enamel 276
 - b. Glidden Professional: Ultra-Hide 150 Interior Latex Semi-Gloss Paint 1416V Series.
 - c. Pittsburgh Paint: 6-512 Series, Speedhide Semi-Gloss Latex Enamel.
 - d. Pratt & Lambert: Enducryl Acrylic Semi Gloss Z6621
 - e. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.
- I. 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. Tnemec: One (1) coat TNEMEC Series 27 F.C. Typoxy @ 3.0 to 5.0 mil DFT.
 - b. Glidden Professional: Devoe Coatings One (1) coat Bar-Rust 231 Multi-Purpose Epoxy Mastic @ 4.0-8.0 mils DFT.
 - c. Wasser: One (1) component MC-CR @ 3.0-4.0 mils DFT.
 - d. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.

4. Finish Coat:
 - a. Tnemec: One (1) coat TNEMEC Series 73 Endura-Shield @ 2.0 to 3.0 mil DFT.
 - b. Glidden Professional: One (1) Coat Devoe Coatings DETHANE 379H Aliphatic Urethane Enamel @ 2.0 to 3.0 mils DFT.
 - c. Wasser: One (1) component MC-Luster @ 2.0-4.0 mils DFT.
 - d. Sherwin Williams: One (1) coat Acrolon 218 HS @ 3-6 mils DFT.

- J. Galvanized Steel including galvanized decking and all steel in pool environments:
 1. Galvanized Steel Roof and Floor Deck: 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.
 - b. Prime Coat: Refer to Division 5, "Steel Deck."

 2. Preparation (other than Galvanized Steel Roof and Floor Deck):
 - a. Preparation: All galvanized metal receiving additional coats shall be tested by use of a copper sulfate test. This includes using a 10% solution of copper sulfate dissolved in water and applied to the galvanized surface. The reaction time between the copper sulfate and zinc should result in turning the galvanized area black within 15 seconds or less. If the reaction takes longer than 15 seconds, further cleaning is required as follows:
 - 1) Preparation: SSPC-SP 16.

 3. Primer (other than Galvanized Steel Roof and Floor Deck):
 - a. TNEMEC: One (1) coat TNEMEC Series 27 F.C. Typoxy @ 2.0-4.0 mils DFT.
 - b. Glidden Professional: Devoe Coatings One (1) coat Bar-Rust 231 Multi-Purpose Epoxy Mastic @ 4.0-8.0 mils DFT.
 - c. Wasser: One (1) component MC-CR @ 3.0-4.0 mils DFT.
 - d. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.

 4. Intermediate Coat (including Galvanized Steel Roof and Floor Deck and all galvanized steel in pool environments):
 - a. Tnemec: One (1) coat TNEMEC Series 27 F.C. Typoxy @ 2.0-4.0 mils DFT.
 - b. Glidden Professional; Devoe Coatings One (1) coat Bar-Rust 231 Multi-Purpose Epoxy Mastic @ 4.0-8.0 mils DFT.
 - c. Wasser: One (1) component MC-CR @ 3.0-4.0 mils DFT.
 - d. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.

 5. Finish Coat:
 - a. Tnemec: One (1) coat TNEMEC Series 73 Endura-Shield at 2.0-3.0 mils DFT.
 - b. Glidden Professional: One (1) Coat Devoe Coatings DETHANE 379H Aliphatic Urethane Enamel @ 2.0 to 3.0 mils DFT.
 - c. Wasser: One (1) component MC-Luster @ 2.0-4.0 mils DFT.
 - d. Sherwin Williams: One (1) coat Acrolon 218 HS @ 3-6 mils DFT.

K. 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) Pratt & Lambert: Filler-Sealer
 - 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) Benjamin Moore: Moore's Interior Wood Penetrating Stain 241
 - 2) Glidden Professional: Wood Pride Interior Oil-Based Wood Stain 1700 Series.
 - 3) Pratt & Lambert: Interior Tonetic Wood Stain
 - 4) Pittsburgh Paints: 44500 Olympic Oil Based Stain
 - 5) 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) Benjamin Moore: Moore's Interior Stays Clear 423/Low Lustre
 - 2) Glidden Professional: Wood Pride Interior Waterbased Satin Varnish 1802-0000.
 - 3) Pratt & Lambert: Acrylic Latex Varnish Satin
 - 4) Pittsburgh Paints: Olympic 42786 Satin Water Based Polyurethane.
 - 5) Sherwin Williams: Wood Classic Waterborne Polyurethane Varnish, A68 Series.

2.6 MECHANICAL

A. Apparatus, Equipment, and Equipment Supports

1. First Coat:
 - a. Benjamin Moore: M04 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - c. Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/ Exterior.
 - d. Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - e. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
2. Second Coat:
 - a. Benjamin Moore: Moorcraft Latex Semi Gloss Enamel 276
 - b. Glidden Professional: Devoe Coatings Devflex 4216HP High Performance Waterborne Acrylic Semi-Gloss Enamel.
 - c. Pittsburgh Paints: 90-474 Series, Pitt-Tech One Pack Interior/Exterior Satin High Performance Industrial Enamel.

- d. Pratt & Lambert: Enducryl Acrylic Semi Gloss Z6621
 - e. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.
- B. Exposed Bare Piping, Valves, Fittings, and Hangers:
- 1. First Coat:
 - a. Benjamin Moore: M04 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - c. Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - d. Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - e. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 - 2. Second Coat:
 - a. Benjamin Moore: Moorcraft Latex Semi Gloss 276
 - b. Glidden Professional: Devoe Coatings Devflex 4216HP High Performance Waterborne Acrylic Semi-Gloss Enamel.
 - c. Pittsburgh Paints: 90-474 Series, Pitt-Tech One Pack Interior/Exterior Satin High Performance Industrial Enamel.
 - d. Pratt & Lambert: Enducryl Acrylic Semi Gloss Z6621
 - e. 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. Benjamin Moore: Moorcraft Vinyl Latex Primer-Sealer 273
 - b. Glidden Professional: High Hide Interior Primer Sealer 1000-1200.
 - c. Pittsburgh Paints: Speedhide Latex Primer-Sealer 6-2
 - d. Pratt & Lambert: Pro Hide Gold High Holdout Latex Primer Z8165
 - e. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
 - 2. Second Coat:
 - a. Benjamin Moore: Moorcraft Vinyl Latex Flat 275
 - b. Glidden Professional: Ultra-Hide 150 Interior Flat Paint 1210V Series.
 - c. Pittsburgh Paints: Speedhide Latex Interior Flat 6-70
 - d. Pratt & Lambert: Pro Hide Gold Flat Z8100
 - e. 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. Benjamin Moore: M04 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.

- c. Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - d. Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - e. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
2. Second and Third Coats:
- a. Benjamin Moore: Moorcraft Latex Semi Gloss Enamel 276
 - b. Glidden Professional: Devoe Coatings Devflex 4216HP High Performance Waterborne Acrylic Semi-Gloss Enamel.
 - c. Pittsburgh Paints: 90-474 Series, Pitt-Tech One Pack Interior/Exterior Satin High Performance Industrial Enamel.
 - d. Pratt & Lambert: Enducryl Acrylic Semi Gloss Z6621
 - e. 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. Glidden Professional: Devoe Coatings Devran 201H Universal Epoxy Primer.
 - b. Koppers: Bitumastic-Super Service Black
 - c. Pittsburgh Paints: 95-240 Series, Pitt-Guard Rapid Coat D-T-R.
 - d. Sherwin Williams: Macropoxy 646 Fast Cure, B58-600/B58V600.
 - e. Wasser: MC Tar.
 2. Second and Third Coats (allow 24 hours drying time after first coat):
 - a. Glidden Professional: One (1) Coat Devoe Coatings DETHANE 379H Aliphatic Urethane Enamel @ 2.0 to 3.0 mils DFT.
 - b. Koppers: Bituglas Aluminum
 - c. Pittsburgh Paints: 95-240 Series, Pitt-Guard Rapid Coat D-T-R.
 - d. Sherwin Williams: Hi-Solids Polyurethane B65-300.
 - e. Wasser: MC Tar.

2.7 ELECTRICAL

- A. Exterior Exposed Electrical Conduit Fittings, Boxes, and other miscellaneous exterior electrical items.
1. First Coat - Galvanized:
 - a. Benjamin Moore: M04 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - c. Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - d. Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - e. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 2. First Coat - Ferrous Metal:
 - a. Benjamin Moore: M04 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - c. Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.

- d. Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - e. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
3. Second and Third Coats:
- a. Benjamin Moore: Impervex Enamel 309
 - b. Glidden Professional: Devoe Coatings Devflex 4216HP High Performance Waterborne Acrylic Semi-Gloss Enamel.
 - c. Pittsburgh Paints: 90-374 Series, Pitt-Tech One Pack Interior/Exterior Gloss High Performance Industrial Enamel.
 - d. Pratt & Lambert: Enducryl Acrylic Gloss Z6611
 - e. 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. Benjamin Moore: M04 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - c. Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - d. Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - e. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
2. First Coat - Ferrous Metal:
- a. Benjamin Moore: M04 Acrylic Metal Primer
 - b. Glidden Professional: Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish.
 - c. Pittsburgh Paints: 90-708 Series, Pitt-Tech One Pack Interior/Exterior Industrial Primer.
 - d. Pratt & Lambert: Steel Tech Acrylic Prime & Finish Z190
 - e. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
3. Second and Third Coats:
- a. Benjamin Moore: Moorcraft Latex Semi Gloss Enamel 276
 - b. Glidden Professional: Devoe Coatings Devflex 4216HP High Performance Waterborne Acrylic Semi-Gloss Enamel.
 - c. Pittsburgh Paint: 90-474 Series, Pitt-Tech One Pack Interior/Exterior Satin High Performance Industrial Enamel.
 - d. Pratt & Lambert: Enducryl Acrylic Gloss Z6611
 - e. 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 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.

3.4 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.

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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.

3.5 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.

3.6 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

MISCELLANEOUS 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 miscellaneous items as specified in Part 2 below.
- B. Related Sections include the following:
 - 1. Division 5 "Metal Fabrication" for miscellaneous framing and supports.
 - 2. Division 16 sections for electrical power supply wiring and motor connections.

1.3 SUBMITTALS

- A. Product Data: For each product indicated, include construction details, materials, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Include location and installation requirements for electrical components.
- C. Wiring diagrams detailing power and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- D. Samples for Initial Selection: Manufacturer's sample finishes showing the full range of colors and textures available for units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples in manufacturer's standard sizes, and of same thickness and material indicated for the Work. If finishes involve normal color or shade variations, include sample sets showing the full range of variations expected.
- F. Maintenance Data: Maintenance manuals for maintaining and repairing miscellaneous specialties.

1.4 MISCELLANEOUS SPECIALTIES DESCRIPTION

- A. Miscellaneous Specialties are items that are purchased completely fabricated and delivered to the jobsite for installation by other than the original fabricator.

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 Products: The design for each miscellaneous item 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 PEDESTRIAN CONTROL EQUIPMENT GATE

A. Provide Bi-Directional Wait High Pedestrian Gate

B. Products

1. Basis of Design: Drawings and Specifications are based on Alvarado Manufacturing SSG Pedestrian Gate or approved equal from one of the following:

- a. Cominfosec – Pegas SFWR
- b. Sentronic International – VE500-ADA

C. Construction:

1. Gate: 1.5" OD 16-gauge stainless steel tubing with two vertical steel strips for attaching optional sign kit.
2. Hinge Post: 2.25" OD 11-gauge stainless steel tubing
3. General: Gate is designed to provide single or bi-directional pedestrian floor control. Single direction operation can be configured for right-hand or left-hand swing by installing the supplied stop tab.
4. Opening: The gate opening is minimum of 36"
5. Finish: Stainless steel polished to a satin #4 finish
6. Latch and Latch Post: Optional latch and latch post allows the gate to be secured when closed.
7. Sign Kit: Optional sign mounts to the vertical strips on the gate. Signs display messages on both sides. Provide "ENTER/DO NOT EXIT" and "EXIT/DO NOT ENTER".

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install all products at locations indicated in compliance with manufacturer's written installation instructions.
- B. Provide all accessories, including mounting hardware and trim, for a complete installation.
- C. Coordinate product installations with all adjacent construction.
- D. Connect products requiring power to building's electrical system according to manufacturer's written instructions.
- E. Test products to verify that all functions properly operate in a safe and efficient manner.

3.2 PROTECTION AND CLEANING

- A. Protect products after installation from damage during construction. If despite such protection damage occurs, remove or replace damaged components or entire unit as required to provide units in their original undamaged condition.

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. Source Limitations: Obtain each sign type through one source from a single manufacturer.

- B. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.
- C. 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. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 INTERIOR DIE-RAISED SIGNAGE

- A. Manufacturer:
 - 1. Subject to compliance with requirements, provide signs as manufactured by The Supersine Company or approved equal.
- B. Sign Construction:
 - 1. Plate material shall be .102" 3003 alloy H-14 Aluminum Sheet. The plate shall have smooth, even, level surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16" measured diagonally.
 - 2. Signs shall be mechanically fabricated with smoothly finished square cut edges.
 - 3. Corners shall be rounded to radius indicated on Sign Type Drawings.

4. All characters, Braille, and graphics are to be raised by a semi-shear process using male/female dies. Characters of the style indicated on the Sign Type Drawings shall be precisely formed, with sharp, well-defined edges.
 5. The raised characters and graphics shall be masked to allow the background and Braille to be painted with a smooth acrylic enamel finish. The character and graphic portions of the signs shall be anodized, with a satin finish.
 6. Backshields at all wall mounted locations shall be cut from .102" H-14 Aluminum, and painted.
 7. Backshields at signs mounted on glass shall be cut from 1/32" thick acrylic sheet, with a reverse screen printed colored background.
- 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.

2.3 INTERIOR DIE-RAISED SIGNAGE

- A. Manufacturer:
1. Subject to compliance with requirements, provide signs as manufactured by The Supersine Company or approved equal.
- B. Sign Construction:
1. Plate material shall be .102" 3003 alloy H-14 Aluminum Sheet. The plate shall have smooth, even, level surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16" measured diagonally.
 2. Signs shall be mechanically fabricated with smoothly finished square cut edges.
 3. Corners shall be rounded to radius indicated on Sign Type Drawings.
 4. All characters, Braille, and graphics are to be raised by a semi-shear process using male/female dies. Characters of the style indicated on the Sign Type Drawings shall be precisely formed, with sharp, well-defined edges.
 5. The raised characters and graphics shall be masked to allow the background and Braille to be painted with a smooth acrylic enamel finish. The character and graphic portions of the signs shall be anodized, with a satin finish.
 6. Backshields at all wall mounted locations shall be cut from .102" H-14 Aluminum, and painted.
 7. Backshields at signs mounted on glass shall be cut from 1/32" thick acrylic sheet, with a reverse screen printed colored background.
- 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.
4. Field color for name insert: Custom color to match Architect's sample.
5. Name insert characters: Custom color to match Architect's sample.

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.
 5. Exterior individual building letters: Mount letters in a concealed manner using standard fastening methods recommended by the manufacturer for the letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners.

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 COMPARTMENTS
(Phenolic-Core)

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 phenolic-core units as follows:
 - 1. Toilet Enclosures: Overhead braced.
- B. Related Sections include the following:
 - 1. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, and similar accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
- C. Samples for Initial Selection: For each type of unit indicated.
- D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch- (150-mm-) square Samples of same thickness and material indicated for Work.

1.4 QUALITY ASSURANCE

- A. Comply with requirements in CID-A-A-60003, "Partitions, Toilets, Complete."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments 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 toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PHENOLIC-CORE UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Accurate Partitions Corporation.
 2. American Sanitary Partition Corporation.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation; Mills Partitions.
 5. Flush Metal Partition Corp.
 6. Global Steel Products Corp.
 7. General Partition Mfg. Corp.
 8. Metpar Corp.
- B. Door, Panel and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.
1. Facing Sheet Color: One color in each room as selected by Architect from manufacturer's full range of colors.
 2. Core Color: Manufacturer's standard dark color.
 3. Urinal-Screen Construction: Matching panels.
 - a. Urinal Screens: Unless noted otherwise, wall-mounted urinal screen panels shall be 24 inches deep x 48 inches high with continuous wall bracket. The bottom of the screen shall be a maximum of 12 inches above finish floor with the top of the screen a minimum of 60 inches above finish floor."
- C. Pilaster Shoes and Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304, not less than 0.0312 inch (0.8 mm) specified thickness and 3 inches (75 mm) high, finished to match hardware.
- D. Brackets (Fittings):
1. Continuous Type: Ear or U-brackets, stainless steel.

2.2 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
1. Material: Stainless steel.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Doors: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be accessible to people with disabilities.
 - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
 - 2. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
 - 2. Continuous Brackets: Secure panels to walls and to pilasters with not less than two brackets attached near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

- C. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

****END OF SECTION****

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. Liquid soap dispenser - surface mounted.
3. Paper towel dispenser – surface mounted.
4. Two-roll toilet tissue dispenser - surface mounted.
5. Sanitary napkin/disposal - surface mounted.
6. Clothes hook - single.
7. Utility Shelf with mop and broom holders.
8. Grab bars.
9. Folding shower seat - reversible.
10. Shower curtain rod - heavy duty.
11. Shower curtain and hooks.

- B. Related Sections include the following:

1. Division 6 Section “Finish Carpentry and Millwork” for countertops.
2. Division 10 Section "Toilet Compartments" for compartments and screens.
3. 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.
- D. Manufacturer's Hand Dryer Warranty: Written warranty, executed by hand dryer manufacturer, against defects in material and workmanship within minimum warranty periods indicated.
 - 1. Minimum Warranty Period for Motor Brushes: Three (3) years from date of Substantial Completion.
 - 2. Minimum Warranty period for all other parts: Ten (10) 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. Hand Dryers:
 - a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 - 3. Childcare Accessories:
 - a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Koala 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. Soap Dispenser, Surface Mounted: Owner Provided, Contractor Installed:
- C. Paper Towel Dispenser, Recessed: Owner Provided, Contractor Installed:
- D. Two-Roll Toilet Tissue Dispenser, Surface mounted: Owner Provided, Contractor Installed:
- E. Sanitary Napkin Disposal, Surface Mounted: Provide stainless-steel sanitary napkin disposal unit with satin finish complying with the following:
 - 1. Products: Bobrick Washroom Equipment, Inc., Series B-270.
 - 2. Surface-Mounted Type: With seamless exposed walls; self-closing top cover; stainless-steel, continuous hinge; and removable, reusable receptacle.
- F. Clothes Hook, Single: Provide clothes hook complying with the following:
 - 1. Products: Bobrick Washroom Equipment, Inc., Series B-76717.
 - 2. Single-Prong Unit: Stainless-steel satin finished, single-prong clothes hook with rectangular wall bracket and backplate for concealed mounting.
- G. Utility Shelf with Mop and Broom Holders: Provide mop and broom holder complying with the following:
 - 1. Products: Bobrick Washroom Equipment, Inc., Series B-224.
 - 2. Mop and Broom Holder with Utility Shelf: 36-inch- (914-mm-) long unit fabricated of minimum nominal 0.05-inch- (1.3-mm-) thick stainless steel with shelf; support brackets for wall mounting; three hooks for wiping rags; four spring-loaded, rubber hat, cam-type,

mop/broom holders mounted on front of shelf; and approximately 1/4-inch- (6-mm-) diameter, stainless-steel rod suspended beneath shelf for drying rags.

- H. 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.
- I. Folding Shower Seat, Reversible: Provide heavy-duty hinged seat designed to fold up against wall when not in use with stainless-steel support braces, hinges, frame, and fasteners; of all-welded construction; and complying with the following:
1. Products: Bobrick Washroom Equipment, Inc., Series B-5181.
 2. Configuration: L-shaped seat, designed for wheelchair access.
 3. Seat Material: Phenolic or polymeric composite of slat-type or one-piece construction. Color as selected by Architect from mfr's full range.
- J. Shower Curtain Rod, Heavy-Duty: Provide stainless-steel shower curtain rod with 3-inch (75-mm) stainless-steel flanges designed for exposed fasteners, in length required for shower opening indicated, and complying with the following:
1. Products: Products: Bobrick Washroom Equipment, Inc., Series B-6047
 2. Heavy-Duty Rod: 1-1/4-inch (32-mm) OD; fabricated from nominal 0.05-inch- (1.3-mm-) thick stainless steel with satin finish.
- K. Shower Curtain and Hooks: Provide shower curtain complying with the following:
1. Products: Bobrick Washroom Equipment, Inc., Series B-204.
 2. Vinyl Shower Curtain: Minimum 0.006-inch- (0.15-mm-) thick, opaque, matte vinyl with hemmed edges and corrosion-resistant grommets at minimum 6 inches (152 mm) o.c. through top hem.
 3. Curtain Size: As required for shower openings indicated.
 4. Shower Curtain Hooks: Stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

****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 01 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.
- 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. 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).
- B. 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
- 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
- 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

PHENOLIC 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. Section includes: Solid Phenolic Lockers, including custom Phone Lockers with integral USB charging ports.
- B. Related Sections:
 - 1. Division 06 Section “Rough Carpentry” for miscellaneous wood framing and blocking.

1.3 SUBMITTALS

- A. Submittals: Comply with procedures and quantities as indicated in Division 1 Submittal Procedure Section.
- B. Shop Drawings: Submit shop drawings indicating room sizes, layout, locker dimensions, material thickness, trim, hardware, finishes, locks, base, doors, accessories, and installation details.
- C. Product Data: Submit manufacturer’s technical data for materials, fabrication, finishing, fastenings, hardware, and installation details.
- D. Samples: Submit samples of edge details, colors, patterns, finishes, and textures.
- E. Closeout Documents: Submit the following:
 - 1. Operation and maintenance data
 - 2. Warranty

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Fabricator shall be capable of providing field service representation.
 - 2. Installer shall be approved by the manufacturer and be experienced in performing work of similar size and scope.
- B. Pre-installation Meeting: Conduct pre-installation meeting prior to installation to verify project requirements and conditions.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with supplier’s ordering and lead-time guidelines to avoid delays.
- B. Delivery: Deliver materials in the manufacturer’s original protective packaging.
- C. Storage and Handling: Store materials in an enclosed shelter providing protection from damage, temperature, humidity, and exposure to the elements.

1.6 COORDINATION AND PROJECT CONDITIONS

- A. Field Measurements: Before material fabrication, verify actual field measurements and show actual measurements on shop drawings.
- B. Coordination: Coordinate field measurements with fabrication schedule and construction progress to avoid construction delays.

1.7 WARRANTY

- A. Submit executed copy of the Summit Lockers 20-year warranty against defects in material signed by an authorized representative of Summit Lockers.

PART 2 – PRODUCTS

2.1 SOLID PHENOLIC LOCKERS

- A. Basis of Design: Drawings and specifications are based on Summit Phenolic Lockers or approved equal from one of the following:
 - 1. ASI Storage Solutions
 - 2. Art Metal Products
 - 3. Hollman
- B. Locker Models: Refer to drawings for Locker Schedules, Sizes, Configurations and Locations.
 - 1. Lockers Single Tier Phenolic Locker, where scheduled and indicated.
 - 2. Lockers Three Tier Phenolic Locker, where scheduled and indicated.

2.2 MATERIALS

- A. Panel Material:
 - 1. Decorative papers impregnated with a melamine resin on faces with a clear protective overcoat and integrally compression molded within a core consisting of solid phenolic impregnated kraft papers.
 - 2. Fire Rating: Core or panel material shall meet fire Class B resistance per ASTM E84
- B. Doors & Ancillary Panels:
 - 1. Material: 1/2" (13mm) thick solid phenolic composite material.
 - 2. Corners: Eased edges
 - 3. Door Fastening: Blind fastening unless through bolts are requested
 - 4. Colors: As selected by Architect from manufacturer's full range of options. All phenolic panel edges are black.
- C. Locker Bodies
 - 1. Exposed edges: Straight profile; eased edges to remove sharpness; machine polished and free from tooling imperfections.

2. Tops, bottoms, and intermediate shelves: 3/8" (9.5mm) thick solid phenolic composite material with ventilation holes.
3. Locker sides: 5/16" (8mm) thick solid phenolic composite material.
4. Locker backs: 1/4"+ (6mm) thick solid phenolic composite material.
5. Colors: Locker bodies are white. All phenolic panel edges are black.

D. Hardware

1. Hinges:
 - a. 180° Stainless Steel continuous hinge
2. Interior Side hooks:
 - a. Material: Stainless steel. Plastic and nylon hooks are not acceptable.
 - b. Two per opening for all openings 30" tall or greater.
3. Fasteners: All fasteners shall be stainless steel.
4. Door Identification Plates:
 - a. Material: Black plastic with reverse engraved numbers and surface mounted with permanent adhesive.
 - b. Fonts to be a minimum 1/2" high and up to four characters.
 - c. Numbering sequence to be provided by architect.
5. Door Locks:
 - a. Stainless steel hasp bar for customer supplied padlock

E. Ventilation

1. Vertical ventilation: Provide six 5/16" (8mm) diameter ventilation holes on tops, bottoms, and intermediate shelves. Provide three 5/16" (8mm) diameter ventilation holes on "Z" type intermediary shelves.
2. Horizontal ventilation: Provide ventilation around the edge of the door equal to at least 1.43 square inches of ventilation surface area per linear foot of door perimeter.

2.3 ACCESSORIES AND OPTIONS

A. Finished Locker Top:

1. Sloped top: 1/2" solid phenolic top color matched with lockers and installed at a 20° rise from front to back, using an extruded aluminum channel across the front.

B. Coat Rod: Stainless steel coat rod installed in locker openings greater than 30" H and 18"D.

C. Additional Door Ventilation:

1. Standard ventilation: Refer to section 2.2.F.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine site conditions before locker installation. Notify architect of unacceptable areas. Do not install lockers until unacceptable conditions have been corrected.

3.2 INSTALLATION

- A. Install lockers in locations as shown on shop drawings per manufacturer's instructions.
- B. Install lockers installed secured, plumb, level, square, and flush. Base by others must be flat and level.
- C. Install all required trim, fillers, end panels, and closures per manufacturer's instructions.
- D. Use hardware supplied or recommended by the manufacturer.
- E. Connect Phone Lockers USB charging ports to building electrical systems.
- F. Attach number plates to doors as indicated on shop drawings.
- G. Correct and/or replace damaged components as directed by architect.

3.3 ADJUSTMENT

- A. Adjust doors and locks for smooth operation without binding.
- B. Lubricate door hinges and locks per manufacturer's instructions.

3.4 CLEANING

- A. Clean all surfaces in accordance with manufacturer's instructions.
- B. Do not use abrasive cleaners.

****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.
3. Miscellaneous pieces including mobile storage units and tables.

- 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 9 Section "Resilient Tile Flooring" for resilient base molding.
4. Division 22 for sinks and service fixtures, service waste lines, connections, ducting within or adjacent to casework, and vents.
5. Division 26 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. Advanced Cabinet Systems
2. Case Systems, Inc.
3. Stevens Industries Inc.
4. 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 (LEED): 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. 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 where indicated on Drawings but not less than one (1) cabinet and one (1) drawer per room.
 - a. Coordinate lock locations with the Architect.
 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.
 3. Metal leg supports and free-standing table hardware.
- B. Mobile unit hardware:
1. Casters: Non-marking, soft, rubber wheels with ball bearing assembly. Provide a minimum of two (2) brakes per unit. Load capacity per caster shall be a minimum of 200 pounds.
- C. Grommets: Provide manufacturer's standard plastic grommets.
- D. Keyboard Tray: Manufacturer's standard articulating undercounter mount with slide, tilt, and rotation mechanism including pull-out mouse pad.
- E. Tote Trays: Heavy-duty vacuum-formed polypropylene plastic with full top rim and pull. Trays shall be manufacturer's standard color, equipped with label holder.
1. Tote tray cabinets shall be equipped with injection molded polycarbonate, continuous side rail support glides. Each side rail support glide with integral support pins shall friction fit into cabinet end panels and vertical dividers, adjustable on 32mm centers.

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.

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****

SITE FURNISHINGS

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. Seating.
2. Bicycle racks.
3. Trash receptacles.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete footings.
2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 BENCHES

- A. Manufacturer: Landscape Forms, Inc., Kalamazoo, MI.
- B. Product: Subject to compliance with requirements, provide the product indicated on Drawings and as described below:
 1. Model: Parc Vue
 2. Configuration: Backed with Arms. Refer to detail on drawings
 3. Mount: Surface Mounted. Refer to detail on drawings
 4. Color: Titanium
 5. Options: Backless seats. No optional arms. Refer to detail on drawings.

2.2 BICYCLE HOOPS

- A. Manufacturer: Landscape Forms, Inc., Kalamazoo, MI.

- B. Product: Subject to compliance with requirements, provide the product indicated on Drawings and as described below:

1. Model: Emerson
2. Mount: Embedded Mount. Refer to detail on drawings
3. Color: Titanium

2.3 TRASH RECEPTACLES

- A. Manufacturer: Landscape Forms, Inc., Kalamazoo, MI.
- B. Product: Subject to compliance with requirements, provide the product indicated on Drawings and as described below:

1. Model: Collect
2. Configuration: Side Opening
3. Mount: Surface Mounted. Refer to detail on drawings
4. Coating: Manufacturer's standard powder coat.
5. Color: Metal: Titanium Polyethylene: Black

2.4 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. 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.

2.6 STEEL AND GALVANIZED STEEL FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

3.3 CLEANING

- A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

****END OF SECTION****

SWIMMING POOL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT and applicable parts of DIVISION 1 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.2 SUMMARY OF WORK (*for general guidance-not all inclusive*)

A. Introduction

1. Provide all labor, materials, equipment and services necessary to construct a leisure pool. This work shall include the structure and installation of pool finishes as well as all products listed in Part 2 of Section 131100.

B. Work included in this section

1. It is the intent of this section to place the entire responsibility for the construction of the pool (including the construction of the pool shell) under one vested CONTRACTOR. Under this section the Swimming Pool Contractor will provide but is not necessarily limited to the following:
- a. Provide all equipment and services required for erection and delivery onto the premises of any equipment or apparatus provided. Remove equipment from premises when no longer required.
 - b. Grade and replace load bearing or high plasticity index soil, pump and dewater as necessary to keep excavations free from water during construction, and provide sub-surface drainage beneath the surge tank as needed or required in the project geotechnical report. Reference Division 31 - Earthwork.
 - c. Provide and maintain proper shoring and bracing for existing utilities, sewers and building foundations where required for related excavations. Reference Division 31 - Earthwork.
 - d. Provide all electrical conduit, wiring, junction boxes etc. to all low voltage pool equipment within pool filter/chemical rooms per Division 26 - Electrical. (Low voltage is considered less than 110 V.)
 - e. Coordinate for all required bonding and grounding of the pool shell, fittings, and equipment.
 - f. Provide all necessary piping and valving as shown on the drawings and specified herein.
 - g. Provide individually sized housekeeping pads for each pool pump. Provide housekeeping pads for pool equipment as required in the drawings.
 - h. Provide the main drain hydrostatic relief system and a sight sump as shown on the drawings. Reference Division 31 - Earthwork.
 - i. Provide winterization products and services for the outdoor swimming pool for a period not less than 12 months including a minimum of one (1) closing and one (1) opening. The Contractor shall provide one (1) additional opening if the outdoor facility is open for less than 40 days. Contractor to include winterization procedures with owner training.

- j. Construct the cast in place or pneumatically applied concrete pool shell and cast in place surge tank as described in these specifications and detailed on the drawings, including reinforcement steel, inserts, fittings, main drain sumps and all embedded items (piping, anchors, etc.) for the pool. Reference Division 3 - Concrete and Structural. Before commencing the placement of concrete, verify electrical bonding of the pool embedded items and reinforcing steel. Also, coordinate and arrange any required electrical, plumbing and or building inspections. Provide any structure drainage around the pool as shown on the drawings. Backfill and compact fill around the pool structure, piping trenches and excavations required by this work. Reference Division 31 - Earthwork.
 - k. Provide an epoxy paint finish in the pool with a slip resistant surface. Provide specialty tile for the depth markings and warning signs. Reference Section 2.16 - Swimming Pool Finishes.
 - l. Assemble and install the cleaning and maintenance equipment for the pool as specified herein.
 - m. Provide for the storage of all pool related equipment, materials and systems. All items are the responsibility of the CONTRACTOR until accepted by owner.
 - n. Obtain final acceptance by jurisdictional health department(s).
 - o. Start, test, calibrate and adjust all mechanical equipment, electrical equipment, recirculation, chemical, and other supplied systems including deck, loose, maintenance, and safety equipment. Instruct the Owner's representative in the systems operation and maintenance as described herein.
 - p. Provide the heating system for the pool. Include all piping, heaters, heat exchangers, booster pumps, controls, gauges, thermostats, control valves and wiring required to draw water from the recirculation line, heat the water and return it back to the recirculation line and interlock with pool recirculation pumps.
- C. Related work specified in other sections
- 1. Section 131413 – Waterslides
 - 2. The following work related to the swimming pool shall be completed by other trades.
 - a. Provide, erect and maintain all necessary barricades, signs, lights and flares for pool construction to protect workers and the public.
 - b. Provide and maintain proper shoring and bracing for existing utilities, sewers and building foundations where required for swimming pool related excavations. Reference Division 31 - Earthwork.
 - c. Provide the under drain system beneath the pool.
 - d. Provide sub-surface drainage beneath the pump pit. Reference Division 31 - Earthwork.
 - e. Construct pump pit including reinforcement, inserts, wall sleeves, anchors, access hatches, and fittings. Reference Division 3 - Concrete.
 - f. Layout, excavate, remove from the construction site, replace and grade materials as required beyond the limits of excavation of the pool shell to complete the work described in this section. Reference Division 31 - Earthwork.
 - g. Prior to concrete pours, verify electrical bonding of the pool embedded items. Coordinate and arrange any required electrical, plumbing and or building inspections to be performed on embedded items. Reference Division 26 - Electrical.

- h. Provide sanitary sewer and storm drain connections. Reference Division 22 - Plumbing.
 - i. Layout and install all deck mounted anchors, sockets, and inserts for the pool.
 - j. Provide deck finish beyond perimeter tile band. Reference Division 32 - Exterior Improvements.
 - k. Provide rules and regulations signage as required by code. Reference Division 1 - General Requirements.
 - l. Provide chlorine resistant caulking (sealant) and backer rod on pool decks. Reference Division 7 - Thermal and Moisture Protection.
- D. Related work specified in Plumbing section. Reference Division 22 - Plumbing. Work to be completed by other contractors.
- 1. Provide trench drains and area drains on pool deck.
 - 2. Provide sanitary sewer piping from the filter room including floor drains, sumps, and sump pump.
 - 3. Provide water service to all hose bibbs, flush hydrant boxes and auto-fill bypass to air gap above fill funnel. Install the slow closing solenoid valve in the bypass auto-fill piping.
 - 4. Install Plumbing Contractor supplied water meter on the fresh water supply line upstream of the manual fill valve and the slow closing solenoid valve.
- E. Related work specified in Mechanical section. Reference Division 23 – HVAC. Work to be completed by other contractors.
- 1. Provide air recirculation systems for pool related spaces.
- F. Related work specified in Electrical sections. Reference Division 26 – Electrical. Work to be completed by other contractors.
- 1. Provide power to the exhaust fans for the chemical rooms.
 - 2. Provide motor starters, auxiliary contacts, magnetic relays and other electrical control devices necessary for the complete operation of the pool systems. Install power to Variable Frequency Drive pool pump starters and power from VFD to the pool pump motor.
 - 3. Ground and bond all pool structures, fittings and equipment in accordance with Article 680 of the N.E.C. Test and verify that the system electrical ground is true and solid. Provide certification to this effort.
 - 4. Obtain permits, inspections, and approvals of all wiring including grounding and bonding of all metal components associated with the pool in accordance with Local, State and National Electrical Codes.
 - 5. Confirm all electrical conduits that penetrate the pool shell are watertight and installed per N.E.C. Article 680.

1.3 QUALITY ASSURANCE

- A. The specifications and drawings illustrate and detail one (1) swimming pool systems that shall be utilized for recreational use. Certain technical aspects of the design are common only to pool

systems planned for public use. Understanding these aspects, their functions and interaction through experience is vital to completing a successful operating system. It is a mandatory requirement that all bidders will have achieved such experience as a prerequisite for bidding this project.

1. CONTRACTOR to refer to section 002113 – INSTRUCTIONS TO BIDDERS for bonding requirements.
2. If the Contractor has not received prior written approval for this project or has not been included in the pre-approved list of Contractors, they must submit a list of projects meeting the aforementioned qualifications, including contact information of the General Contractor shall be submitted for review and approval at least 10 days prior to bidding of the project. The Contractor must have completed at least five (5) public-use leisure pools with individual water surface areas in excess of 4500 square feet and a depth of 6'-0" or more within the past 10 years.
3. The Contractor must submit prior to the start of construction the name of the on-site Project Superintendent including their relevant experience. The Contractor's on-site Project Superintendent must have completed at least five (5) public-use leisure pools with individual water surface areas in excess of 4500 square feet and a depth of 6'-0" or more within the past 10 years. A list of projects meeting the aforementioned qualifications, including contact information of the General Contractor as well as Owner shall be included with the experience submittal. Project Superintendent must not change on the project unless written authorization has been provided by the Architect and Owner.
4. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligation of the contract and to complete the work described or if the bidder does not have the qualifications stated herein. Subject to compliance with item 2 above on this specification.

1.4 REGULATORY AGENCY REQUIREMENTS AND ENGINEERING SERVICES

- A. The system shall comply with all necessary pre-construction approvals obtained by the Owner and Owner's Consultants from local regulatory agencies governing the design and construction of public swimming pools.
- B. The Contractor shall give all necessary notices, obtain all permits and pay all government fees, and other costs in connection with his work, including the filing of all necessary as-built drawings, prepare all documents and obtain all necessary approvals of governmental departments having jurisdiction over their work. The Contractor shall also be responsible for obtaining all required certificates of inspection for his work and deliver same to the Owner and Owner's Consultants before requesting acceptance and final payment for the work.
- C. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus or drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on drawings and/or specified.

1.5 COORDINATION AND CLARIFICATION

- A. Coordinate with other contractors or subcontractors all work relating to this section.
- B. The Contractor must establish with other contractors or subcontractors, having related work in this section, that all work necessary to complete the pool as shown on the drawings and in the specifications is included in the base bid and alternates to the Owner.

- C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the Contractor shall notify the Architect through channels established by the specifications and request a clarification ten (10) days prior to the bid date.

1.6 ALTERNATES

- A. Review the description of the alternates in Division 1 and on the drawings for possible effect upon work in this section. Alternates related to the work in this section are described in this division and on the bid proposal form.
- B. Pool Alternates
 - 1. Alternate #1: Provide 76' Poolside Waterslide, item #65-370, in lieu of the fiberglass waterslides and tower structure detailed on the drawings and specified in section 131413. The feature pumps and piping shall be replaced with a single 2" Schedule 80 PVC supply off of the recirculation pump capable of 20 GPM flow. Water depth to be modified from 3.5' in the base bid at the slide plunge area to 4.0' per manufacturer's requirements.

1.7 CONTRACTOR'S ALTERNATE PROPOSAL

- A. Contractor shall submit his bid to the owner based on materials, equipment and methods as specified in this Section. No substitutions of material will be allowed.
- B. It is the intent of the contract documents to encourage competition. The base proposal must be on providing the construction methods and equipment as specified and detailed. Any proposed system substitution must have prior written approval by the Architect.
- C. If there is any deviation from the basis of design equipment it is the responsibility of the contractor to confirm that all engineering criteria are appropriate for the substituted equipment.
- D. All proposed substitutions of specified construction methods and equipment shall include a complete submittal as required by these specifications and drawings of appropriate scale incorporating all required changes. The Contractor shall provide a list of at least ten (10) satisfactory installations comparable to this project that have been manufactured and installed under the manufacturer's current legal name. Submit a list of such projects with the name, address and current telephone number of the Owner's Operator and Architect of Record to the Architect on the bid date.
- E. Any changes or modifications to the Contract Documents that are not authorized by the architect shall be the sole responsibility of the Contractor.

1.8 SUBMITTALS

- A. All submittals shall be made in accordance with the requirements of Division 1 - General Requirements and in strict compliance with the following procedures and guidelines.
- B. Six (6) sets of shop drawings and engineering data shall be tabbed, indexed, referenced to the specifications, bound in 3 ring binders and submitted in two stages. Provide 8 1/2" x 11" cover sheet for each item submitted identifying item and product number. The first stage shall include all embedded items for the pool shell (including piping diagrams) and the second stage shall be for all remaining items. Electronic submittals will be acceptable in lieu of the six (6) hard copies. All electronic submittals shall be organized, numbered, and submitted in the same format as the project specifications. Only complete sets will be reviewed.
 - 1. Engineering data covering all systems, equipment, structures and fabricated materials, which will become a permanent part of the work under this contract, shall be submitted for review. This data shall include drawings and descriptive information in sufficient detail and

scale to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorage and supports required; performance characteristics; fabrication and dimensions needed for installation and correlation with other materials and equipment. A certification, in writing, shall be provided indicating that all equipment will fit in the space allotted and as shown on the drawings.

2. All submittals regardless of origin shall be stamped with the approval of the CONTRACTOR and identified with the name and number of this contract, CONTRACTOR'S name, and references to applicable specification paragraphs and contract drawings. Each submittal shall indicate the intended use of the item in the work. When catalog pages are submitted, applicable items shall be clearly identified. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.
3. The submittals will not be accepted from anyone but the CONTRACTOR. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.
4. The CONTRACTOR'S stamp of approval is a representation that the CONTRACTOR accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers and similar data, and that he has reviewed or coordinated each submittal with the requirements of the work and the contract documents.
5. Each submittal shall include a statement prepared by the originator of the drawings and data, certifying compliance with the contract documents except for deviations, which are specifically identified.
6. All deviations from the contract documents shall be identified on each submittal and shall be tabulated in the CONTRACTOR'S letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by the CONTRACTOR (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.
7. The CONTRACTOR shall accept full responsibility for the completeness of each submission, and, in the case of a resubmission, shall verify that all exceptions previously noted have been taken into account. In the event that more than one resubmission is required because of failure of CONTRACTOR to respond to exceptions and rejections previously noted, CONTRACTOR shall make all further resubmissions in person at the consultant's office.
8. Any need for more than one resubmission, or any other delay in obtaining review of submittals, will not entitle the CONTRACTOR to an extension of the contract time unless delay of the work is directly caused by a change in the work authorized by a change order.
9. Review of drawings and data submitted by CONTRACTOR will cover only general conformity to the drawings and specifications, external connections and dimensions that affect the layout. Review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device or item shown. Review of submittals shall not relieve CONTRACTOR from responsibility for errors, omissions, or deviations, or responsibility for compliance with the contract documents.
10. When the drawings and data are returned marked REJECTED, REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM, the corrections shall be made as noted thereon and as instructed and six corrected copies (or one copy and one corrected reproducible copy) resubmitted.

11. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) to indicate the sequence of the resubmittal. All resubmittals shall be indexed, tabbed, referenced to the specifications and bound in a three-ring binder and submitted at one time.
 12. When corrected copies are resubmitted, the CONTRACTOR shall, in writing, direct specific attention to all revisions and shall list separately any revisions made other than those called for on previous submissions.
 13. When the drawings and data are returned marked NO EXCEPTIONS TAKEN or MAKE CORRECTIONS NOTED, no additional copies need to be furnished unless specifically requested to do so for record.
- C. Permits, Receipts and Test Reports
1. Provide the Architect with copies of all permits and receipts for fee payments.
 2. Submit a sample format for each test report intended for use. Submit test reports required herein only on approved forms.
- D. Include complete product data indexed, tabbed, and referenced to specifications with 8 ½" x 11" cover sheet covering:
1. Paragraph 2.1 - Overflow System
 2. Paragraph 2.2 - Pumping Equipment
 3. Paragraph 2.3 - Filtration Equipment
 4. Paragraph 2.4 - Recirculation Fittings
 5. Paragraph 2.5 - Piping Systems
 6. Paragraph 2.6 - Chemical Treatment Systems
 7. Paragraph 2.7 - Chemistry Monitoring and Control Systems
 8. Paragraph 2.8 - Flow Meters
 9. Paragraph 2.9 - Water Level Controllers
 10. Paragraph 2.10 - Inserts and Anchor Sockets
 11. Paragraph 2.11 - Deck Equipment
 12. Paragraph 2.12 - Loose Equipment
 13. Paragraph 2.13 - Maintenance Equipment
 14. Paragraph 2.14 - Safety Equipment
 15. Paragraph 2.15 - Thermometers
 16. Paragraph 2.16 – Swimming Pool Finishes

17. Paragraph 2.17 - Waterproofing
 18. Paragraph 2.18 - Sealants
 19. Paragraph 2.19 - Water Features and Support Equipment
 20. Paragraph 2.20 - Pool Heaters
 21. Paragraph 2.21 - Underwater Lights
- E. Include engineering/construction drawings for the pool structure.
1. Reference Division 3 - Concrete.
- F. Include engineering construction drawings for all pool piping.
- G. Provide a complete set of structural drawings for the waterslide and associated feature footing structures bearing the seal, signature, and date of a licensed professional engineer in the State of Michigan. Drawings shall include plans, elevations, cross sections, details, and calculations required to construct the waterslide and associated feature footing structures. Structural drawings shall clearly identify all reinforcement, construction joints, embedded items including waterstops, excavation lines and finish concrete elevations, under drainage requirements, under drain routing, clean out locations and location dimensions of all accessory items provided under this section. A licensed professional engineer shall utilize existing soils and geotechnical data in the preparation of the structural design criteria. Provide all design calculations and support data required to show compliance with performance requirements specified, including design assumptions concerning element restraint. All calculations shall be certified and sealed by the licensed professional engineer. Provide a design in response to actual site conditions.
- H. Installation of the waterslide and associated feature footings shall not commence until detailed plans and specifications are approved by the department of Building and Safety. The responsibility for all costs associated with obtaining such approval shall be part of the General Construction contract.
- I. Reference Section 131413 – Waterslides
- 1.9 OPERATION AND MAINTENANCE MANUALS AND CLOSE-OUT SUBMITTALS
- A. Detailed operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment supplier and/or CONTRACTOR shall prepare an operation and maintenance manual for all equipment. Parts lists and operating and maintenance instructions shall be provided.
- B. Each operation and maintenance manual shall include the following:
1. Equipment function and calibration, normal operating characteristics, and limiting conditions.
 2. Assembly, installation, alignment, adjustment and checking instructions.
 3. Operating instructions for start up, routine and normal operation, regulation and control, shut down and emergency conditions.
 4. One (1) copy of all instructional videos.

5. Operating cycles shall be specifically described in outline format and in referenced detail. A wall-mounted color-coded piping flow diagram shall be provided in the pool equipment room. The diagram shall be engraved on laminated plastic with color-coded piping to match color of coding on piping, and including valves identified with number on tags. The minimum size shall be 11 inch x 17 inch.
6. Include manufacturer recommended maintenance schedule, parts lists, piping diagram (to agree with wall mounted diagram) and trouble-shooting information for all pool mechanical equipment.
7. Using reference to keyed valves and wall diagram, include specific written instructions for procedures to be followed for the following:
 - a. Emptying and refilling the pool including de-watering during the period that the pool will be empty;
 - b. Water level control adjustment and chemical control operation;
 - c. Normal surge tank operation and balancing;
 - d. Filter operation and backwashing; and
 - e. Super chlorination.
8. Lubrication and maintenance instructions.
9. Guide to "trouble-shooting".
10. Parts list and predicted life of parts subject to wear.
11. Outline, cross section, and assembly drawings; engineering data and wiring diagrams.
12. Test data and performance curves, where applicable.
13. Specific written instructions for procedure for emptying and refilling the pool including de-watering during any period that the pool will be empty. Include furnishing and installing a yellow warning sign 8-1/2 in. x 11 in., to be mounted in the filter room, that reads:

WARNING
Prior to emptying Pool
Consult O & M Manuals for Procedures

Add another sign shall read:

Keep all Caps, Plugs and Tops Tight Fitting to Prevent Escape of Fumes.

14. One set of applicable submittals shall be included in each manual.
- C. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by the CONTRACTOR.
- D. Manuals and other data shall be printed on heavy, first quality paper, 8-1/2 x 11 inch size with standard 3-hole punching and inserted in plastic covers. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches or 11 x 17 inches. Where reduction is not practical, larger drawings shall be folded separately and placed in envelopes that are bound into the manuals. Each envelope shall bear suitable identification on the outside.

- E. Six (6) bound volumes of each manual shall be submitted. All parts lists and information shall be assembled in substantial manuals and permanent, three-ring or three-post binders. Material shall be assembled and bound in the same order as specified, and each volume shall have a table of contents and suitable index tabs.
- F. All material shall be marked with project identification. Non-applicable information shall be marked out or deleted.
- G. Shipment of equipment will not be considered complete until all required manuals and data have been received.

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in manufacturer's original, unopened containers and crates with all labels intact and legible.
- B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.
- C. Handle materials in a manner to prevent damage.
- D. Store all materials on clean raised platforms with weather protective coverings. Provide continuous protection of materials against damage or deterioration.
- E. Remove damaged materials from site.

1.11 WARRANTIES

- A. The CONTRACTOR warrants to the Owner and Architect that materials and equipment provided under the contract will be of good quality and new unless otherwise required or permitted by the contract documents, that the work will be free from defects not inherent in the quality required or permitted, and that the work will conform with the requirements of the contract documents. Work not conforming to these requirements, including substitutions not properly approved and authorized will be considered defective. The CONTRACTOR'S warranty will exclude remedies for damage or defect caused by abuse, improper or insufficient maintenance, improper operations, modifications not executed by the CONTRACTOR or improper wear and tear under normal use. If required by the Architect, the CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of materials and equipment. All warranties shall be for a period of one year from the date of substantial completion or the owner begins using the pool unless otherwise specified.
- B. The CONTRACTOR shall agree to repair or replace any defective or non-complying work at no cost to the Owner upon written notification from the Owner within the warranty period. Pro-rated warranties are not acceptable.
- C. Submit all warranties covering, but not limited to the following:
 - 1. All pool deck equipment and accessories against defects in material, manufacturer and installation for a period of one (1) year.
 - 2. Defects in material, manufacture or installation of the recirculating overflow system for a period of one (1) year.
 - 3. Defects in material, manufacture and installation of the filtration, backwash, chlorination, pH adjustments and cleaning systems, including controls for a period of one (1) year.

4. Defects in material or workmanship of the pool structure causing a loss of water for a period of three (3) years.
5. Defects in material, workmanship, and installation of the pool piping system for a period of three (3) years.
6. Defects in material, workmanship, and installation of the pool pumps for a period of one (1) year.
7. Manufacturer's minimum five (5) year warranty against defective materials, components and workmanship in the pool chemical controller. ORP, pH, flow and temperature sensors shall be covered by a standard two (2) year warranty. All other sensors and flow cell components shall be covered by a standard one (1) year warranty.
8. Manufacturer's minimum eighteen (18) month warranty against defective materials, components and workmanship in the Variable Frequency Drive system effective the date of supply
9. Defects in material, workmanship, and installation of the pool painted finish against delamination for a period of one (1) year.
10. Manufacturer's minimum fifteen (15) year warranty on the filter tank against defective materials or workmanship of the tank and components. (Additional warranty time may be purchased from the manufacturer.) Prorated warranties are not acceptable.
11. Manufacturer's minimum one (1) year warranty against defective materials, components and workmanship in the sanitizing feed system.
12. Manufacturer's minimum one (1) year warranty against defective materials, components and workmanship in the pH buffer feed system.
13. Manufacturer's minimum five (5) year warranty on the complete heat exchanger assembly.

1.12 SYSTEM TRAINING

- A. A qualified representative of the CONTRACTOR performing work under this section shall put the equipment into operation and instruct the Owner's representatives in the operation of this equipment to the Owner's satisfaction immediately after project's substantial completion.
- B. The CONTRACTOR'S training representative shall have completed the equipment/system's manufacturer's training requirements and be certified, by the manufacturer, to provide and teach system training.
- C. The representative from the CONTRACTOR shall be either a CPO (Certified Pool Operator) or have an AFO (Aquatic Facility Operator) certification.
- D. Training periods shall consist of 32 hours of on-site training and scheduled as follows:
 1. 16 hours of initial training on the complete swimming pool system. Training to include winterization procedures – Refer to Section 1.02 for winterization protocol. The 16 hours of initial training is to be comprised of at least 4 hours of training on water chemistry analysis and adjustment. The water chemistry training will include in depth review of the use of the Langelier index and its computation.

2. The initial 16 hours of training shall include information on the care, operation, adjustment, and maintenance of all items provided by the CONTRACTOR under the "Part 2 – Products" section of this specification.
3. 16 hours of training after the Owner's staff has had experience operating the system. This time may be requested any time after the pool has been placed in operation within a period of one (1) year from the time the pool was accepted by the Owner. The additional training shall contain at least 2 hours of review of water chemistry.
4. The CONTRACTOR shall provide a project specific video recording instruction manual in addition to the training sessions. The video instructions shall be project specific and shall include information on the care, operation, adjustment, and maintenance of all items provided by the CONTRACTOR under the "Part 2 – Products" section of this specification. This video recording shall be done separate from the Owner training.
5. The CONTRACTOR shall include one (1) copy of all video recording instructions in each Operations and Maintenance Manual.

1.13 POOL FILL WATER QUALITY

- A. The Owner shall bear the cost of the water required for two (2) complete fillings of the pool (the initial water tightness test and the final filling). Removal of iron or copper (if in excess of .3 ppm) will be required for the final fill to avoid staining of the pool finish. Any subsequent fillings or partial fillings (more than 25%) of the pool shall be by the CONTRACTOR, at its own expense.
- B. The CONTRACTOR shall provide the necessary plant equipment so that the temperature of fill water will be within plus or minus 10 degrees of the ambient air and/or the pool structure at the time of filling. Extreme caution is urged if the temperature variance is greater than 10 degree F.
- C. The CONTRACTOR shall provide the necessary chemicals and to adjust and balance the water chemistry in the pool to the following levels:

pH	7.4 - 7.6
Calcium Hardness	200 - 400 PPM
Total Alkalinity	80 - 120 PPM
Langelier saturation index	-0.3 - +0.3
Total Dissolved Solids (TDS)	not to exceed 1,500 PPM

1.14 START-UP CHEMICALS

- A. The CONTRACTOR shall maintain the chemical balance of the pool water (including the cost of all chemicals required) until the pool and mechanical systems are fully operational and accepted by the Architect and the Owner.
- B. Provide the Owner with sufficient quantities of the necessary chemicals to maintain the pool operation for a minimum of thirty (30) days from substantial completion or the owner begins using the pool.
- C. Chemicals to be provided to the Owner shall include those required by the chemical feed systems installed.

1.15 RECORD DRAWINGS

- A. Provide a complete set of record drawings of the entire pool system including all sub-systems. All record drawings shall be prepared in accordance with the requirements of Section 017839 and shall be a complete, stand-alone set. The CONTRACTOR shall be permitted to obtain original

documents and copy them for this purpose only. Provide the record set on compact disk (AutoCAD Release 2010 or compatible software).

PART 2 - PRODUCTS

2.1 OVERFLOW SYSTEM

- A. It is the intent of the specifications that the perimeter overflow system and surface cleaning be maintained under all conditions of normal operation and that no water be discharged to waste except when cleaning the filters or emptying the pool.
- B. Stainless Steel Gutter
1. Manufacturers
 - a. A perimeter overflow system for the pool shall consist of a continuous overflow channel and filtered water supply line generally following the details shown on the drawings shall be supplied around the entire perimeter of the pool.
 - 1) Basis of Design: The stainless steel gutter system as manufactured by Paddock Pool Equipment Co. Inc. to the dimensions shown in the drawings.
 - 2) Source Limitations: All perimeter gutter system components shall be provided through one source and from a single manufacturer.
 2. Materials
 - a. All materials are to be compatible with the swimming pool environment. Carbon steel, aluminum, magnesium, wood, and fiberglass are not acceptable. Mill Certifications and documentation of stainless steel grade, finish, and carbon content are to be provided to the Engineer for approval prior to fabrication.
 - 1) All stainless steel shall be low carbon (carbon-controlled to no greater than .03% carbon) AISI Type 304L stainless steel that includes molybdenum and nitrogen in the chemical composition (as verified by mill certificates).
 3. Functional Description of System
 - a. The perimeter gutter system shall include a stainless steel gutter channel: The gutter trough shall be formed to the dimensions and configuration detailed on the drawings. The shop-fabricated sections shall be delivered to the job site for field installation. The gutter shall contain adequate cross-sectional area as indicated to ensure smooth, unimpeded water flow.
 - b. A continuous handhold shall be incorporated at the water level of the pool on the perimeter gutter system in accordance with the appropriate sections of applicable swimming pool code.
 - c. The supply conduit shall be of the size and configuration detailed on the drawings. Engineered jet inlet orifice nozzles providing openings no greater than .31" in. (8-mm) diameter shall be permanently installed in the gutter at the appropriate locations and selectively spaced continuously around the pool perimeter to provide balanced water distribution throughout all areas of the pool. The orifices shall project downward at a 45-degree angle to ensure optimum distribution of the filtered water. There shall be at least one orifice for every six (6) gpm (1.36-m³/hour) of the circulation rate. All horizontal welds must be accessible for inspection and repair
 - d. Slip-resistance: All horizontal surfaces of the stainless steel perimeter gutter system shall incorporate an integral treatment consisting of a series of uniform upward protrusions extending outwardly from the flat horizontal surface of the stainless steel spaced apart from one another by a distance, which produces a slip-resistant

surface. Such slip-resistant treatment must be permanent and may not include the use of any abrasive process, which changes the appearance or corrosion resistance of the stainless steel. The slip-resistant surface shall be certified to comply with the requirements of ASTM C1028 and F-1637-95.

- 1) Aggregate or sand blasting, grinding, or other abrasive treatments specifically are not to be used. All leading edges of this material shall be chamfered, smooth, and acceptable for skin contact.
- e. Gutter Channel Grating: Water entering the perimeter gutter shall be directed over an energy dissipating diffuser grating with constant orifices, which shall completely cover the gutter channel bed to assure optimum distribution of incoming water and prevent excessive turbulence or rebound to the pool.
- 1) Acceptable products: Paddock custom polymer grating.
 - 2) Grating systems shall be oriented to provide openings that are parallel to the edge of the gutter in the configuration as shown on the drawings. The top surface shall consist of integral slots alternating with slip-resistant bearing surfaces.
 - 3) The grating shall provide a permanently slip-resistant surface and shall have the capacity to sustain a uniform load of 100 pounds per square foot (488-kg/m²). It shall be attached to the gutter system by means of a tamper-proof non-corrosive anchoring system to prevent vandalism or removal without the use of special tools. The grating shall provide no less than 30% open area to ensure adequate circulation of the pool water into the gutter. The top surface of the grating shall be a permanent bi-directional slip-resistant surface consisting of integrally machined groves and shall have cross groves running perpendicular to the grating orientation
 - 4) The grating shall be a high density stabilized polymer grating that shall never require refinishing. The grating shall be machined from a solid block of material, and no fasteners, adhesives, joining or other assembly methods shall be used to fabricate or assemble the grating sections. The grating shall be colorfast and easy to clean with a permanent integral slip-resistant surface, providing no greater than .315-inch (8-mm) opening and shall have a minimum cross-sectional thickness of 1-in. (25.4-mm).
 - 5) The grating must be guaranteed by the manufacturer for fifteen (15) years not to crack, flake, separate, rot, swell, break, splinter, discolor, or delaminate, regardless of pool water chemistry. Repeated blows from a heavy hammer shall not cause the grating to crack, chip, or shatter. Should any such deterioration occur during the guarantee period, the grating is to be replaced without cost to the Owner.
 - 6) Grating shall be made entirely from FDA- and USDA-approved materials. Color to be permanent white or as selected by the Architect. Grating samples shall be provided to the Architect and approved prior to final production.
 - 7) Hold-downs and fasteners shall be constructed entirely from PVC or stainless steel and be incorporated into the system so as to prevent tampering or removal without the use of special tools.
- f. Stainless Steel Collector and Converter Boxes: Stainless steel supply converter boxes and gutter collector boxes) shall be provided in the quantities and at the locations as shown on the drawings or as required to maintain proper hydraulic performance. Each supply converter box or collector shall be provided with a stainless steel flanged connection in the appropriate size for the interconnecting piping. No couplings, carbon steel or mild steel flanges shall be used.

- g. Gutter return convertor boxes shall be designed to boost velocity through the gutter outlet using a tangential flow velocity accelerator. After installation, the collector boxes shall be fully encapsulated in concrete by the Contractor.
- h. Anchors: The Perimeter System Manufacturer shall provide forged "U" shaped coated steel threaded anchors to be installed in the pool wall. The anchors shall be installed at the elevation indicated on the gutter detail and shall be located at a maximum of 4 feet (1.2-m) on center. The anchor system shall be fully adjustable in all directions and have vertical adjustability without field modification. "Drop-in" anchors shall be acceptable when provided to the Contractor for their installation. Anchors formed from bent reinforcing steel (rebar) may not be used.
- i. Accessories: Furnish and install the following accessories in the in the quantities and at the locations as shown on the drawings or as required for proper function or use.
 - 1) Recessed Rope Hooks: Rope hooks shall be provided as indicated on the drawings, and shall consist of a stainless steel cylinder with a stainless steel cross-tie bar recessed into the vertical gutter face. Each rope hook shall have an inside diameter of at least 1".
 - 2) Jet Wash Fittings: Jet wash fittings shall be supplied at the locations indicated on the plans and shall attach to the gutter in the manner detailed.
 - 3) Targets and markings: The perimeter gutter system shall have swimming lane racing targets located as shown on the drawings. The targets shall consist of a permanent black slip-resistant PVC material that shall be incorporated into the surface at the specified locations. Paints or coating systems shall not be used for target markings.

4. Fabrication

- a. The perimeter gutter system shall be completely shop-fabricated in appropriate length sections. Field fabrication is not acceptable.
 - 1) The perimeter gutter system shall be fabricated in strict accordance with the Manufacturers' procedures in conformance with the criteria of the American Welding Society. All welding shall be performed in accordance with the procedures established by the American Welding Society, and those of the Manufacturer. All spatter, burns, and discoloration must be removed. Welds shall be cleaned and made non-corrosive.
 - 2) The grain finish on the stainless steel handholds shall be parallel with the water's surface.

5. Source Quality Control

- a. The entire system shall be inspected prior to shipment to verify compliance with the fabrication drawings and quality of workmanship.

2.2 PUMPING EQUIPMENT

- A. Any proposed substitutions shall include a mechanical drawing incorporating all required changes in layout, piping and valves. The cost of such changes shall be included in the price of the substitute. CONTRACTOR to confirm voltage prior to ordering pump. All motors shall be capable of continuously running without overloading at any point on the characteristic curve of the pump without overload or harm. CONTRACTOR shall confirm by 1/4 inch scale shop drawing that the pumps and filters to be provided will fit in the available space and can be removed for servicing.

1. Pumps shall be certified by the National Sanitation Foundation (NSF) and bear the certification mark.
2. Pump casing shall be cast iron fitted with a replaceable bronze case wear ring. Mechanical seals shall be provided specific for a clear, mildly chlorinated water application. Pump impeller shall be enclosed type of cast bronze, statically and dynamically balanced, and trimmed for the specified design conditions. If a VFD is to be used in conjunction with a pump, the impeller shall be trimmed to the maximum diameter based on the rated motor horse power. All bronze materials shall be suitable for use in a chlorinated environment. Suction and discharge flanges shall be provided and tapped for gauge connections. Provide steel or cast iron bases.
3. Pump impellers to be trimmed to a maximum diameter based on the most limiting condition of either the diameter of the maximum non-overloading rated motor horse power at the design point or a diameter resulting in 10% greater head than the specified head.
4. Pump motor shall be totally enclosed, fan cooled (TEFC) and premium efficiency of the horsepower and speed specified. A pump requiring larger horsepower shall not be acceptable.
5. Provide a hair and lint strainer, for each pump, of fiberglass or epoxy coated stainless steel construction with a clear observation top in the sizes (or pipe sizes) indicated on the drawings. Verify and coordinate pipe and pump suction sizes in the field. Strainer to be of a low pressure drop full-open or a tapered eccentric reducing type. Straight reducing type strainers will not be acceptable without the addition of an approved tapered eccentric reducer between the strainer and the pump (in which case, sufficient space in the pump pit must be verified). Provide a stainless steel basket with at least 4 times the free open area as the inlet pipe, and one spare basket with each strainer.
 - a. Basis of Design: As manufactured by MerMade Filter Inc., or Neptune/Benson Inc., or Fluidtrol Process Technologies, Inc.
6. Provide a fusion-bonded epoxy coating on all wetted parts to protect pump internals from corrosion, including pump volute interior and complete pump impeller. Sandblast to bare, white metal. Thickness shall be 8 to 12 mils (heavy film). Verify thickness by non-destructive testing. Coat parts as recommended by manufacturer, including preheating parts to 400 degrees and electrostatic deposition or fluidized bed technique. Provide primers if required to resist chlorinated water <10 ppm. Coating shall be Scotchkote 134 manufactured by Fusesco or approved equal.
7. Entire pumping unit shall be mounted on a base using cap screws to preserve the back pull-out feature of the pump. Pumps shall not be secured with floor studs. The pump base shall be coated with the same epoxy coating as the pump. An OSHA approved guard shall protect coupling and exposed rotating components of the pump and motor where required.
8. Recirculating Pumps and Motors
 - a. Leisure Pool
 - 1) Provide one (1) horizontally mounted centrifugal pump, as shown on the drawings and described in these specifications. Each pump is to be of a straight centrifugal, end suction, bronze fitted, close coupled type, capable of pumping 750 GPM against 75 ft. TDH with an efficiency of no less than 75% and a required net positive suction head (NPSHr) no greater than 14 ft. It shall be provided with a 20 HP, 1750 RPM, 460 VAC, 3 phase, 60 cycle electrically driven motor meeting these specifications.

- a) Basis of Design: The system design is based upon Paco. Pumps manufactured by Paco, ITT Marlow, Griswold, or Aurora shall all be considered, provided they meet the requirements.
 - b. All recirculation pumps shall be provided by the same manufacturer. Confirm voltages prior to ordering pumps.
9. Other System Pumps and Motors
- a. Provide one (1) portable utility pump. The pump shall be a 1 HP, 3600 RPM, 115/230 volt, 1 phase, 60 cycle unit capable of 60 GPM at 25 ft. TDH.
 - 1) Basis of Design: Pump to be a Godwin GSP10 or approved equal.
10. Feature Pumps and Motors
- a. Open Flume Waterslide Pump
 - 1) Provide one (1) horizontally mounted centrifugal pump, as shown on the drawings and described in these specifications. Each pump is to be of a straight centrifugal, end suction, bronze fitted, close coupled type, capable of pumping 1000 GPM against 42 ft. TDH with an efficiency of no less than 80% and a required net positive suction head (NPSHr) no greater than 7 ft. It shall be provided with a 15 HP, 1750 RPM, 460 VAC, 3 phase, 60 cycle electrically driven motor meeting these specifications.
 - a) Basis of Design: The system design is based upon Paco. Pumps manufactured by Paco, ITT Marlow, Griswold, or Aurora shall all be considered, provided they meet the requirements.
 - b. Enclosed Flume Waterslide Pump
 - 1) Provide one (1) horizontally mounted centrifugal pump, as shown on the drawings and described in these specifications. Each pump is to be of a straight centrifugal, end suction, bronze fitted, close coupled type, capable of pumping 500 GPM against 40 ft. TDH with an efficiency of no less than 75% and a required net positive suction head (NPSHr) no greater than 10 ft. It shall be provided with a 7.5 HP, 1750 RPM, 460 VAC, 3 phase, 60 cycle electrically driven motor meeting these specifications.
 - a) Basis of Design: The system design is based upon Paco. Pumps manufactured by Paco, ITT Marlow, Griswold, or Aurora shall all be considered, provided they meet the requirements.
 - c. Feature Pump
 - 1) Provide one (1) horizontally mounted centrifugal pump, as shown on the drawings and described in these specifications. Each pump is to be of a straight centrifugal, end suction, bronze fitted, close coupled type, capable of pumping 300 GPM against 30 ft. TDH with an efficiency of no less than 75% and a required net positive suction head (NPSHr) no greater than 10 ft. It shall be provided with a 5 HP, 1750 RPM, 460 VAC, 3 phase, 60 cycle electrically driven motor meeting these specifications.
 - a) Basis of Design: The system design is based upon Paco. Pumps manufactured by Paco, ITT Marlow, Griswold, or Aurora shall all be considered, provided they meet the requirements.
- B. Variable Frequency Drive Starters
- 1. Provide VFD starters for all pool pumps. VFDs shall be a product of H2Flow Controls, Pentair AcuDrive, Neptune Benson, or approved equal.

- a. Basis of Design: Eco-Flo-C by H2 Flow Controls.
2. It is the contractor's responsibility to ensure that all equipment is provided with the correct operating voltage and that all interconnected electrical and electronic equipment shall adequately communicate and operate the specified pumping equipment. All equipment installations shall meet or exceed the requirements of the National Electric Code and all other local and state regulations.
3. Specified equipment in this section shall be mounted in accordance with manufacturer's requirements and in a suitable location where indicated on the plans or approved by the Architect/Engineer. All electronic equipment installed where a corrosive atmosphere may exist shall be enclosed in NEMA 4 stainless steel or NEMA 4X nonmetallic enclosures. In other locations NEMA 12 enclosures are acceptable. The programmable and display features of all electronic equipment shall be accomplished via NEMA 4X enclosed key pads and operator backlit LCD Graphical/Alpha/Numerical Displays. VFD's installed within a supplementary panel shall not be vented or cooled from ambient external air. With the exception of the VFD's heatsink and water-resistant heatsink fan, the VFD's electronics shall be fully sealed within the NEMA 12 or higher enclosure. So called 'NEMA 12 or NEMA 4 Vented' enclosures are not permitted.
4. The VFD shall convert incoming fixed frequency three phase AC power into a variable voltage and variable frequency three phase output utilizing pulse width modulation. Advanced Space Vector Control will be utilized to reduce motor heating and provide precise control of the AC motor.
5. The VFD shall be capable of adjusting the pump motor speed based upon specific flow requirements. A 4-20 milliamp output signal from a Programmable Aquatic Controller, PLC, electronic flow meter transmitter or other electronic device shall supply the required flow information to the VFD to regulate motor speed. The VFD shall be capable of interfacing to this analog output signal be commissioned to achieve a 'constant flow' condition. The VFD shall also be provided with a manually operated potentiometer to adjust the pump speed in the case of an electronic communication failure.
6. Electronic equipment shall be supplied with a phase rotational check capability. The contractor shall also be required to assure that a phase rotational check is accomplished with the bypass switch, herein specified, in the across the line position to assure correct rotation when connected to all motor power sources.
7. The VFD shall include a built-in Line Filter to mitigate harmonic distortions being transmitted back through the supply lines.
8. The VFD shall utilize DC link reactors to filter out bus ripple and provide smooth DC power to the transistor section.
9. The VFD shall utilize IGBT transistors to produce a pulse width modulated output. SCR output stages are not acceptable.
10. The VFD shall have a full load amp rating which exceeds or meets NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, and shall be able to provide 110% of its variable torque rating and 150% of its constant torque rating for one minute.
11. The VFD shall utilize space vector control to reduce motor harmonics and torque ripple.
12. The VFD shall include the ability to reliably protect the pump from any of the following abnormal pump conditions: Run Dry/Loss of Prime; Cavitation; Dead head/Closed Valve;

Worn impeller; Blocked Filter; Bearing Failure/Wear Detection. Protection using measured current (Amps), as a method for these protective features shall not be acceptable.

13. The VFD shall provide a display with selectable readout of parameters, including: Speed; Torque; Electrical Power; Current; Output Voltage; Frequency; Heatsink Temperature; Motor Temperature; Run Time; Energy Consumed; Mains Time.
14. The VFD shall include the capability for copying of settings when multiple similar pumps are involved. Settings established in one VFD shall be transferred to the others via a removable keypad.
15. All VFDs shall be provided with a bypass function to allow for pump motor operation by bypassing the variable frequency drive. Bypass mechanism may be internal to the VFD cabinet or provided in a separate enclosure with NEMA rating equivalent to the specified drive enclosure. NEMA 12 'vented' panels are not acceptable. The bypass shall be UL listed as a motor disconnect device.
16. Three Motor Contactors shall be included. Contactor A is required to be in series with the Line Power supply and the VFD, Contactor C is required to be in series with the VFD and the motor and Contactor B is required to bypass the VFD. In 'VFD' operation, contactors A and C are engaged and contactor B is open. When in 'Bypass' mode, contactors A and C are open and contactor B is engaged.
 - a. All contactors shall be appropriately rated for the supply voltage and pump motor specified and shall be in accordance with NEC standards.
 - b. Contactor B shall include an appropriately rated Motor Overload.
 - c. Resettable pump motor overload protection shall be provided for both the VFD and across the line sources of power to all motors.
17. A Control Power Transformer shall be included so as to provide the necessary control voltage required to operate the Motor Contactors. The VFD panel or separate Bypass panel, shall include a door mounted 3-position lockable selector switch. The switch shall be labeled: VFD-OFF-BYPASS. The switch is to require a key to move from one position to another. Two keys shall be provided to the customer. The Bypass panel shall be manufactured in accordance with and approved to UL508.
18. All applications shall require the inclusion of an appropriately rated Line Reactor to reduce harmonic distortion. The Line Reactor shall be housed in an enclosure according to the manufacturer's instructions, taking careful note of the device radiated heat and the chemical environment in which it may be installed. Pentair Acu-Drive includes as standard a built in DC Link Reactor (equivalent to 5% Line Reactor). Where this is insufficient, a separate larger Line Reactor shall be provided.
19. All applications that will have a cable length between the VFD and the Pump Motor which exceeds 300 feet shall require the inclusion of an appropriately rated Motor Protection Filter (dV/dt filter). When included, the Motor Protection Filter shall be housed in an enclosure according to the manufacturer's instructions, taking careful note of the device radiated heat and the chemical environment in which it may be installed.
20. The VFD shall include additional contacts for interface with a remote start/stop panel and/or emergency stop function. When the VFD is supplied for a spa hydrotherapy pump, the drive shall also interface with a remote timer switch to control pump operation via a preset timed duration (15 minute timer switch). VFD supplier shall provide compatible remote start/stop control panel for remote on/off control of all feature pumps. Refer to electrical for installation and verify location of remote start/stop panel with architect.

21. Installations in locations where a Power Disconnect is not within 'line of sight' of the VFD Control Panel, or where deemed necessary by local electrical codes, shall require the installer to provide a suitably rated Circuit Breaker Disconnect.
22. The VFD shall be UL listed to accept a supply voltage of -15% / + 10% of its stated supply rating.
23. The VFD shall be electronically lockable in order to prevent unauthorized or unintended program changes.
24. Motors to which the VFD is to be installed shall have a minimum insulation of "Class F".
25. User Interface for initial programming and day to day operation.
 - a. The VFD shall include a programmable Controller with an operator backlit LCD Graphical / Alpha / Numerical Display. The Controller shall comprise the following features:
 - b. Real Time Clock
 - c. Password protection
 - d. Hard-wired tamper protection feature
 - e. Custom software to control the VFD via a Modbus communication network.
 - f. Automatic Flow Control. The Controller and VFD are to automatically adjust the pump's speed in order to compensate for a filter becoming dirty. The system is to maintain a minimum flow (GPM) required to meet State mandated turnover rates.
 - g. Programmable speeds for daytime and nighttime turnover rates.
 - h. Non-volatile memory. All programmed parameters as well as the real time clock settings shall be maintained in the event of a power outage.
 - i. The Controller shall be capable of interfacing to an analog output signal from a Flow Transducer and displaying measured flow in GPM
 - j. Automatic reset of alarms caused by power brown outs/power loss
 - k. External input for seasonal/unoccupied speed
26. Equipment specified in this section shall be programmed and tested under power after connection to the required motor by a factory trained technician. All low voltage control wiring connections to the respective pool systems shall be provided by the Swimming Pool Contractor. Line voltage and/or high voltage connections and interlocks shall be provided by the Electrical Contractor.

C. Pump Gauges

1. Pressure gauges shall be installed on the discharge of the pumps.
2. Compound gauges shall be provided at the intake port of the pumps, after the hair and lint strainer.
3. Gauges shall be liquid filled, 316L stainless steel bourdon tube type with a minimum 2-1/2 inch diameter dial, high impact polypropylene or stainless steel case, corrosion resistant white scale with black divisions and numerals, 300 Series stainless steel heavy duty rotary bushed movement, black enameled balanced Micrometer pointer.
 - a. Basis of Design: Gauges shall be as manufactured by Weksler Instrument Corporation or approved equal.

4. Scale ranges shall be selected to indicate the normal system operating pressure of each system or location within the system. Pressure ranges shall be calibrated in psig (0-60 psi) and compound gauge shall be calibrated in inches of mercury (0-30 in Hg / 0-60 psi).
5. A stainless steel filter type pressure snubber shall be provided for each pressure gauge installed consisting of a 3/8 inch diameter by 1/8 inch thick micro metallic stainless steel filter and placed in the line just before the pressure gauge. Provide isolation brass valves or brass gauge cocks at each gauge for easy replacement and maintenance.

2.3 FILTRATION EQUIPMENT

- A. The filter system shall consist of high rate pressure sand filter tanks as shown on the drawings. Every aspect and component of the filter system must be certified by the National Sanitation Foundation (NSF) and bear the certification mark. The filter must have an engraved metal data plate permanently affixed on the face of the system that describes operational data and instructions and indicates start up date.
- B. It is the intent of these specifications to describe a filtration system complete in every respect with all accessory items and supplied and warranted by one manufacturer.
- C. Horizontally Oriented Fiberglass Tanks
 1. The filter tanks shall be horizontally oriented single cell fiberglass tanks, minimum 42 inches in diameter. The filter system must be listed as approved by National Sanitation Foundation prior to bid date.
 - a. Basis of Design: Fiberglass filters shall be the product of Paragon Aquatics / Stark, Waterco, or Neptune Benson provided they meet the specifications and layout. System design based upon Neptune Benson. Valves must be provided to backwash one filter at a time.
 2. Filter tanks must incorporate all components and feature as described in this section.
 3. Two (2) saddle style bases shall be provided for tank support. Systems that incorporate stacked tanks shall include similar bases and mounting saddles for the upper vessel. Tank supports and connections shall be seismic rated to support the filter tanks for the appropriate seismic zone where the project is located. Access to the tank shall be provided by a 14" x 18" manhole with two (2) curved yokes. Manhole seal shall be complete with a one piece 1/4" neoprene gasket and positioned so that internal pressure from the filter will augment the seal. No additional hardware or through bolts will be allowed.
 4. Each filter tank shall be equipped with the necessary flanges and connections for the internal and external piping. Connections shall be comprised of fiberglass flanges and schedule 80 PVC flanges.
 5. All tank connections 2 inches and smaller shall be 150 lb. Type 316L stainless steel threaded full couplings. All tank connections 3 inches and larger shall be heavy steel bosses drilled and tapped both sides to receive standard flanged fittings or Sch. 40 Type 316L stainless steel nipples.
 6. The discharge from the automatic air release valve shall be hard piped to waste. Each filter tank shall have a means of releasing air. Each coupling or orifice is to be provided with a slotted PVC sand retainer or stainless steel strainer. An automatic air release system shall be provided for each tank.

7. The drain system shall consist of a 3/4 inch 316L stainless steel coupling mounted at the lowest point in the bottom head. This drain shall be valved and piped to the nearest floor drain.

D. Filter Piping - Internal

1. The lower internal distribution system shall be a horizontal header/lateral arrangement. The header shall be Schedule 80 PVC construction, capped on one end and flanged or threaded at the other end for field connection. Lateral connections shall be spaced no more than 6 inches on centers, and shall be 1-1/2 inch FPT connections. All attachments to header shall be solvent welded and thermo-welded to insure integrity of connection.
2. Under drain system shall be factory installed and constructed of extra heavy Schedule 80 high impact PVC. Multiple PVC main headers to be tapped and threaded to receive laterals.
3. Laterals shall consist of 1-1/2 inch Schedule 80 PVC pipe with openings as required. Each lateral shall be fabricated complete with socket cap on one end and male adapter on the other end. Both fittings to be solvent welded to the slotted pipe. Laterals shall be designed and sized at the factory so as to be installed in the field and over the entire cross sections area of the filter.
4. The upper distributor shall consist of PVC piping Schedule 80 and/or deflector plate per manufacturer standard design.
5. Each filter shall be supplied with a pressure equalizing upper internal distribution system consisting of a horizontal header/lateral arrangement. The header piping shall be constructed of Schedule 80 PVC. The header/lateral piping and all connections shall be designed and sized to provide uniform distribution and unrestricted flow during the filtration and backwash cycles.
6. Upper laterals shall be constructed of Schedule 80 PVC pipe with machine slotted openings or orifices. All machined slots or orifices shall be clean, de-burred and free of any obstructions that would not permit the free flow of water through the opening. Details of the lateral attachment to the header shall be submitted for review and approval.
7. The lower and upper distribution systems shall be properly supported and anchored. All hardware in wetted areas shall be Type 316L stainless steel or non-metallic. Tank interiors must be inspected prior to the media being placed in the filters.

E. Filter Piping - External (Face)

1. External face piping shall be Schedule 80 PVC pipe and fittings. Flanges shall be located so as to allow for easy dismantling of face piping. All fittings shall be solvent cemented.
2. Piping shall be drilled and tapped where necessary to accommodate gauge tubing connectors.
3. All valves 3" and larger shall be constructed with cast aluminum S12A alloy (as defined by ASTM B275) housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and 316L stainless steel shaft. Valves shall be rated for 150 psi bubble tight shutoff. Unless otherwise specified, all nuts and bolts shall be stainless steel with stainless steel

washers to be used when secured to PVC flanges. Systems incorporating solenoid, pneumatic, pressure amplified, hydraulic or multi-directional valves shall not be acceptable.

4. Standard accessory items shall include sight glass rated for 50 psi with polycarbonate glass, remote mounted gauge panel with two 4½" diameter pressure gauges, ¼" petcocks, ¼" poly vent tubing with PVC compression adapters.

F. Backwash Control

1. The filter manifold face piping shall be designed to allow for one (1) filter tank to be backwashed at a time while the recirculation system is operating. A manual backwashing system shall be provided with the filter system.
2. Manual Backwash System
 - a. The manual backwash system shall be equipped with a face piping configuration such that the operator shall be manually control and operator both the time and sequencing of the backwash cycle. Valving on the filter face piping shall be a mechanical linkage device allowing the operator to simultaneously move two (2) valves at once. All mechanical linkage components shall be PVC or Type 316L Stainless Steel.

G. Automatic Air Relief Valve

1. A 1" valve shall be provided to automatically and continuously release air in the filter. The valve shall be fabricated of plastic with Buna-N seals. A plumbing kit shall be provided with two (2) PVC ball valves to allow manual air relief and isolation of the automatic valve. Valves fabricated of cast iron, bronze or stainless steel valves will not be accepted.

H. Filter Media

1. Filter media shall be a carefully selected grade of hard uniformly graded silica material. Media shall be milled angular shaped particles of silica quartz. The filter sand shall have a particle size between 0.45 mm and 0.55 mm and have a uniformity coefficient not to exceed 1.53. Specific gravity shall not be less than 2.5 with a pH of 7.0.
2. All media (sand) shall be cleaned and free from any clay or limestone deposits. Bottom layer of support media shall be placed by hand to avoid damage to the under drain system and leveled before the addition of the upper layer of filter media.
3. All media shall be delivered after approval by the manufacturer of the filter and stored in 100 pound bags for ease of handling and elimination of possible contamination.
4. Media to be supplied by the filter manufacturer and approved by the filter manufacturer prior to shipping.

I. Filter Size

1. Filters have been sized based on a maximum allowable filtration rate of 15 GPM/SF:

	Units	Leisure Pool
Volume	Gallons	87,615
Flow Rate	GPM	750
Filter Model		SHFFG 48-72 (2 tanks)

Filter Size	Sq. Ft.	27.7
Turnover Rate	Hours	1.95
Filtration Rate	GPM/Sq.Ft.	13.5

2.4 RECIRCULATION FITTINGS

- A. Main outlets (main drains) shall be concrete sumps with 12 gauge PVC frame and PVC grating and sized as shown on the plan. Grate openings shall not exceed 11/32 inch in width, providing an open flow area to allow water velocity not to exceed 1.0 fps. The grate shall be PVC and fit closely and flush with top surface of frame, and secured to frame with vandal proof fasteners. All exposed edges of main outlets shall be rounded and smooth, free of burrs and sharp edges. All main drain covers shall comply with the Virginia Graeme Baker Act and ASME A112.19.8-2007.
- B. Provide hydrostatic relief valves consisting of a 2" cyclac relief valve connected to a FPT commercial style Schedule 80 PVC collector tube. The collection tube shall have seepage holes, 3/8 inch in diameter, and shall be screwed securely to the valve body. The hydrostatic relief valve shall be designed to seal with minimum pressure and shall have a non-plugging, self-cleaning raised valve seat. Hydrostatic relief valve to be Hayward Number SP1056 with collector tube model Hayward Number SP1055, or approved equal.
- C. Adjustable floor inlet fittings shall be provided each consisting of an ABS plastic body and adjusting top plate with a positive locking device. A spanner wrench shall be provided to facilitate flow adjustment. The inlet body shall be provided with a 2-inch cyclac solvent weld connection and internal NPT threads to facilitate line pressure testing. Floor inlet fittings shall be Sta-Rite No. 8417-0000-White or approved equal.
- D. Sight sump frame and cover shall be size appropriately to provide access to the vertical sight sump standpipe as indicated in the plans. Frame and cover shall be Zurn model #ZANB-1461-14-VP, nickel bronze with polished scored top, vandal proof screws or approved equal.
- E. Anti-vortex plates shall be provided at the suction points of the main recirculation pump in the surge tank. Each plate shall be connected to the suction pipe via a PVC flange and shall be 1/2 in. thick with minimum dimension of at least 2.5 times the connecting pipe diameter. The plate shall be located 4 inches above the finished floor of the surge tank. Four (4) 3/4 in. stainless steel threaded rods, nuts, anchor bolts and washers shall be used to fix the offset distance and provide a secure base for the suction pipe.

2.5 PIPING SYSTEMS

- A. General
 1. Provide all recirculating piping between the pool and the filter room, fill receptor and all interconnecting piping to and from the chemical feed systems and chemical controller.
 2. Provide all necessary pipe supports and support systems required to support all associated piping and valves.
 3. Provide all other tubing, conduit, or piping associated with equipment specified herein. Coordinate with other trades.
- B. Pipes
 1. Pipe routing as shown and detailed on the contract drawings is diagrammatic only and is not intended to show minor details or exact locations of piping systems. Installation is

required to be adjusted to accommodate interference and adjustments anticipated and encountered. Pipe sizes on plans refer to nominal inside diameter of the pipe.

2. All PVC swimming pool piping shall be NSF approved and conform to the requirements of ASTM D-1785.
3. All PVC pipes shall be the product of one manufacturer. Approved manufacturers of PVC piping are Eslon, Harvel, and Chemtrol or approved equal.
4. Swimming pool piping above the floor or deck in the filter room shall be Schedule 80 PVC.
5. Swimming pool piping below the filter room floor or deck shall be NSF approved, Schedule 80 PVC.
6. All below grade swimming pool piping not located beneath the pool floor can be backfilled with native granular material free of ice, clay, debris, organic matter, and rocks larger than 4" across their greatest dimension, and per recommendations indicated in the project geotechnical report.
7. The influent and effluent lines to the heat exchanger unit shall be CPVC. Connections between metallic piping and/or equipment and PVC shall be flanged.
8. All PVC and CPVC fittings shall be the product of one manufacturer. Molded fittings shall be as manufactured by Asahi, Eslon, Chemtrol, Harvel, Spear, Lasco or acceptable substitute. Fabricated fittings shall be as manufactured by Harrison Machine, Plastinetics, or acceptable substitute.
9. Vertical sight sump piping shall be NSF approved, Schedule 40 PVC. Horizontal sight sump piping shall be NSF approved, Schedule 40 PVC that is perforated and wrapped with fabric and have 3/8" diameter holes located top and bottom on 4 ft centers. Horizontal sight sump piping shall extend 1 ft minimum beyond the main drain.
10. Chemical feed lines from chemical feeders to recirculation piping shall be Schedule 80 PVC piping. Piping shall be hard piped into the recirculation plumbing. All required valves shall be of all PVC construction.
11. Splash collar for the fill funnel shall be clear Schedule 80 PVC and manufactured from a Type I, Grade I PVC compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in compliance to ASTM D1785.
12. All flanged plumbing connection hardware shall be stainless steel.
13. All materials shall be installed by workmen thoroughly skilled in their trades and all work shall present a neat and mechanical appearance when complete. The CONTRACTOR, at no additional expense to the Owner, shall replace or correct any work not judged acceptable by the Architect, Owner's testing agency, or their consultants.
14. All support hardware, brackets, fasteners, hangers, etc. installed in the surge tank shall be 316L stainless steel.
15. No installation shall be made that will provide a cross-connection or interconnection between a distributing supply for drinking purposes and the swimming pool, or between the pool and a sanitary or storm water sewer system that will permit a backflow of water into the pool water system.

16. All piping shall be hydrostatically (water) pressure tested for leaks before and after backfilling to guarantee water tightness. Pneumatic (air) pressure test not allowed.
 17. The CONTRACTOR shall provide 1/4" PVC water stops for this work for watertight penetration of concrete walls. Water stops shall be round and the O.D. shall be sized to 150% of the O.D. of the pipe. The water stops shall be thermo-welded to the pipe from both sides and shall be located at the centerline of the wall being penetrated prior to placing the concrete to assure a watertight seal.
 18. CONTRACTOR must adhere to all the applicable provisions in Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.
 19. All mechanical equipment to be connected into the recirculation piping system shall be done so using flanged or union connections.
 20. Provisions shall be made to purge all pipes in the system.
 21. Concentric reducers shall be fiberglass by MerMade Filter, Inc., or equivalent reducers of schedule 80 PVC construction.
- C. Pipe Hangers and Supports
1. Manufacturer
 - a. Subject to compliance with these specifications, pipe hanger and support systems shall be manufactured by Cooper B-line (basis of design), Inc, TOLCO, and Anvil International or approved equal.
 2. Hangers
 - a. Pipes 2 inches and smaller
 - 1) Adjustable steel clevis hanger, B-Line models B3100 or B3104.
 - 2) Adjustable steel swivel ring (band type) hanger, B-Line model B3170.
 - b. Pipes 2-1/2 inches and larger
 - 1) Adjustable steel clevis hanger, B-Line model B3100.
 - 2) Adjustable steel yoke pipe roll, B-Line model B3114.
 3. Multiple or Trapeze Hangers
 - a. Trapeze hangers shall be constructed from 12 gauge roll formed ASTM A1011 SS, Grade 33 structural steel channel, 1-5/8 by 1-5/8 inch minimum, B-Line B22 strut or stronger as required.
 - b. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe, B-Line B-2000 series.
 4. Wall Supports
 - a. Pipes 2-1/2 inches and smaller
 - 1) Steel offset "J" hook hanger, B-Line model B3600.
 - b. Pipes 3 inches and larger
 - 1) Welded strut bracket and pipe straps, B-Line models B3064 and B2000 series.

- 2) Welded steel bracket B-Line model B3066 or B3067 with roller chair or adjustable steel yoke pipe roll. B-Line model B3120 or B3110.
5. Floor Supports
 - a. Electroplated carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. B-Line model B3093 and B3088T or B3090 and B8088. Pipe saddle shall be screwed or welded to appropriate base stand.
 6. Vertical Supports
 - a. Steel riser clamp sized to outside diameter of pipe, B-Line model B3373.
 7. Plastic Pipe Supports
 - a. V-Bottom clevis hangers with galvanized 18-gauge continuous support channel, B-Line models B3106 and B3106V, to form a continuous support system for all plastic pipes smaller than 1 inch or flexible tubing.
 - b. A vented and sloped continuous PVC Schedule 40 pipe no smaller than 1-1/2 inch outside diameter will be used to route flexible tubing with the appropriate pipe supports.
 8. Supplementary Structural Supports - Design and fabricate supports using structural quality steel bolted framing materials. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch or greater as required by loading conditions. Submit design for pipe tunnels, pipe galleries etc. for approval. Use clamps and fittings designed for use with the strut system.
- D. Hanger Attachments
1. Upper Attachments
 - a. Beam Clamps
 - 1) Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
 - 2) C-Clamps shall be locknuts and cup point set screws similar to B-Line model B351L or B3036L. Top flange c-clamps shall be used when attaching a hanger rod to the flange of structural steel, B-Line model B3034 or B3033 or approved equal. Refer to manufacturers recommendations for set screw torque. Retaining straps shall be used to maintain the clamp position on the beam where required.
 - 3) Center load beam clamps shall be used where specified. Steel clamps shall be B-Line models B3050 or B3055. Forged steel beam clamps with cross bolt shall be B-Line B3291-B3297 series or approved equal as required to fit beams.
 - b. Concrete Inserts
 - 1) Cast in place spot concrete inserts shall be used applicable, either steel or malleable iron body, B-line B2500 or B3014 or approved equal. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rods sizes, B-line models N2500 or B3014N series.
 - 2) Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 Grade 33 structural quality carbon steel,

complete with styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs/ft. in concrete, B-Line models B221, 321, or 521 or approved equal. Select channel nuts suitable for strut and rod sizes.

E. Hanger Accessories

1. Hanger rods shall be threaded on both ends or continuously threaded rods of circular cross section. Use adjustable lock nuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.

F. Hanger Finish

1. Indoor Finishes
 - a. Hangers shall be zinc plated in accordance with ASTM B633 OR shall have an electro-deposited green epoxy finish.
 - b. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR shall have an electro-deposited green epoxy finish.
 - c. Zinc Plated hardware is not acceptable for use in chemical rooms.
2. Outdoor Finishes
 - a. Hanger and strut subject to weathered conditions shall be hot dipped galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dipped galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.
 - b. Hangers and strut located in corrosive areas shall be type 316L stainless steel with stainless steel hardware.

G. Valves

1. Valves 3 inches and larger shall be butterfly type valves, with PVC body, 150# SWP with stainless steel shaft, polypropylene disc and replaceable resilient seat bonded to a rigid shaft and guaranteed for bubble tight shutoff from 27 inch vacuum to 150 PSI. Extended neck 2 inch beyond flanges for any insulated piping shall be provided with handle for manual operation. All valve components shall be suitable for swimming pool chlorinated water service. Butterfly valves shall be Georg Fischer Type 563, Asahi/America Type SP Pool-Pro, Chemtrol Model-B, Simtech VP series, Colonial Valve 411 Series, or approved equal.
2. Valves smaller than 3 inches shall be PVC true union ball valves, full port, three-piece construction, blowout-proof stem, Viton seal with socket end connectors.
3. Check valves shall be a quick closing non-slam type, either self-aligning wafer or flanged type, of corrosion resistant materials suitable for use in a swimming pool environment. Install check valves in accordance with the manufacturer's recommendations. Locate check valves at least 5 pipe diameters from pumps and fittings. Check valves shall be either by Technocheck Corp., model 5050, with epoxy coated cast iron body and bronze swing plates on a stainless steel spring; or approved equal, for installation between 150 lb flanges.
4. Modulating float valve in the surge tank shall have PVC body and stainless steel wafer disc. All hardware shall be non-corrodible. The float-operated valves shall be provided horizontally on the main drain lines in the surge tank. Valve shall consist of all non-corrosion components including shaft, float arm, pins and floats. Valve shall be suitable

for mounting on a 125E class standard PVC flange. The float arm leverage weight and pivot lengths shall be adjustable to obtain desired ratio of surge tank level change to pool gutter overflow level change. Two floats and stabilizer required. Valve shall be Model FV-D XWB (Extra Weight Ball) as manufactured by MerMade Filter, Inc. or approved equal manufactured by EPD, or Fluidtrol Process Technologies, Inc.

5. Submerged valves up to 3 inches shall be PVC true union ball valves. Submerged valves over 3 inches shall be PVC bodied, wafer type, butterfly valves with stainless steel handle extensions as required. Valves shall be by approved manufacturers listed above. Submerged valves must be provided with all stainless steel connectors. The stem housing extensions shall be properly supported and braced.
6. All butterfly type valves 8 inches and larger shall be fitted with a water tight gear operator.
7. All valves located 7 feet or greater off the floor shall be fitted with a chain operator.
8. All submerged valves, valves buried below grade, or valves not readily accessible, shall be provided with a stainless steel reach rod and handle.

H. Pipe and valve identification

1. All exposed pool piping shall be equipped with color coded flow directional arrows at thirty (30) inch intervals per local and state swimming pool health code. The Contractor shall verify that all pool piping identification is in accordance with all local and state health regulations.
2. All valves shall be identified with minimum 1-1/2 inch diameter brass tags stamped with minimum 1/2-inch high numbers and attached to valves with #16 brass jack chain. (Plastic laminate engraved tags with nylon attachment acceptable.) Valves shall be described as to their function and referenced in the operating instruction manual and wall mounted piping diagram to be prepared by the CONTRACTOR.

2.6 CHEMICAL TREATMENT SYSTEMS

A. Sodium Hypochlorite (Liquid Chlorine)

1. Chemical feeders for chlorine shall be peristaltic type pumps. Chemical feed pump shall be provided and connected to the filtered water return lines to the pool as shown on the pool plans. The pump shall be capable of feeding a solution to the pool to maintain chlorine (12% sodium hypochlorite) level against the back pressure involved and shall be fully adjustable while in operation.
2. The pump shall be provided complete with fractional horsepower motor for 120V 60 Hz current, plastic feed lines, and fitting necessary for connections to the pool system piping.
3. All chemical pumps shall be electrically connected to, and operated by the water chemistry controllers.
4. The chemical pump shall be affixed with a metallic stamped label indicating the chemical being pumped and the pool to which it is connected.
5. Wall mount or provide non-metallic shelf support for the chemical feed pump.
6. Chemical feeders to be manufactured by LMI, ProMinent, G. H. Stenner & Co., or approved equal.

- a. Leisure Pool Chlorine Pump (two required): Model 85M4 35 GPD
7. All feeder systems to be provided with an injection check valve at point of tap in and strainers with foot valves for suction from 55-gallon drums, carboys or bulk tank. Bulk tank feed shall be from the top.
8. Provide one (1) 500 gallon bulk chlorine solution tank in the chlorine room as shown on the drawings. Tank to be a double wall bulk tank constructed of polyethylene rigid support with top manway and vent. Tank shall be 59" outside diameter by 71" high. Manufacturer shall be Chemtainer, Industries, TC5971DC represented by Steve Golomski of Sun-Day Corporation 314-961-0197 or approved equal.
- B. pH Buffering System (Muriatic Acid)
1. Chemical feeders for muriatic acid shall be peristaltic type pumps. Chemical feed pump shall be provided and connected to the filtered water return lines to the pool as shown on the pool plans. The pump shall be capable of feeding a solution to the pool to maintain pH level against the back pressure involved and shall be fully adjustable while in operation.
2. The pump shall be provided complete with fractional horsepower motor for 120V 60 Hz current, plastic feed lines, and fitting necessary for connections to pool system piping.
3. The chemical pump shall be electrically connected to, and operated by the water chemistry controllers.
4. The acid pump shall be affixed with a metallic stamped label indicating the chemical being pumped and the pool to which it is connected.
5. Provide non-metallic wall mounted shelf support for the chemical feeder.
6. Provide two (2) fifteen (15) gallon acid drums.
7. Provide one (1) two drum modular spill platform. Platform shall be molded high-density polyethylene with removable polyethylene grating. Platform shall be 26.25" x 51.5" x 6.5" with a spill capacity of 30 gallons and a load capacity of 5,000 pounds. Platform shall be an Eagle two drum modular spill platform model 1632, or approved equal.
8. Provide one (1) low profile ramp. Ramp shall be molded high-density polyethylene. Ramp shall be an Eagle low profile ramp model 1689, or approved equal.
9. Provide "Vapor Shield" vent check valve for the acid drum/tank which seals container while allowing the liquid to be removed via pump. The Vapor-Shield shall prevent an internal vacuum and collapse of a sealed container. It will also prevent the pump from developing a vacuum-lock while attempting to remove the liquid from the sealed container. The Vapor-Shield shall prevent the release of any acid vapors. The Vapor-Shield body shall be constructed entirely from schedule 80 PVC with polypropylene tube fittings and factory-installed acid resistant viton sealant on all threaded connections. The diaphragm and o-rings shall be constructed of acid resistant viton. No metallic or materials not rated appropriate for use with acid shall be used. The Vapor-Shield shall be fitted with a 3/4" male NPT threaded fitting to allow for the installation onto any common: five (5) through fifty-two (52) gallon acid shipping container caps and lids. The unit shall be supplied with no less than fifteen (15) feet of 3/8" polyethylene tubing. Recreonics catalog no. 52-095. An Acid Fume Scrubber, part #7747090, with refill reagent kit, #7747091, manufactured by ProMinent shall be considered an equal.

10. Chemical feeders to be manufactured by LMI, ProMinent, G. H. Stenner & Co., or approved equal.

a. Leisure Pool Acid Pump (one required): Model 45M3 22 GPD

2.7 WATER CHEMISTRY MONITORING AND CONTROL SYSTEMS

A. The water chemistry control system for the leisure pool shall provide continuous monitoring and control of sanitizers, oxidizers, pH, ORP, temperature, system flow rate, and water chemistry balance calculations. All line-voltage wiring shall be performed in a separate NEMA 4X enclosure that precludes access to the controller electronics. Installation of the system shall be per the manufacturer's specification and no exceptions shall be allowed. A factory trained/authorized representative shall provide training to the Owner and the training shall be videotaped per 131100, Section 1.12 of the project contract documents. The specified controller, a BECSys7 manufactured by BECS Technology, Inc. shall be provided or Chemtrol by SB Control Systems, AcuTrol by Pentair, ProMinent, or a technically equal system capable of providing equal performance for all operating functions.

B. Certifications

1. The controller shall carry the following product certifications

a. NSF/ANSI Standard 50;

b. UL 61010-1

C. Sensors

1. The controller shall come with the following sensors

a. pH - The controller shall provide a measurement of pH by utilizing a sensor with the following characteristics:

1) 0 – 14 sensing range

2) ABS body with ½" NPT process connection

3) Minimum of 32 milliliters of inorganic electrolyte gel; organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal

4) A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction

5) A silver/silver chloride (Ag/AgCl) reference element

6) A general purpose glass membrane pH sensing element

7) Operating temperature range of 0 - 80 degrees C

8) Operating pressure range of 0 - 100 psiG.

9) The controller shall continuously monitor, display and data log pH with 0.1 or 0.01 resolution (programmable).

b. ORP - The controller shall provide a measurement of ORP by utilizing a sensor with the following characteristics:

1) -1000 to +1000mV sensing range

2) ABS body with ½" NPT process connection

3) Minimum of 32 milliliters of inorganic electrolyte gel; organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal

- 4) A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction
 - 5) A silver/silver chloride (Ag/AgCl) reference element
 - 6) A solid platinum or solid gold ORP sensing element with a minimum of 1 cm² surface area; platinum-plated and gold-plated sensing elements, which are susceptible to abrasives, shall not be considered equal
 - 7) Operating temperature range of 0 - 80 degrees C
 - 8) Operating pressure range of 0 - 100 psig
 - 9) The controller shall continuously monitor, display and data log ORP with 1mV resolution
- c. Flow Sensor - The controller shall provide a measurement of pool circulation flow rate and volume by utilizing a flow sensor with the following characteristics:
- 1) 0-8800 gpm (0-33265 liter/min) measuring range,
 - 2) Magmeter flow sensor with a frequency output,
 - 3) Dual O-ring seal,
 - 4) Cable to meet length requirement for installation,
 - 5) Saddle to meet return line size,
 - 6) Flow volume: 999 trillion gallons, 1 gallon resolution; 999 trillion liters, 1 liter resolution.
 - 7) The controller shall continuously monitor, display and data log flow rate with 0.1 gpm resolution.
- d. Temperature - The controller shall provide a measurement of water temperature by utilizing a sensor with the following characteristics:
- 1) 32 – 212°F (0 – 100°C) sensing range;
 - 2) 2 wire, 100Ω resistive temperature detector (RTD) with a 0.00385 Alpha.
 - 3) The controller shall continuously monitor, display and data log temperature with 1°F resolution.

D. User Interface

1. Standard Display - The standard display shall be a backlit transfective LCD with 14 line x 40 alpha/numeric graphical characters that will continuously display information related to the following:
 - a. All installed sensor readings
 - b. Set points, with current control status
 - c. All active alarms, including time activated
 - d. Smart menus w/ integrated on-screen help
 - e. Contrast adjustment of the backlit LCD shall be provided through clearly marked keys on the front-panel without the need for access to internal controller circuitry. After initial adjustment, controller shall monitor internal temperature and automatically adjust contrast to prevent LCD blackout in extreme ambient temperature conditions. Controllers that do not include front-panel contrast adjustment and automatic temperature compensation shall not be considered equal.

- f. The standard user interface shall include single-touch access to Set Points, Relay Modes, Calibrations, Backwash status and settings, Menu access, and Reset Fail/Safes. An alphanumeric keypad shall be provided for ease of system configuration.

E. Control Functions

1. Water Chemistry

- a. pH Control: The controller shall continuously control pH. Chemical feed shall be configurable for feed-up, feed-down, or dual feed and either on/off or time-based proportional feed.
- b. Sanitizer Control: The controller shall continuously control sanitizer based upon the ORP reading, the amperometric sensor, or both with a bracketed control program. Chemical feed shall be configurable for either on/off or time-based proportional feed.
- c. Bracketed Sanitizer Control: With the amperometric ppm sensor, the controller shall be configurable for bracketed sanitizer control; The bracketed control algorithm shall allow either the ORP or ppm setpoint to be chosen as the primary control point, while using other parameter to create a secondary boundary (min and max settings) that must be maintained in addition to the primary control point.
- d. Sanitizer Booster Feed: The controller shall have a sanitizer booster program with selectable ORP and/or ppm set points with separate ending set points, allowing the option of the booster sanitizer to control to a lower set point while the primary system can recover.
- e. Superchlorination: The controller shall have a programmable superchlorination function, based upon ORP or ppm superchlor setpoint, which is triggered manually.
- f. Dechlorination: The controller shall have a programmable dechlorination function, based upon ORP or ppm dechlor setpoint, which is triggered either manually or by the completion of the superchlorination function.
- g. LSI & RSI: The controller shall compute the Langelier Saturation Index and the Ryznar Saturation Index based upon current inputs and the Ca Hardness and Alkalinity entered by the operator.

2. Expanded

- a. Flow Monitoring: The controller shall continuously monitor, display, and datalog system flow, maintaining a total flow volume. A Low Flow Alarm shall be operator settable, which can be programmed to disable chemical feeds.

F. Main Recirculation Pump

1. On/Off Control with Relay

- a. Controller shall provide the capability to interface to and control a recirculation pump with a programmable relay. The controller shall provide 3 operator-settable independent Fireman Cycle settings and relays. The controller shall include the following capabilities, available as appropriate based upon installed sensors and implemented features:
 - 1) Fireman Cycle: Upon the following events, the controller shall automatically delay recirculation pump shutdown until the Heater controls have been deactivated and the corresponding Fireman Cycles have expired:
 - a) Backwash Operations

- b) Energy Conservation mode (24 hr., 7 day function)
- c) Manual off (per Operator)
- 2) Immediate: Upon the following events, the controller shall immediately turn off the recirculation pump (and Heater controls), without first satisfying Fireman Cycle timing requirements:
 - a) Surge Tank Level Low Alarm: Turn off pump immediately (surge tank is almost empty)
 - b) Strainer Vacuum High Alarm: Turn off pump immediately (possible entrapment)
 - c) Emergency shutdown, triggered by front-panel Emergency Off: Turn off pump immediately (per Operator)

G. Control Outputs

1. Relay Outputs

a. Solid-State Relays

- 1) The controller shall come with a total of 4 integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating conditions, accounting for the effects of the temperature gradient inside the NEMA 4X enclosure. Systems that utilize relays that are not de-rated must submit an engineering evaluation justifying the use of relays at their full, optimal-condition capacity. All solid-state relays shall have a provision for an electrical interlock with the circulation pump motor starter.

2. Mechanical Relays

a. The controller shall come with a total of 5 mechanical relays:

- 1) 1 integral 8A dry contact mechanical relay, and
- 2) 4 integral 3A dry contact or line powered mechanical relays.
- 3) Since mechanical relays have the inherent risk of failing in the closed (active) position, as a safety measure the controller shall preclude the ability to assign any of the integral mechanical relays to chemical feed functions. Systems that do not preclude mechanical relays from being configured for chemical feeds shall not be considered equal. All mechanical relays shall have a provision for an electrical interlock with the circulation pump motor starter.

H. Safety Features

1. Manual-On limit

- a. The controller shall have built-in limits to the amount of time any relay control output may be forced on (i.e. in "Manual On" mode). This is an important safety feature to prevent control outputs from inadvertently being left forced on after service or diagnostics.

2. High/Low Alarm Settings & Control Lockouts

- a. The controller shall have programmable high and low alarm settings for pH, ORP, PPM, temperature, low flow & no flow and chemical overfeed, turbidity, pressure & vacuum, surge tank levels, chemical inventory. The controller shall have a programmable lockout of sanitizer feed upon pH high or low alarm.

3. No Flow Alarm & Flow Restored Delay
 - a. The controller shall activate a No Flow alarm when the dedicated sample stream flow switch indicates there is insufficient flow through the sample stream. This No Flow alarm shall lockout all chemical feed control operations. The controller shall include a Flow Restored Delay, which shall extend the No Flow lockout user-programmable amount of time after the No Flow alarm ends (i.e. flow is restored). This feature is necessary to assure that the system has valid, stable sensor readings of circulating water prior to making chemical feed control decisions.
4. Feed Limit Alarms
 - a. The controller shall trigger a FailSafe alarm if a chemical feed relay remains on longer than the programmable Feed Limit Timer. Chemical feeds shall automatically be disabled if the corresponding reading goes into a FailSafe alarm condition.
5. Emergency Off
 - a. The controller shall have a dedicated Emergency Off button on the front panel of the system, which immediately halts all chemical feeds and control outputs when pressed. This feature shall be password protectable, which shall require entry of one of the Security passwords.
6. Safety shield
 - a. The controller shall include a safety shield or other mechanism for allowing fuse replacement without access to high voltage circuitry or wiring.
- I. Security
 1. The controller shall have three security password levels: six for operators, two for managers and one for the distributor providing for a history of access identified by the user.
- J. Data Logging
 1. The controller shall have 512K battery backed-up RAM for input level recording and events. All input level shall be recorded for 10 to 56 days depending on sample rate (2 to 10 minutes).
 2. The controller shall record and maintain the latest 1100 events over a maximum of 14 days recording all alarms, parameter changes, user logins, and operational cycles related to all control features.
- K. Local Alarms Indicators
 1. The controller shall signal all alarm conditions with the following indicators:
 - a. A bright red flashing LED on the front of the controller,
 - b. Activation of a master alarm signal provided as a dry contact relay enabling the use of 0-240 VAC alarms, and
 - c. Each active alarm listed on the LCD display along with time activated.
- L. Enclosures
 1. The controller shall be housed in a NEMA 4X polycarbonate enclosure.

2. Field wiring enclosure - All high voltage field wiring shall be through a separate NEMA 4X enclosure that precludes access to controller electronics. All high voltage connections shall be clearly identified and a field wiring diagram shall be provided with the controller for installer reference. All controller high-voltage relay assignment parameters shall be programmed at the factory prior to delivery to installation location.

M. Flow Cell

1. PVC flow cell
 - a. The flow cell shall have a PVC body with two ½" NPT ports for pH and ORP sensors, two ¼"NPT ports for temperature sensor and sensor wash acid injection, and a clear acrylic front viewing window. The flowcell design shall provide precise sample flow rate and water velocity regulation past the probes. The flowcell shall come provided with PVC ½" isolation ball valves, PVC ¼" wet test valve and standard reed or optional rotary flow switch.
 - b. Each flow cell shall be equipped with a pressure-sensing device. The pressure sensor shall consist of a compound pressure/vacuum gauge manufactured in stainless steel, 2 ½" diameter, liquid filled with an operating pressure range of 0 to 60 psig and vacuum of 0 to -30 in./ Hg.

N. Start-up and Manuals

1. The control system shall be provided with on-site start-up, on-site operator training, and 1 year on-site warranty service performed by a representative trained and authorized by the controller manufacturer.
2. Manufacturer shall supply an Operation and Maintenance Manual describing features, operating instructions, maintenance procedures and replacement parts.

2.8 FLOW METERS

A. Flow Meter

1. Flow meters (1 required) shall be installed according to the manufacturer in the filtered water return line to the pool. Flow sensor shall be the GF Signet 2551 insertion magmeter. Provide the coaxial cable from the sensor to the display/transmitter. Flow meter accuracy shall be +/- 2% of reading.
2. Backwash piping flow meter (2 required) shall be a pilot, impact ball, variable area type with one piece, impact resistant machined acrylic plastic body. GPM scale to be permanently etched or imprinted on the meter. Flow rate indicator to be of stainless steel material. Scale range to be appropriate for specific flow rate. Pipe size to accommodate backwash rate. Backwash piping flow meter shall be BLUE-WHITE series F-300 or approved equal.

2.9 WATER LEVEL CONTROLLERS

A. In Surge Tank Water Level Controller

1. Provide a water level sensing and control system for the Leisure Pool that will monitor the water level in the surge tank and automatically activate the auto water make-up control valve. For sensing water level and activating make-up water control valve for each pool, use Series ELC-810 Controller housed in a watertight NEMA 4X UL94 5V UL flammability rated polycarbonate enclosure to meet IP66 and NEMA 4, 4X, 12 and 13 ratings. The Controller shall utilize one sensor to control water level. ELC-810 series shall have a

menu-driven LCD display screen and utilize a five-switch user interface for navigation through the menu. The menu shall allow changing the following settings: delay to shutoff, alternate sensor option, maximum time on, manual override, delay to normal, type of sensor, high level option, flow sensor active, and sounder with alarm. All menu settings shall be capable of password protection. The Controller shall be capable of displaying the following data: last fill time, last drain time, last alarm. The Controller shall be capable of determining the following: maximum time on exceeded, over current to solenoid valve, no valve/valve wiring problem, and sensor not working properly. The Controller shall have a low voltage interlock with auto water make-up solenoid valve, shall provide adjustable time delay for increasing level and manual override; and shall require 115 VAC, 1 phase, 60 Hz power. Manufactured by AquatiControl Technology, Model ELC-810-SS-ST-XXX (Contractor to coordinate the specific length of cable required for each controller prior to ordering). Refer to drawings for additional information. Provided and installed by CONTRACTOR and connected by electrical.

2. Provide a proximity switch sensor that shall be sensitive to within +/- 1/8" (4mm) of nominal water level. Supply voltage to sensor shall be 12V to 24V DC from Controller. Current consumption shall be < or = 15mA. Response frequency shall be 100Hz. Maximum control output shall be 200mA. Sensor operating temperature shall be -25 Deg. C to 70 Deg. C. Operating humidity shall range from 35% RH to 95% RH. Sensor shall be mounted in a 1" SCH80 PVC pipe (length to be determined by depth of surge tank). Sensing pipe to be mounted to surge tank wall with composite/non-metallic hangers and stainless steel hardware. Sensing pipe shall be capable of being submerged under water safely. Refer to drawings for additional information.
3. Wiring from the sensor to the Controller shall be provided and shall be connected to the terminal points mounted within a corrosion-resistant, nonmetallic NEMA 4X enclosure. All wiring connections shall be made through the bottom of the enclosure. The enclosure size shall be no less than 8" wide x 5" high x 4" deep. The access door shall be the entire front face panel of the enclosure. Confirm location in field.
4. Major components shall be plugged in using WAGO terminal blocks for ease of installation and replacement. Unit shall be designed to activate a 24-volt AC solenoid valve.
5. Provide a make-up water solenoid valve, normally closed, stainless steel fitted, bronze body, 24 VAC slow closing type. Size to pipe. Interlock with automatic water level control system. Refer to the Drawings for additional information. Such as ASCO, or approved equal.
6. Discharge of make-up water shall be into a fill standpipe and piping to the Leisure Pool. Refer to the Drawings for additional information.

2.10 INSERTS AND ANCHOR SOCKETS

- A. Sockets and anchors shall be provided as stainless steel or cast bronze for swimming pool accessories. The CONTRACTOR shall confirm compatibility of deck equipment and deck anchors with the deck equipment manufacturer. All anchors or sockets shall be provided with flush closure caps and escutcheons with set screws where indicated. Escutcheons shall be of the keyhole or oblong shape, similar to the casted, electro-polished stainless steel escutcheon with set screw by Paragon #28303SS, or approved equal.
 1. Anchor sockets for all railings and grab rails shall be of the wedge type, cast bronze, 4 inches in depth and made to receive 1.50 inch OD tubing as manufactured by Paragon #28105, or approved equal. The wedge shall be cast bronze, incorporate a stainless steel tightening bolt and flat washer, and be designed as the sacrificial element to the anchor

system. All metallic components shall be passivated, in compliance with ASTM A967-99, incorporating organic acid passivation techniques for maximum corrosion resistance.

2. Anchor sockets for all stanchions shall be of cast bronze, sized to receive a full 6 inches penetration of 1.900 inch OD tubing as manufactured by Paragon Aquatics Catalog No. 38201TC, Spectrum Products No. 23626, Kiefer No. 700103, or approved equal. Each anchor socket is to be provided with a flush threaded, vandal proof closure cap Paragon Aquatics Catalog No. 38201TC or Spectrum Products No. 23628, or Kiefer No. 700103C, and a grounding lug with screw. Provide Paragon Aquatics catalog no. 38303, Spectrum Products catalog no. 23630, Kiefer No. 700103K, or approved equal spanner wrenches for removing the closure cap.
3. Cup anchors for racing lane lines, water polo tether and boundary lines etc. shall be incorporated into the perimeter overflow system.
4. Anchor assembly for pool lift shall be a pair of threaded bronze anchor sockets mounted on a jig. The anchor assembly shall include a grounding lug for proper bonding. Install in accordance with manufacturer's instructions and provide the concrete foundation reinforcing required to properly anchor and support the unit for its intended use. Manufacturer shall provide an anchor that has a completely flush cover or flush plug for times when the lift is not in use.
5. Recessed steps shall be a single molding of white ABS with an integral slip resistant tread surface. The step shall be 16.5 in. wide by 6 in. deep. All portions of the backside shall be completely filled with non-shrink grout and set into the wall block-out and mortared in with non-shrink grout. Step by KDI Paragon, S.R. Smith, or approved equal.

2.11 DECK EQUIPMENT

- A. Grab rails shall be provided as required in the quantities and to the dimensions as shown on the drawings. Grab rails shall be fabricated of one continuous length of polished and buffed tubing. The tubing shall be ASTM-A-554 grade 304L stainless steel, 1.50 inch OD x .120 inch minimum wall thickness, polished and buffed to 320 grit finish and shall be passivated, in compliance with ASTM A967-99, incorporating organic acid passivation techniques for maximum corrosion resistance. All bends shall be smooth and free of wrinkles. Grab rails shall be pretzel bend style with dimensions as indicated in the plans and as manufactured by Spectrum, SR Smith, Paragon, or approved equal.
- B. Entry rails shall be provided as shown on the drawings, fabricated from one continuous piece of polished and buffed ASTM-A-554 grade 304L stainless steel, 1.500 inch OD x .120 inch wall thickness, polished and buffed to 320 grit finish and shall be passivated for maximum corrosion resistance. Bends shall be smooth and wrinkle free. Custom rails shall be as manufactured by Spectrum Products, or approved equal. Custom rail submittal drawings shall be complete with details of custom fabrication and installation information.
- C. Stanchion posts shall be provided as required and in the quantities shown on the drawings. The posts shall be a straight length of type 304L stainless steel tubing, 1.900 in. OD x .145 in. wall thickness x 8 ft. 0 in. overall length, polished and buffed to 320 grit finish. Stanchions shall be capped at one end with a closure plug containing a U-shaped hook and fitted with a stainless steel eyebolt attached to an adjustable nickel plated bronze sliding collar. Stanchion shall be as manufactured by Paragon Aquatics, catalog no. 38106, or Spectrum Products catalog no. 23614 with Paragon Aquatics catalog no. 38301 or Spectrum Products catalog no. 23625, sliding collar, with eyebolt or approved equal.
- D. Lifeguard chairs (4 required) shall be constructed of UV inhibited recycled HDPE chairs. Seat height shall be 40" above the pool deck. All joints shall be secured using T- 316L stainless steel screws. All major sub-assemblies shall be secured together with chrome-plated CP18-

8SS through bolts and nuts. Chair shall include umbrella guide and holders. Color shall be selected by the architect. Lifeguard chairs shall be Tailwind Furniture model no. LG510, or equivalent by Spectrum Products or Kiefer.

- E. Surge tank access hatch (1 required) shall be provided as shown on the drawings. The access hatch shall be a single door 3 ft.-2 in. x 2 ft.6 in with 1" fillable pan to receive ceramic tile and grout or concrete fill to match the surrounding deck. The frame shall be ¼ inch extruded aluminum with built in neoprene cushion and continuous anchor flange. Door shall be ¼" aluminum plate reinforced with aluminum stiffeners as required. Door shall be equipped with heavy continuous stainless steel hinges and shall have compression spring operators for easy operation. Door shall open to 90 degrees and lock automatically in that position. Door shall be built to withstand a live load of 150 lbs. per square foot and equipped with a continuous Type 316L stainless steel hinge, tubular type, and an automatic hold open arm with release handle. All hardware is to be type 316L, 18-8, stainless steel. A flush lift handle and a snap lock with removable key wrench shall be provided. Factory finish shall be mill finish with bituminous coating applied to the exterior of the frame. The access door shall be Type TER-3 single leaf pan type door as manufactured by the Bilco Company.
- F. Surge tank ladder rungs shall be ½ inch Grade 60 steel encased with co-polymer polypropylene plastic as manufactured by M.A. Industries, Inc, phone 770-487-7761.
- G. Pool Lift (1 required) shall be a battery powered handicap lift with footrest assembly. Lift shall comply with the Americans with Disabilities Act Access Guidelines (ADAAG), be capable of lifting 400 lbs, and shall include a stainless steel anchor socket, cover, spanner key, and a seat belt assembly. All stainless steel components shall be 304L. Lift to be a Splash Aquatic Lift, model #300-0000, manufactured by S.R. Smith, the Traveler II XRC500 model #27610, manufactured by Spectrum Products, or approved equal. Contractor to confirm pool lift fits on pool perimeter and operates correctly.

2.12 LOOSE EQUIPMENT

- A. Competition floating lane rope (1 required) shall be as shown on the drawings and described in these specifications. Floating lane ropes shall be a non-turbulent type with wave quelling floats and 3/16" stainless steel coated cable. Floats shall be injection-molded polyethylene. Colors to alternate the length of the pool with a contrasting solid color for the final 15 feet (Architect/Owner to select colors). All floating lane ropes shall be provided as completely assembled and installed with take up reel, type 304 stainless steel spring and cable lock, hooks, and wrench. 5/8" wrench shall be made of a forged steel shaft with a polished chrome finish. The take up reel shall be constructed of type 304 stainless steel. The spool shall be a bronze nickel-plated casting with a nylon sleeve. Floating lane ropes shall be similar to Competitor Swim Products, Competitor 4" Racing Lanes, Kiefer Advantage I (4.5"), or Anti-Wave ForeRunner (4.75"), pre-assembled and sized to fit the length of the pool.
- B. Backstroke flags shall be made of Nylon material, triangular in shape (12" wide x 17" long), and alternating in color, and sewn onto a Nylon tape. Additional tape shall be provided at both ends for fastening to the stanchions. Submit samples for review and approval. Equipment shall be Kiefer Nylon Backstroke Flags, #600120, or approved equal.
- C. Lane rope storage reel shall be fabricated from two heavy-duty thermos-formed plastic wheels joined together by a 1-3/4 inch aluminum axle. This unit must ride easily on four hard rubber wheels. The reel shall have a tow handle for safe movability. The storage reel should be able to hold 525' of 4" lane ropes or 300' of 6" lane ropes. The CONTRACTOR is responsible for assembly. The correct number of storage reels shall be provided to store all lane line markers. Lane line storage reel to be Competitor Swim Products Classic Stor Lane Reel, Catalog #200 350 with Competitor storage reel cover, catalog #200 351, Kiefer Racing Lane Storage Reel #210300, with Storage Reel Cover #210301, or approved equal.

- D. Battery powered pace clocks (2 required) shall be a portable type with stand, 15-inch octagonal face with a stabilizing foot and a built-in recessed handle. The pace clock shall be the Kiefer, 15" pace clock, catalog #210503 or approved equal. Color selections shall be made by the Architect.
- E. Lifeline shall be 3/4 inch blue and white polyethylene rope with floats that are 5 inch diameter by 9 inch long. Floats to be spaced on five foot centers. All metallic rope hooks shall be stainless steel. Provide lifeline at five foot break between shallow and deep water as shown on the drawings. Lifeline to be equal to Recreonics no. 14-381.BW or Lincoln Aquatics 44-115 safety line rope, Recreonics no. 14-381 or Lincoln Aquatics 44-190 locking 5" x 9" floats, and Recreonics no. 14-456 or Lincoln Aquatics 44-125 rope end hooks.
- F. Water Basketball - Deck mounted water basketball (1 goal required) shall be provided at the locations shown on the drawings.
1. Multi-height Basketball Goal
 - a. Goal Mast Pole -The goal main support mast shall be constructed from 4"x4" 0.120 wall thickness 304L stainless steel. Mast anchoring plate shall be constructed from 3/8" 304L stainless steel plate. The mast pole shall have 1" OD reinforcing bushings positioned through the tube at the extension arm attachment positions to prevent excessive deformation and movement. The mast shall be fabricated using approved GMAW and GTAW processes.
 - b. Extension Arms - The goal extension arms shall be constructed of 3"x1/2" 304L stainless steel. Extension arms shall be precision bent to allow for backboard supports positioned on 23" centers, reducing the stress on the backboard frame elements.
 - c. Height Adjustment System - Goal shall have a compression height adjustment mechanism that is infinitely adjustable over a range of 50" range with and initial rim to water height of 24".
 - d. Backboard - 36"x48" backboard shall be constructed of U.V. protected abrasion resistant 1/2" polycarbonate. Backboard shall be marked with a regulation border and target area. The backboard support frame shall be constructed from 1.5"x1.5" 304L stainless steel tubing using approved GTAW welding processes.
 - e. Rim - Goal shall include a regulation specification double static ring hoop. Hoop shall have a manufacturer unconditional lifetime warranty.
 - f. Hardware - All fasteners and other hardware shall be corrosion resistant 304 or higher alloy stainless steel. All extension arm pivot points shall be protected from steel on steel contact by chemical resistant plastic bushings
 - g. The water basketball unit shall be the Spectrum Aquatics Model 133058, Hydroshot II provided by First Team Inc., or equivalent.
- G. Water Volleyball
1. Deck mounted water volleyball shall be provided at the locations shown on the drawings. Equipment shall include: heavy duty 2 3/8" dia. powder coated aluminum stanchion posts with finishing rings, anchors with caps, heavy duty net with net shortening kit, adjustable height net clamps and hot colored ball. Hardware shall be brass and stainless steel.
- H. T-wrench for operation of valve extensions shall be fabricated of 3/4" diameter SCH 40 stainless steel pipe. The T-wrench shall be 4'-0" in length with a 24" long welded "T" handle. The wrench shall be fitted with a 3/4" square stainless steel male end, 1" in length, for operation of valve extensions at the surge tank. Two complete T-wrenches shall be provided.

2.13 MAINTENANCE EQUIPMENT

- A. The following items are to be supplied by the CONTRACTOR unless otherwise noted. All proprietary names are to designate performance only. Equal products will be accepted.
1. Wall brush (2 required) - Brush backing shall be a flexible polyethylene material with five (5) rows of nylon bristles. Pool brush holder shall be permanent mold cast aluminum with hydrofoil flap. Holder shall have stainless steel screws to facilitate brush changes. Handle bracket shall be quick detachable mount to fit standard 1 ¼ or 1 ½ inch diameter handles. Brush to be Recreonics no. 10-135, Lincoln Aquatics 31-020, or approved equal.
 2. Skimming net (2 required) - Skimmer head shall consist of one-piece molded plastic frame with a reinforced, integral handle bracket suitable for quick attachment to a standard 1¼ or 1 ½ inch diameter handle using bolts and wing nut. The standard nylon net shall be attached to the frame using the groove and spline method. Net depth shall be 4 inches minimum in the center. Skimmer net shall be manufactured by Skimlife No. SS8, or approved equal.
 3. Telescopic Poles (2 required) - Cleaning tool handle shall be of the telescopic design and fabricated from corrosion resistant, high-quality anodized aluminum. Poles shall be fully adjustable, to desired length, with a simple twist of a cyclac threaded locking device. Poles shall consist of a 1 inch tube fitted inside a 1¼ inch tube and be adjustable from a range of 8 ft. to 16 ft. Handle shall be adjustable from 8 ft. to approximately 16 ft. having a threaded bushing type clamp to lock handle at desired position. Poles shall be manufactured by Pool King, or approved equal.
 4. Portable Vacuum Poles
 - a. Stainless steel poles (1 required) – Vacuum head attachment poles are to have a heavy duty 1¼ inch stainless steel handle with special brass male and female threaded inserts on the ends. Poles are to be 8 ft. each, totaling a 24 ft. length for vacuum head attachment. Poles are to be Recreonics no. 10-330 with female thread adaptor being Recreonics no. 10-335 or approved equals.
 5. Test Kits (2 required)
 - a. The first test kit shall feature liquid reagents, color comparator, waterproof instructions and treatment charts, chemistry guide and water gram. Test kit to have the ability to test for free and total chlorine (0.5 – 5.0 ppm), bromine (1-10 ppm), pH (7.0 – 8.0), acid and base demand, total alkalinity, calcium hardness and cyanuric acid. Test kit shall be Taylor Complete 2005 test kit, or approved equal.
 - b. The second test kit shall be photometric and utilize tablet reagents for stability that will allow accurate measurement of free and total chlorine (0-10 ppm), bromine, pH, alkalinity, calcium hardness, and cyanuric acid. The test kit shall have solid-state digital electronics and built-in filters. The test kit shall be direct-reading with automatic blank settings, automatic power cut-off, and store the last 10 results in nonvolatile memory. Test kit shall be a Pooltest 6 system based on the Palintest system of water analysis. Provide SPH 006D Pooltest 6 - Hard Carry Case Kit and SPC 006 Check Standard or AquaPRO 6 Test Kit manufactured by Orbeco-Hellige Inc. and Reference Standard Kit (LP275680).
 6. Vacuum Cleaner (filtered water return to pool) - (1 required) to be complete with a 36 inch dual manifold head with 50 feet of 2 inch floating hose. Hose to be Recreonics, catalog no. 10-422 or approved equal. 24 ft. stainless steel pole shall be available for attachment. The portable cartridge vacuum cleaner system shall include a 155 square foot T-316

stainless steel up-flow single cartridge filter, a 1 HP self-priming thermoplastic self-priming pump 1-1/2" suction and discharge connection and 110 cubic inch strainer capacity. Cartridge shall be Harmsco no. ST/155 or approved equal. The pump motor shall be 115/230 volt single phase, 60-cycle, open-drip proof and shall be UL and NSF listed. The pump motor shall be provided with a 120-volt Hubbell switch, weather proof switch cover, in-line pre-wired GFCI and a 100' power cord. The cord shall be wired to a 20 amp, 115/230 volt switch which shall be mounted on pump motor. All interconnecting pipe and fittings shall be schedule 40 PVC. The entire assembly shall be bolted to a T-316 stainless steel cart and shall have pneumatic wheels with grease fittings and roller bearing hubs. The system shall be provided with one spare cartridge filter. Unit to be Recreonics, catalog no. 10-806, Lincoln Aquatics no. 27-010, or approved equal. Accessories shall include a 1½ inch x 25 ft. discharge hose with stainless steel hose clamp. Hose to be manufactured by Quaker Plastic Corporation no. QT-131, or approved equal.

7. JetMax Robotic Pool Cleaner - Provide one (1) single pump motor driven automatic swimming pool vacuum device. Cleaner weighs 18 lbs and has internal oil-cooled, water-cooled, brushless pump motor that filters 6,600 GPH. Jet-drive valve system on top propels the cleaner forward and back by diverting the filtered water expelled by the pump motor. Four non-marring rubber wheels on free-spinning axles guide the cleaner along pool surfaces. Motion sensor detects any obstruction in the path of the cleaner and changes direction. Two axle locking screws provide adaptable cleaning patterns for pool shape and size. The cleaner is to have four moving parts only. Cleaners with drive motors, gears, pulleys, belts or tracks are not acceptable. The cleaner to have an automatic program to clean pool floor and radius walls, travelling 1 ft per second, scrubbing pool surfaces with two power-washing jets, vacuuming a 2¼ ft wide path using two offset 7½ square inch suction inlets underneath, filtering fine debris <10 microns small and solids as large as 1½ inch into an internal reusable filter bag. Unit complete with 120 ft cord, manual guidance attachment, 2 filter bags, digital timer, power supply with 24 volt transformer, operator manual. Requires 110 volt GFCI receptacle onsite, consumes 2½ amps electricity. The pool cleaner shall be a JetMax Turbo as manufactured by Aqua Products, or approved equal.
8. Stainless Steel Cleaner - Provide a stainless steel cleaner. The cleaner shall comprise of one (1) gallon of organic passivation solution. It shall be complete with instructions for proper maintenance of stainless steel surfaces and material safety data sheets for the passivation solution. The cleaner shall be the Spectra-Clean System 2 as manufactured by Spectrum Products. Product to be applied with 3M scouring pad, or equivalent.

2.14 SAFETY EQUIPMENT

- A. The following items are to be supplied by the CONTRACTOR unless otherwise noted. All proprietary names are to designate performance only. Equal products will be accepted.
 1. Ring buoy and extension rope (4 required) – Buoy shall be 24 inch diameter vinyl clad PVC foam with a metal ring molded inside. Buoy shall have a 3/8 inch polyethylene rope attached to it at four points and be a minimum 60 feet in length. Preserver shall be U.S.C.G. approved. Buoy and rope to be mounted at each lifeguard chair on hooks. Ring buoy to be manufactured by Cal-June no. G-24-WH or approved equal. Throw rope to be Recreonics no. 12-261, Lincoln Aquatics No. 42-050, or approved equal.
 2. Life hook and pole (1 required) – Life hook shall be an anodized aluminum 3/8 inch OD "shepherd's crook" with a 1-1/8-inch OD handle attachment suitable for a 1¼-inch 16 ft. aluminum extension pole. Hook shall be of looped construction. Each pole to be provided with a set of spring type stainless steel pole clamps for mounting on each lifeguard chair.

Life hook shall be equal to manufactured by Rainbow no. 153. Pole clamps shall be Recreonics no. 10-353, or approved equal.

3. Spineboards (1 required) - Spineboard shall be 72" long x 20" wide, constructed of 100% virgin high density polyethylene. The design shall provide stiffness and torsional rigidity while remaining lightweight. The spineboard shall accommodate up to 500 lbs and shall feature customizable buoyancy that allows users to adjust the buoyancy by inserting polyethylene foam rods (supplied with the spineboard). There shall be (10) handholds around the perimeter of the board. The spineboard shall be supplied with one (1) 2-piece head immobilizer, one (1) head strap, four (4) body straps, one (1) head immobilizer with head bed, and two (2) flotation rods. The spineboard shall be CJ Rescue 6 package as manufactured by CJ spineboard at 1-206-824-8886 or approved equal. The CONTRACTOR shall provide one (1) set of heavy duty stainless steel utility hooks per spineboard for storing the spineboard at a convenient and readily accessible location near the pool (Recreonics catalog no. 10-362).
4. First aid kit (1 required) - First aid kit shall be a 24 unit kit per American Red Cross standards as manufactured by Swift First Aid, or approved equal.
5. Rescue tube (8 required) - Provide one rescue tube for each lifeguard chair. Rescue tube to be Recreonics No. 12-303, or approved equal.
6. Safety eyewash station (1 required) - Safety eyewash station shall be a self-contained system in which eyewash bottles are securely positioned in a portable holder. Eyewash bottles shall be 32 ounces and easily removable from case, and shall contain a sterile, saline solution with the ability to neutralize a varying quantity acids or caustics. Eyewash stations shall be equipped with a double back screw and holes for easy mounting in location to be determined by the Architect. Stations shall be Recreonics 12-033, Lincoln Aquatics 49-026, or approved equal.
7. Safety eyeglasses - Provided a safety eyeglass dispenser station containing ten (10) pairs of safety glasses. Eyeglasses shall be ANSI/OSHA accepted, and be equal to Lab Safety Supply Inc. (1-800-356-0783) no. WQ-14740B.
8. Bag Valve Masks – Provide two (2) bag valve mask assistant resuscitation systems, one size Adult (1500ml tidal volume) and one size Infant/Child (450ml tidal volume). Product shall be a latex free disposable bag mask unit with support strap, transparent patient valve, and textured surface to eliminate slipping. Integral swivel valve, available with a closed reservoir system. Standard pack includes resuscitator, oxygen reservoir and a transparent bag for storage. Bag Valve Masks shall be Ambu SPUR II, or approved equal.

2.15 THERMOMETERS

- A. The following items are to be supplied by the CONTRACTOR unless otherwise noted. All proprietary names are to designate performance only. Equal products will be accepted.
 1. Portable thermometer (1 required) shall be a molded ABS plastic tube body type with the ability to measure temperature in both degrees Fahrenheit and Celsius. A 3 ft. polyethylene cord is to be attached to thermometer. Thermometer is to be manufactured by Pac-Fab/Rainbow no. R141036 or approved equal.
 2. Inline thermometer to be near the heating loop and shall have a 9 inch adjustable angle with a minimum 6 inch stem. There shall be a minimum of two (2) thermometers per loop, and must have ability to read temperature in both degrees Fahrenheit and Celsius. Thermometers are to be Recreonics no. 32-702, Lincoln Aquatics no. 21-125, or approved equal.

3. Digital temperature indicator (1 required) shall be a 115 volt, wall mounting case, sensor and a stainless steel immersion well. Weiss Instruments model 20DT or approved equal. Digital thermometer not required if Chemtrol 3000 is used.

2.16 SWIMMING POOL FINISHES

A. Paint

1. Scope shall consist of the pool interior with the addition of a non-slip additive. Note: Provide a sample mock-up on a 4 ft. x 4 ft. plywood sheet showing the coating with the non-slip additive. Sample to be approved by owner and architect.
2. Coating shall be a low VOC compliant polyamidoamine epoxy suitable for chlorinated water below 3.2 ppm for installation on concrete surfaces. CONTRACTOR shall provide on-site technical services and approval from the coating manufacturer prior to application and during the coating application. Coating shall be Tnemec Series 161HS, Induron Perma-Clean II Semi-Gloss or approved equal. Color shall be white.
3. Surface Preparation
 - a. Cast-In-Place Concrete
 - 1) Allow concrete to cure a minimum of 28 days at 60 deg. F. Brush-off pool interior surfaces, then blast clean to remove laitance and weak surface concrete to produce an anchor profile similar to medium grade sandpaper referencing SSPC-SP13/NACE 6, ICRI-CSP 2-4 Surface Preparation of Concrete. Blasting shall open up surface voids, holes and irregularities. No holes or holidays in the paint membrane will be allowed. Fill with an approved grout or Tnemec Series 215 Surfacing Epoxy, or Induron EFS707 Epoxy Surfacer and Filler, any hole or irregularity that cannot be satisfactorily painted. Do not entirely remove the surface or completely expose underlying aggregate. After blasting, neutralize concrete with a solution of 2 cups aqua ammonia per 5 gallons of water. Flush with clean water and allow to thoroughly dry.
 - b. Pneumatically Applied Concrete
 - 1) Allow concrete to cure a minimum of 28 days at 60 deg. F. Prior to applying paint to a pneumatically applied concrete surface, a brown coat plaster leveling surface shall be applied. The pneumatically applied concrete surface shall be prepared for the application of the brown coat by removing all loose materials, laitance, minerals, and chemical traces. If a brown coat has been utilized, provide a clean, firm surface or anchor profile similar to a medium grade sandpaper, suitable for the application of paint. No holes or holidays in the paint surface will be allowed. Fill with an approved grout or Tnemec Series 215 Surfacing Epoxy, or Induron EFS707 Epoxy Surfacer and Filler, any hole or irregularity that cannot be satisfactorily painted.
4. Application Procedures
 - a. Before applying any material, measure and record the temperature and relative humidity. Apply only if temperature is above 55 deg. F. and at no lower temperature than 5 deg. F. above the dew point. Do not apply when the relative humidity is greater than 85%. If possible, plan the painting schedule so that all painting is done in the coolest part of the day. Provide proper ventilation so that paint fumes do not become concentrated.
5. Application of the Primer

- a. After the pool surface has been thoroughly dried and cleaned the primer coat can be applied. Surface spreading rate shall be observed as not to exceed the recommended manufacturer's rate of application. The primer will be applied at a minimum rate of 200 SF per gallon and shall conform to local VOC requirements. A good heavy coat shall be applied. A rough or porous concrete pool will require more paint than recommended. On particularly rough surfaces two coats are recommended in order to provide a smooth, uniform finish. Note: Any marks or irregularities that show through the primer will also be apparent when the finish coat is applied.
6. Application will be made by brush, roll, lambs wool applicator, or spray. When the finish coat is to be a color other than white the primer will be tinted.
 7. Application of the Finish
 - a. After the primer is dry enough to walk on without removing or marking surface, apply the finish coat(s) in accordance with the manufacturer's instructions. Application shall be done by the use of a brush, roller, lamb's wool applicator, or spray methods at a rate of 150-250 SF per gallon. Allow a minimum of 5 hours (at 75 deg. F) drying time between coats. Two coats of finish paint are recommended to improve upon general appearance of pool shell. Allow 7 days curing (at 77 deg. F.) before filling the pool.
 8. Application of pool striping, depth markings, warning signs and wall targets, shall be done after final coat of finish paint has cured for at least 24 hours.
 9. Slip resistant additive shall be applied to the all outdoor areas, entry steps, ramp areas, zero entry and all deck markings.
 10. Final paint coating shall be allowed to dry a minimum of 7 days at 35 degree Fahrenheit or above, before filling the pool.
- B. Message Tile and Depth Markings
1. Horizontal and vertical depth markings and warning signs shall be 6" x 6" with 4" high numbers and letters. All horizontal depth markers shall be slip resistant. Single tile abbreviations shall be used for 'FT' and 'IN'.

2.17 WATERPROOFING

- A. Products
1. Interior surfaces of the surge tank with NO additional finishes: Apply two (2) coats of Aquafin IC (total 100 mil thickness), Xypex, Vandex, Plainseal 88, Thoroseal directly to surface of the surge tank.
- B. Surface Preparation
1. Surface shall be structurally sound and free of any foreign substances and debris that could reduce or impair adhesion. Surfaces shall be roughened by sand blasting, water jetting, shot blasting, scarifying, or grinding. Surface defects or holes shall be patched per manufacturer's recommendations.
- C. Application
1. Do not apply materials under conditions where the ambient air temperature is less than 40 degrees Fahrenheit, or to a frozen substrate.

2. All mixing of products, quantities and application procedures shall be done in accordance with the manufacturer's recommendations.

2.18 SEALANTS

- A. Provide sealed expansion joints as shown on the pool and pool structural drawings or noted on the Contractor's construction/expansion joint layout, and as required. Expansion joints shall be constructed and sealed as indicated and in accordance with the manufacturer's recommendation. Sealant to be manufactured by LATICRETE International, Inc., Mapei, or Deck-O-Seal.

1. For submerged joints:
 - a. Latasil, one component, neutral cure, high performance, 100% silicone sealant in the color(s) as selected. Shall be used in conjunction with Latasil 9118 Primer per manufacturer's recommendations.
 - b. Mapesil T, 100% silicone sealant in the color(s) as selected.
2. For joints behind the coping, or other horizontal deck joints:
 - a. Deck-O-Seal, two component (gun-grade or pourable, self-leveling), high resilience, non sag, non flowing, polysulfide-based sealing compound in the color(s) as selected. Shall be used in conjunction with P/G Primer per manufacturer's recommendations.

B. Material Storage

1. All materials are to be stored in the original unopened factory containers in a cool dry location 60 to 80 degrees F. Protected from the elements and the hazards of construction. Open only as many containers as can be used in any particular period.

C. Joint Preparation

1. Clean the joints of all deleterious material, to sound, clean and dry substrate.
2. Joint is to be formed or filled with an approved, resilient, non-asphaltic, closed cell, polyethylene joint filler material down to firm substrate. Allow space at the top of the joint for the installation of approved closed cell polyethylene backer rod and install same to the required depth below the surface of the slab to control the depth of the sealant bead to within manufacturer requirements.

D. Surface Preparation

1. Concrete surfaces to receive sealant must be fully cured, clean, dry and free of dirt, dust and any deleterious material that might compromise the adhesion and performance of the sealant. Curing aids, form release agents and joint former residue must be completely removed, if necessary by sand blasting and/or grinding. Loose dust must be brushed off.
2. Prime all surfaces to receive Latasil sealant with Latasil 9118 Primer prior to sealant application, and surfaces to receive Deck-O-Seal sealant with P/G Primer prior to application.

E. Application

1. Apply sealant in accordance with the manufacturer's recommendations.
2. Tool the joint immediately after application to insure a firm, intimate contact with the joint interface.

3. Remove excess sealant and smears from adjacent surfaces with Xylol or Toluol before sealant cures.
4. After the sealant has fully cured (generally a minimum period of five days at 72 degrees and 50% humidity), paint the surface of the sealant with a chlorine resistant chlorinated rubber or equivalent pool paint, such as Ramuc, in a compatible color as selected by the Architect. NOTE: Latasil cannot be painted.

2.19 WATER FEATURES AND SUPPORT EQUIPMENT

A. Leisure Pool Play Features

1. FUNBRELLA (1 required)
 - a. Product Code: 0010-0485
 - b. Characteristics: The Funbrella column shall be constructed of schedule 10 stainless steel structural tubing. The column shall contain a top cap at the column end and allow for the free flow of water.
 - c. Dimensions: The overall height of the structure shall be no less than 37 inches above final grade.
 - d. Recommended Flow Rate: The hydraulic requirements shall be 15 gpm @ 15 psi.
 - e. Nozzle Count: N/A
 - f. Water Display: Water flows out of the top cap creating a cascading umbrella.
 - g. Anchoring/Levelling System: The stainless steel playPHASE anchoring system shall provide the ability to add, remove and interchange products without having to change infrastructure and footings. The component shall be fastened directly to the playPHASE base flange with an EPDM gasket to provide a water tight seal between the component flange and the playPHASE flange. The playPHASE base is flush-to-grade with no exposed bolts or dome covers.
2. SPIN SPRAY 1 (1 required)
 - a. Product Code: 0010-0653
 - b. Characteristics: The Spin Spray consists of two (2) column bends which shall be constructed of schedule 10 stainless steel structural tubing. The base assembly shall be joined to the top assembly by a rotational hub which shall allow 120° rotation. The rotational joint shall be free of pinch points and protrusion hazards and contain no flexible hoses. The end of the top assembly shall house a urethane nozzle cap. Two semi-circle acrylic handles shall be mounted at the bottom of the top assembly to act as handles. Tamper resistant fasteners shall be used to hold all components together to prevent leakage.
 - c. Dimensions: The overall height of the structure shall be no less than 81 inches above final grade. The overall width of the structure shall be no less than 14 x 11 inches.
 - d. Recommended Flow Rate: The hydraulic requirements shall be 3 gpm @ 5 psi.
 - e. Nozzle Count: One (1)
 - f. Water Display: Water shall flow through one (1) urethane nozzle cap mounted in the end of the column creating an upward geyser. The rotational hub allows for 120° rotational spray.
 - g. Anchoring/Levelling System: The stainless steel playPHASE anchoring system shall provide the ability to add, remove and interchange products without having

to change infrastructure and footings. The component shall be fastened directly to the playPHASE base flange with an EPDM gasket to provide a water tight seal between the component flange and the playPHASE flange. The playPHASE base is flush-to-grade with no exposed bolts or dome covers.

3. TWIST N SPILL 1 (1 required)
 - a. Product Code: 0010-1806
 - b. Characteristics: The Twist n Spill main columns shall be constructed of schedule 10 stainless steel structural tubing. Two bends shall be welded seamlessly to the main column. The upper arm shall support a dumping bucket, and the lower arm shall support an oval acrylic splash plate 16 x 24 inches. A rotational hub shall be installed in the lower portion of the main column joining the upper column. Two (2) half round acrylic handles shall be mounted above the rotational joint allowing for the water players to rotate the upper portion of the column 360°. The rotational joint shall be free of pinch points and protrusion hazards and contain no flexible hoses. A 16.5 inch weighted circular bucket that dumps 5.9 gallons shall be affixed to the top of the column by a spindle with stainless steel bearings and a threaded end cap.
 - c. Dimensions: The overall height of the structure shall be no less than 139 inches above final grade. The overall width of the structure shall be no less than 53 inches. The overall depth of the structure shall be no less than 24 inches.
 - d. Recommended Flow Rate: The hydraulic requirements shall be 8 gpm @ 5 psi.
 - e. Nozzle Count: N/A
 - f. Water Display: Water will flow through the water supply holes on the bucket spindle. Once at capacity for gravity rotation, the dumping bucket will be emptied downward, causing the bucket to return to its starting position. The rotation hub will allow for 360° rotation.
 - g. Anchoring/Levelling System: The stainless steel playPHASE anchoring system shall provide the ability to add, remove and interchange products without having to change infrastructure and footings. The component shall be fastened directly to the playPHASE base flange with an EPDM gasket to provide a water tight seal between the component flange and the playPHASE flange. The playPHASE base is flush-to-grade with no exposed bolts or dome covers.

2.20 POOL HEATERS

- A. The pool heater for the leisure pool shall having an input rating of 750,000 Btu/hr.
 1. Basis of design: the pool heater for the leisure pool shall be manufactured by LOCHINVAR, model COPPER-FIN II Commercial Model CPN751.
- B. The pool heater shall be orificed for operation on (Natural Gas) (L.P. Gas).
- C. The water containing section shall be of a "Fin Tube" design, with straight cupro-nickel tubes having extruded integral fins spaced seven (7) fins per inch. The tubes shall terminate into a one piece, glass lined, cast iron header. There shall be no bolts, gasket or "O" rings in the head configuration. There shall be access to the front header of the heat exchanger for the purposes of inspection, cleaning or repair. The heat exchanger shall be mounted in a stress free jacket assembly in order to provide a "free floating design" able to withstand the effect of thermal shock. The pool heater shall bear the ASME "H" stamp for 160 PSI working pressure and shall be National Board listed.

- D. The combustion chamber shall be sealed and lined with Loch-Heat ceramic fiberboard insulation. High temperature stainless steel burners of a premix design shall be used. A fan assisted combustion process shall precisely control the fuel/air mixture for maximum efficiency. Combustion air blowers shall operate for a pre-purge period before burner ignition and a post-purge period burner operation.
- E. The pool heater shall be constructed with a heavy gauge steel jacket assembly, galvanized on both sides. All exterior surfaces shall be finished in a 3-coat acrylic enamel finish.
- F. The pool heater shall be certified by the American Gas Association Laboratories. The pool heater shall operate at a thermal efficiency of 85% and comply with the energy efficiency requirements of the latest edition of the ASHRAE Standard 90.1-1999.
- G. The pool heater shall have a factory supplied pumped bypass assembly to insure proper operation without condensation. The bypass assembly shall include a sealed all bronze pump. The bypass assembly shall be constructed of schedule 80 CPVC piping with brass inserts and an automatic three-way valve.
- H. Standard operating controls shall include an electronic temperature control and immersion limit controls for pool water temperature, a heater safety high limit and auxiliary heater limit control. All controls shall be factory installed within the weatherproof enclosure and include a lighted on/off main power switch and indicating lights for call for heat and flame failure.
- I. The pool heater shall use a hot surface ignition system with full flame monitoring capability. Multiple main gas valves with redundant valve seats and built in low gas pressure regulators shall be supplied as standard. Additional standard controls shall include a blocked flue pressure switch, a low air pressure switch for each fan, a 24 VAC transformer for the control circuit and an ASME temperature and pressure relief valve. All components shall have multi-pin plug in type connectors to ease service, troubleshooting and lower removal and replacement cost. Proper operation of the burners, all controls and the heat exchanger shall be verified with a full factory fire test prior to shipping. A quality test report shall be supplied.
- J. The pool heater shall be approved for outdoor installation. The pool heater shall be approved for conventional venting (see mechanical detail) and shall be classified Category I, negative draft, and non-condensing, using a type "B" double wall vent material.
- K. The pool heater shall have an independent laboratory rating for Oxides of Nitrogen (NO_x) of less than 20 ppm corrected to 3% O₂.
- L. The Contractor shall provide the pool water heating system. Heating system to include all piping, heaters, booster pumps, controls, gauges, thermostats, control valves and wiring required to draw water from the recirculation piping, heat the water and return it back to the recirculation piping. The Contractor shall interlock pool heating system with pool recirculation pumps.
- M. Contractor shall have pool heater manufacturer representative on site to start and adjust pool heater. Copies of the startup report shall be sent to the Manufacturer and Architect/Engineer prior to final site observation and shall include the following information for each pool heater:
 - 1. Temperature settings
 - 2. Inlet Gas Supply Pressure
 - 3. Manifold Gas Pressure
 - 4. Air Pressure
 - 5. Gas Piping Configuration

6. Venting Configuration
7. Booster pump interlocked with recirculation pump
8. Separate circuits for pump and heater
9. Flow switch installed
10. A component and integrated check shall be made of all controls. Factory tests do not substitute for this test.

2.21 UNDERWATER LIGHTS

- A. Underwater lights shall be equivalent to 500 watts of incandescent light. Underwater lights shall be UL listed and in the quantities shown and as detailed in the construction drawings and as described in these specifications. Coordinate for proper installation. Refer to the drawings for quantities and locations.
- B. The pool underwater lights shall be 120VAC or 12VAC, 55 watts LED-type, and equivalent to 500 watts of incandescent light. Fixture housing shall be stainless steel construction with minimum wall thickness of 0.020 inch per UL 676 underwater pool lighting standard. The niche shall be stainless steel with cast brass mounting ring or PVC plastic with stainless steel mounting ring. Brass construction pressure grounding lug on interior and exterior services. Lens shall be 8-3/8 diameter clear tempered heat resistant glass. Gasket to be single-piece "U" shaped santoprene or silicone. Fasteners shall be silicon-bronze or stainless steel. The light fixture shall be supplied with a #16-3 STW (120V) or 12-3 SJTW (12V) submersible cord with ground wire positively grounded inside the fixture. Cord entrance shall be a watertight seal and epoxy encapsulated. Light fixture to be IntelliBrite 5g White LED pool light series by Pentair Commercial Pool and Aquatics or approved equal. Underwater lights shall be provided with cord length as required to allow for deck relamping of all fixtures.
- C. Junction boxes shall be provided in the quantities required and shall be located at least 8" above the pool coping and 5' from the pool edge. Refer to the Electrical drawings. Cord length shall be sufficient to run from fixture to the junction box with sufficient cable in the niche to re-lamp the fixture on the deck. The conduit from the niche to the junction box shall be glued and water tight. Junction boxes shall be furnished by the Contractor and installed by Electrical.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS, INSPECTION AND PREPARATION

- A. Carefully examine all of the contract documents for requirements that affect the work of this section. Prior to starting any work, notify the General Contractor of defects requiring correction. Do not start work until conditions are satisfactory.
- B. Verify that all work by others, related to this section, has been completed. This includes all earthwork, concrete work, and mechanical, electrical and plumbing connections.
- C. Protect all materials and work completed by others from damage while completing the work in this section.

3.2 FIELD MEASUREMENTS

- A. Verify benchmark and pool location prior to layout.

- B. If field measurements differ from the construction drawing dimensions, notification shall be given to the Architect prior to proceeding with work.
- 3.3 EXCAVATION, REINFORCING STEEL AND SWIMMING POOL PNEUMATICALLY APPLIED OR CAST-IN-PLACE CONCRETE
- A. Reference Division 31 - Earthwork
 - B. Reference Division 3 - Concrete
 - C. Reference Section 131102 – Swimming Pool Pneumatically Applied Concrete
 - D. Reference Section 131101 – Swimming Pool Cast-In-Place Concrete
- 3.4 TOLERANCES FOR CONSTRUCTION OF THE POOL SHELL
- A. The completed structures shall be constructed level and to the dimensions, elevation, depths and thickness as shown on the plans.
 - B. The elevation tolerance of the pool shell and gutter lip shall be plus or minus 1/8 inch.
 - C. The vertical wall surface tolerance of the pool shell, for the first 36 inches from the water surface shall be plus or minus 1/4 inch from plumb measured with a 6 foot straight edge.
 - D. Ground wires or grade pins, if used, shall be installed in such a manner that they accurately outline the section of the pool shell as indicated on the plans. They shall be located at intervals sufficient to insure proper thickness throughout and shall be maintained tight. Grade pins or grounding wires shall not be permanently embedded in the pool shell.
- 3.5 WATER TIGHTNESS TEST
- A. This test applies to the pool and the surge tank. The water tightness test shall be completed prior to the application of the pool finish.
 - B. Water Tightness Test Procedure
 - 1. Preparation
 - a. Allow the concrete structure to set 28 days for curing purposes. Once the pool shell has gained sufficient strength to withstand the test load and after all the outlets have been securely sealed, the pool shall be filled with water.
 - 2. Fill: Fill and then isolate the pool and the surge tank. The water tightness test shall begin after the vessel has been filled for a minimum of three (3) days. During the filling, all outlets shall be monitored for water tightness and all concrete joints shall be monitored for any visible leakage. If any visible leakage from the vessel is observed, the condition shall be corrected prior to the start of the test.
 - a. After the initial fill, all ground water shall be removed from the pool sight sump or the pool location de-watering system. This shall be completed prior to the start of the water tightness test. De-watering of the pool sight sump shall be maintained during the entire duration of the test.
 - 3. Evaporation/Precipitation Measurement Procedure
 - a. Fill a floating, restrained, partially filled, calibrated, open container with water and allow the container to float within the pool during the testing period. This will be used to measure evaporation and precipitation.

4. Measurement

- a. On a separate sheet of paper draw a sketch of the pool. Measurements shall be taken at the pool and the surge tank. Multiple test points with averaging are recommended for vessels which will be exposed to wind. Document the separate findings on the chart below. Repeat the measurements and document every 12 hours for a total of three (3) days. The General Contractor shall check the pool and the surge tank for water loss with the Architect or Owner's representative every 12 hours.

Total Allowable Water Loss:	Total Gallons:	(0.1%) x 0.001 = _____	Pan Depth Per 24 Hrs.
Pool Measurements	Pool	Surge Tank	Pan Measurements
12 Hrs.			
24 Hrs.			
36 Hrs.			
48 Hrs.			
60 Hrs.			
72 Hrs.			

5. Total Loss = 7.481 x Structure Surface Area (SF) x Total Water Loss per Day (FT) – Evaporation per Day (FT) + Precipitation per Day (FT)

- a. Day #1 =
b. Day #2 =
c. Day #3 =

6. Repair

- a. The allowable leakage rate for an unlined pool structure shall not exceed 0.1 percent of the total water volume in a 24-hour period. (Example: 0.001 x 200,000 gallon pool = 200 gallons per 24 hour period.) This excludes the loss/addition of evaporation/precipitation.

7. Absorption

- a. Waiting 3 days after the initial water fill will allow the concrete to absorb water and shall be sufficient to minimize the effect of absorption on the test results.

8. Evaporation

- a. Evaporation shall not have a significant effect on natatoria that are completely enclosed with no air circulation during the water tightness test. However, evaporation will have a significant effect on the water level in natatoria that has air movement across the water surface or are still partially uncovered.

9. If leaks are detected, repair the vessel and make water tight in accordance with these requirements.

10. With regard to this test, the curing requirements, the final fill and the cost of the water for two (2) complete fillings shall be borne by the Owner. Any subsequent fillings or partial fillings (more than 25%) of the pool shall be by the CONTRACTOR, at its own expense.

3.6 PIPING INSTALLATION

A. General

- Provide and erect, according to the best practices of the trade, all piping shown on the drawings and required for the complete installation of these systems. The piping shown on the drawings shall be considered as diagrammatic in indicating the general run and connections, and may or may not in all parts be shown in its true position. The piping may have to be off set, lowered or raised as required or as directed at the site. This does not relieve the CONTRACTOR from responsibility for the proper erection of the systems or piping in every respect suitable for the work intended as described in the specifications and approved by the Architect. In the erection of all piping, it shall be properly supported and proper provisions shall be made for expansion, contraction and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods in strict accordance with the manufacturer's instructions. All changes in direction shall be made with fittings. All open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the systems. Plugs of rags, wool, cotton waste or similar materials will not be used in plugging. All piping shall be arranged so as not to interfere with removal and maintenance of equipment, filters or devices, and so as not to block access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided in the piping at connections to all items of equipment. All piping shall be installed to ensure noiseless circulation. All valves and specialties shall be so placed to permit easy operation and access.

B. Pipe Hangers and Supports

- Pipes shall be adequately supported by pipe hangers and supports specified in Paragraph 2.05 Pipe, Hangers, and Valves.
- Horizontal PVC Schedule 80 piping shall be supported in accordance with the manufacturer's recommendations for fluid temperature not exceeding 120 degree F and as listed below:

Nominal Pipe Size	Hanger Support Spacing	Minimum Rod Size for Single Rod Hanger
1-1/4" and less	5'-0"	3/8"
1-1/2" to 3"	6'-0"	1/2"
4" to 6"	8'-0"	5/8"
8" to 12"	10'-0"	7/8"
Greater than 12"	12'-0"	1"

- Horizontal CPVC Schedule 80 piping shall be supported in accordance with the manufacturer's recommendations for fluid temperature not exceeding 140 degree F and as listed below:

Nominal Pipe Size	Hanger Support Spacing	Minimum Rod Size for Single Rod Hanger
1/2" and less *	4'-0"	3/8"
3/4" to 2"	6'-0"	3/8"
2-1/2" to 3"	7'-0"	1/2"
4" to 8"	8'-0"	7/8"

Greater than 12"	10'-0"	1"
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- C. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored epoxy paint, or non adhesive isolation tape.
- D. Install hangers to provide a minimum of 1 inch space between finished covering and adjacent work.
- E. Place a hanger within 12 inches of each horizontal elbow.
- F. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.
- G. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified in section 2.5.C.3. Trapeze hangers shall be spaced according to the smallest pipe size, or install intermediate supports according to the support spacing schedules.
- H. Do not support piping from other pipes, ductwork or other equipment that is not building structure. Do not modify building structure for hanger installation.
- I. Concrete Inserts
 - 1. Provide inserts for placement in form work before concrete is poured.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Where concrete slabs form finished ceilings, provide inserts to be flush with the slab surface.
 - 4. Provide hook rods to concrete reinforcement section for inserts carrying pipe over 4 inches.
- J. Pipe Hangers and Supports
 - 1. All piping shall be rigidly supported from the building structure by means of hanger assemblies properly selected and sized for the application in accordance with the manufacturer's recommendations and specifications.
 - 2. All piping in a service tunnel, if required shall be supported by a structure of the CONTRACTOR'S design. The structure shall be non-corrodible and shall be of a size and configuration to rigidly support all the piping as shown in the plans at a minimum spacing as shown below.
 - 3. Piping hangers shall be spaced per the below schedule and shall have hangers not more than one foot on each side of every change in direction. The piping systems shall be installed in an approved manner and shall not overload the building structural frame. The CONTRACTOR shall provide additional hangers and miscellaneous steel supports as required to distribute the piping system load over several structural members where required or directed. Maximum allowable spacing for piping shall be as follows:

<u>PVC Piping</u>	<u>Maximum Spacing</u>
3/4" through 2"	5'-0"
2 1/2" through 4"	6'-0"
6" through 10"	9'-0"
12" through 14"	12'-0"

4. Round rods supporting the pipe hangers shall be of the following dimensions:

1/2" to 2" pipe	-3/8" rod
2-1/2" to 3" pipe	-1/2" rod
4" to 5" pipe	-5/8" rod
6" pipe	-3/4" rod

5. Hanger rods shall be galvanized steel. Provide for controlling level and slope by turn buckles or other approved means of adjustment and incorporate lock nuts.
6. Where piping is installed side by side, the CONTRACTOR will support the piping by utilizing trapeze type hanger assemblies. Horizontal trapeze member shall be non-metallic channel. The CONTRACTOR shall provide heavier members as required for the load to be supported for the entire span distance. Hanger rods shall be as specified above and properly sized for the load supported, but not less than 5/8 inches diameter.
7. The use of pipe hooks, chains, or perforated iron for pipe hanger supports will not be permitted.
8. Attachment of piping hangers to the building structure shall be provided in a manner approved by the Architect. The CONTRACTOR shall provide concrete inserts to be installed by the General Contractor in the building construction at the time the concrete is poured and hangers shall be attached to these inserts.

K. Piping Installation

1. Trench bottoms shall be smooth and free of rocks and debris. If the trench is dug in ledge rock, hardpan or where large boulders are not removed, place 3 inches of sand or compacted fine-grained soil below pipe. Pipe must be supported over its entire length with firm, stable material. Blocking will not be used to change pipe grade or provide intermittent support over low sections in the trench. Surround the pipe with backfill meeting the requirements of Section 312000 with a particle size of 1-1/2 inch or less and in accordance with the project geotechnical report. Compact in layers not to exceed 6 inches with vibratory method. Follow installation methods of ASTM D2774 "Underground Installation of Thermoplastic Pressure Piping".
2. Installations are to be installed in a straight run of pipe, with a minimum 10 pipe diameters upstream and minimum 5 pipe diameters downstream of any pipe fitting.

L. Flushing, Draining and Cleaning Pipe Systems

1. The CONTRACTOR shall flush out all water systems with water before placing them in operation. Other systems shall be cleaned by using compressed air or nitrogen. After systems are in operation and during the test period, all strainer screens shall be removed and thoroughly cleaned.

M. Expansion and Contraction

1. The CONTRACTOR shall make all necessary provisions for expansion and contraction of piping with offsets, loops, flexible connections and anchors as required to prevent undue strain. The CONTRACTOR shall provide shop drawings for proposed method and arrangement for control of expansion and contraction of piping.

N. Testing

1. All piping installation and pressure testing shall be reviewed by the Owner's testing agency before commencement of backfilling. A minimum notice of one (1) week is required prior to review. Results of review shall be documented.
2. All pool related piping, shall be hydraulically pressure tested (with water, not air) to a pressure of not less than 50 PSI for a period of no less than two (2) hours.
3. Contractor is responsible for the maintenance of a sustained 20 PSI pressure on all pool related piping throughout the course of construction.
4. The Contractor shall adhere to the applicable provisions of Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.

3.7 EQUIPMENT AND SYSTEMS INSTALLATION

- A. The CONTRACTOR shall assemble and install all equipment, special parts and accessories as shown on pool drawings, specifications and shop drawings of the equipment suppliers.
- B. The CONTRACTOR shall provide all anchors and inserts to be imbedded in the deck including all fittings, inserts and structure sleeves and required anchorage as shown on the plans and as indicated in this section of the specifications. Equipment shall be set true and plumb, using factory jigs where available. Removable equipment items shall be easily removable from anchors and shall fit without noticeable wobble.
- C. Provide templates for all equipment anchors. Provide anchor bolts of the size and spacing as required by the equipment manufacturer. All anchor bolts shall be stainless steel Type 316L and of a length capable of adequate anchorage into rough slab-on-grade allowing for finish deck tile and setting bed. Anchors shall be set and cast into place during building concrete work. Inspect all anchor settings for horizontal and vertical alignment prior to placing concrete.
- D. The CONTRACTOR shall install all equipment and systems in accordance with manufacturer's directions. Equipment shall all be assembled and in place for final observation.
- E. All items necessary to complete this section are shown on the plans or described in the specifications including items that may be purchased by the Owner. Items are detailed and specified as a guide for dimensional purposes. The CONTRACTOR must make provisions accordingly and submit shop drawings and submittals based on that data.

3.8 START-UP AND INSTRUCTION

- A. The CONTRACTOR shall supply the services of an experienced swimming pool operator/instructor for a period of not less than two days (total 16 hours) after the pool has been filled and initially placed in operation. During this period, the Owner's representatives who will be operating the pool shall be thoroughly instructed in all phases of the pool's operation. The CONTRACTOR shall deliver six (6) complete sets of operating and maintenance instructions for the swimming pool, structures, finishes and all component equipment. Prior to leaving the job, the CONTRACTOR shall obtain written certification from the designated Owner's representative acknowledging that the instruction period has been completed and all necessary operating information provided. The CONTRACTOR shall, in his contract, include the cost of two (2) additional days (total 16 hours) of instruction and operational check out by the qualified representative of the CONTRACTOR during the first season of operation.

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SWIMMING POOL

- B. Written reports of each of these visits outlining the pool's operation, competence and performance of the pool's operation personnel, and other pertinent comments shall be submitted to the Owner and Architect/Engineer within one (1) week after each visit.
- C. The CONTRACTOR shall provide specific written procedures to be followed for emptying and refilling the pool as mentioned previously in this section. The procedures must be included in the bound volume of operating instructions and references in the front index with a note headed by the words: "CAUTION -- VERY IMPORTANT".

****END OF SECTION****

SWIMMING POOL 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. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes for the following:

- 1. Swimming pool:
 - a. Bottom slab(s).
 - b. Walls
 - c. Miscellaneous features, slabs on grade and all other elements.
- 2. Surge tank:
 - a. Bottom slab, walls and top slab.

- B. Related Requirements:

- 1. Division 03 for all concrete not related to swimming pool construction.
- 2. Division 03 or Division 13 for water tightness testing.
- 3. Section 131102 "Swimming Pool Shotcrete". Shotcrete may be substituted for swimming pool cast-in-place walls.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 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 Pool 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, forms and form removal limitations, anchor rod and anchorage device installation tolerances if required for equipment installation, under slab pipe encasement requirements, and concrete protection.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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. Indicate amounts of mixing water to be withheld for later addition at Project site.
- 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.
 1. Location of construction joints is subject to approval of the Engineer.
- E. Samples: For waterstops.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.

5. Waterstops.
6. Curing compounds.
7. Bonding agents.
8. Joint-filler strips, if required.
9. Repair materials.
10. Dowel bar substitutes.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.7 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 Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. 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.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.8 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.

1.9 FIELD CONDITIONS

- A. 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 (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 - 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.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:
 - 1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301 (ACI 301M).
 - 2. ACI 117 (ACI 117M).

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.

- B. 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.
- C. Void Forms (if indicated on drawings): Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2.4 REINFORCEMENT ACCESSORIES

- A. 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:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- B. Dowel Bar Substitutes: Tapered, threaded couplers, pre-assembled to reinforcing with mounting plate for attachment to form work and a pressed in metal disc thread protector which can be easily removed. The mechanical connection shall meet building code requirements of developing in tension or compression. The mechanical connection shall be the positive locking, taper threaded type coupler manufactured from high quality steel. The bar ends must be taper threaded using the manufacturer's requirements.
 - 1. Lenton Form Saver; Erico Corp.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I/II, gray.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded. 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. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do 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.
- F. Water: ASTM C 94/C 94M and potable.

2.6 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Sika Greenstreak.
 - b. Vinylex Waterstop & Accessories.
 - 2. Profile: Ribbed without center bulb, non-tapered.

3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick); nontapered.
- B. Non-Expanding Plastic Adhesive Waterstops: Manufactured rectangular or trapezoidal strip, single-component, self-sealing adhesive compound, for adhesive bonding to concrete, 5/8 by 1-1/2 inch.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Synko-Flex SF302, Henry Company.
 - 1) Synko-Flex SF311 Solvent Based Primer.

2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation-Construction Systems; Confilm.
 - b. ChemMasters, Inc; Spray-Film.
 - c. Dayton Superior; AquaFilm J74RTU.
 - d. Euclid Chemical Company (The); an RPM company; Eucobar.
 - e. L&M Construction Chemicals, Inc; E-CON.
 - f. Metalcrete Industries; Waterhold.
 - g. Sika Corporation; Caltexol CIMFILM.
 - h. TK Products; TK-2120 TRI-FILM.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of pool finish.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation-Construction Systems; MasterKure CC 200 WB (Pre-2014: Kure-N-Seal W).

- b. Dayton Superior; Cure & Seal 1315 J22 WB.
- c. Euclid Chemical Company (The); an RPM company; Diamond Clear VOX.
- d. L&M Construction Chemicals, Inc; Dress & Seal WB.
- e. SpecChem, LLC; Cure & Seal WB 25.
- f. W.R. Meadows, Inc; Vocomp-20.

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
 - 1. Provide for cast-in-place concrete coping.
- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dayton Superior Corporation; Conspec Strong Bond.
 - b. Euclid Chemical Company (The), an RPM company; Flex-Con.
 - c. W. R. Meadows, Inc.; Sealtight Acry-Lok.
 - d. Kaufman Products, Inc.; Surebond.

2.9 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Xypex Concrete Waterproofing by Crystallization, Xypex Chemical Corporation.
 - a. Xypex Concentrate.
 - 2. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 3. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 4. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 - 5. Compressive Strength: Not less than 4100 psi (29 MPa) 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 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Xypex Concrete Waterproofing by Crystallization, Xypex Chemical Corporation.
 - a. Xypex Concentrate.
 2. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 3. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 4. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 5. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, 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 water-reducing admixture in pumped concrete and concrete with a w/c ratio below 0.50.

2.11 CONCRETE MIXTURES FOR SWIMMING POOL ELEMENTS

- A. Slabs, Walls, Coping and Other Elements: Normal-weight concrete.
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 2. Maximum W/C Ratio: 0.42.
 3. Minimum Cement Content: 600 lb/cu. yd.

4. Slump Limit: 4 inches (100 mm), 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

2.12 FABRICATING REINFORCEMENT

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

2.13 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 (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2.14 DRAINAGE FILL

- A. Drainage Course under bottom slabs: Narrowly graded mixture of frost-free, washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), 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 (ACI 117M).
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
 2. Class D, 1 inch (25 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct 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. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
 1. Comply with pool and gutter profile shown if edges not shown to be chamfered.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

- 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. If required for equipment or piping installation, install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

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 (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not 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 Engineer.

3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that 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. Dowel bar substitutes may be used in lieu of lap splices.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. 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 (38 mm) into concrete.
 - 3. Locate joints for beams and slabs 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 slabs and beams.
 - 5. Vertical joints in walls shall be located at corners, and in concealed locations where possible.
 - 6. Use a bonding agent:

- a. At locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - b. At cove joint where cove mortar is placed against hardened wall and slab.
 - c. At coping where coping is placed against hardened wall.
- C. Contraction Joints in Slabs: No contraction joints shall be placed in pool bottom slab.
- D. Joints in Coping:
- 1. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated, or, 2 feet maximum. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - a. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - b. Isolation Joints: Install vertical joint-filler strips at _ feet.
 - 1) Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants are indicated.

3.7 WATERSTOP INSTALLATION

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Non-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.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. 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 not to 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 (ACI 301M).
 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 (150 mm) 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.
 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.

3.9 FINISHING FORMED SURFACES

- 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. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. 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 SLABS AND WALLS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Verify all finish requirements with swimming pool finish subcontractor before finishing concrete.
 - 1. Provide certification, with swimming pool finish subcontractor, that concrete finish complies with manufacturer's recommendations for final pool finish.
- C. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
 - 1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- D. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish.
- E. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten 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 ceramic tile, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3.2 mm).

3.11 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. 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.

3.12 CONCRETE PROTECTING AND CURING

- 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 (ACI 301M) 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 (1 kg/sq. m 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, 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 remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- 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 (300-mm) 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 (300 mm), 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.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) 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.

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1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). 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 matches 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 Engineer.
- 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.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced 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 (6 mm) 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 (25 mm) 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 (19-mm) 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 (25 mm) 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. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Headed bolts (if required for equipment and piping installation).
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.
 - 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M 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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231/C 231M, 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 (4.4 deg C) and below or 80 deg F (27 deg C) 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.
 - 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.

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- a. 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. 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 (3.4 MPa).
8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
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 Engineer. Testing and inspecting 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 Engineer.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION

SWIMMING POOL SHOTCRETE

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 shotcrete applied by dry-mix or wet-mix process for the following:
 - 1. Swimming pool walls.
- B. Related Sections include the following:
 - 1. Division 13 Section "Swimming Pools" for pool shell tolerances and other items.
 - 2. Division 13 Section "Swimming Pool Cast In Place Concrete" for pool bottom slabs and other pool-related structures.
 - 3. Division 13 Section "Swimming Pool Cast In Place Concrete" for pool coping.
 - 4. Division 03 or Division 13 for water tightness testing.

1.3 DEFINITIONS

- A. Shotcrete: Mortar or concrete pneumatically projected onto a surface at high velocity.
- B. Dry-Mix Shotcrete: Shotcrete with most of the mixing water added at nozzle.
- C. Wet-Mix Shotcrete: Shotcrete with ingredients, including mixing water, mixed before introduction into delivery hose.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product including reinforcement and forming accessories, shotcrete materials, admixtures, and curing compounds.
- B. Design Mixtures: For each shotcrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. For predampened dry-mix mixtures, indicate amounts of mixing water to be added to the dry-mix materials before mixing and conveying through the delivery hose.

- C. Shop Drawings: For shotcrete installation. Include support and anchor details; reinforcement materials and grades and details of fabricating, bending, and placing reinforcement; number and location of splices; special reinforcement required for openings through shotcrete structures; formwork materials and details of formwork fabrication, assembly, and support; and locations of proposed construction joints.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each of the following:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials.
- C. Preconstruction Test Reports: For shotcrete.
- D. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer employing nozzle operators for the Project, each of whom attains mean core grades not exceeding 2.5, according to ACI 506.2, on preconstruction tests, is ACI Shotcrete Nozzleman certified in Dry-Mix Process for Vertical Position, is ACI Shotcrete Nozzleman certified in Wet-Mix Process for Vertical Position as appropriate to the required shotcrete work.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. ACI Publications: Comply with ACI 506.2, "Specification for Shotcrete," unless modified by requirements in the Contract Documents.
- D. Shotcrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design shotcrete mixtures.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing and inspections indicated below:
 - 1. Produce shotcrete test panels before shotcrete placement according to requirements in ACI 506.2 and ASTM C 1140 for each design mixture, shooting orientation, and nozzle operator. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of average thickness of shotcrete, but not less than 3-1/2 inches (90 mm).
 - 2. From each test panel, testing agency will obtain six test specimens: one set of three specimens unreinforced and one set of three specimens reinforced. Agency will perform the following:

- a. Strength Testing: Test each set of unreinforced specimens for compressive strength according to ASTM C 42/C 42M.
- b. Core Grading: Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms: Form-facing panels that will provide continuous, straight, smooth, concrete surfaces. Furnish panels in largest practical sizes to minimize number of joints.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice" and as follows:
 - 1. For uncoated reinforcement, use all-plastic bar supports.
- C. Reinforcing Anchors: ASTM A 36/A 36M, unheaded rods or ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), hex-head bolts; carbon steel; and carbon-steel nuts.

- 1. Finish: Plain, uncoated.

2.3 SHOTCRETE MATERIALS

- A. Source Limitations for Shotcrete: Obtain each color, size, type, and variety of shotcrete material and shotcrete mixture from single manufacturer with resources to provide shotcrete of consistent quality in appearance and physical properties.
- B. Portland Cement: ASTM C 150, Type I or Type III. Use only one brand and type of cement for Project.
 - 1. Fly Ash: ASTM C 618, Class C or Class F.
- C. Normal-Weight Aggregates: ASTM C 33, from a single source, and as follows:
 - 1. Combined Aggregate Size: ACI 506R or ASTM C 1436, Grading No. 2 sieve analysis.
- D. Water: Potable, complying with ASTM C 94/C 94M, free from deleterious materials that may affect color stability, setting, or strength of shotcrete.
- E. Ground Wire: High-strength steel wire, 0.8 to 1.0 mm in diameter.
- F. Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.4 ADMIXTURES

- A. General: ASTM C 1141, Class A (liquid) or Class B (non-liquid), but limited to the following admixture materials. Provide admixtures for shotcrete that contain not more than 0.1 percent chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.
 - 1. Accelerating Admixture, Conventional: ASTM C 494/C 494M, Type C or Type E.
 - 2. Pozzolanic Admixture: Fly ash, ground granulated blast-furnace slag, and silica fume as limited in "Shotcrete Materials" Article.
 - 3. Coloring Admixture: Coloring agent as limited in "Shotcrete Materials" Article.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry, or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.6 SHOTCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of shotcrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 506.2.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based laboratory trial mixture or field test data, or both.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Cementitious Materials: Limit use of fly ash to not exceed, in combination, 15 percent of portland cement by weight.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement or cementitious materials permitted by ACI 301.
- E. Admixtures: When included in shotcrete design mixtures, use admixtures according to manufacturer's written instructions.
- F. Design-Mixture Adjustments: Subject to compliance with requirements, shotcrete design-mixture adjustments may be proposed when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.7 SHOTCRETE MIXTURES

- A. Shotcrete Mixture: Proportion mixture to provide shotcrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
2. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight wet-mix shotcrete having an air content before pumping of 8 percent with a tolerance of plus or minus 1-1/2 percent.

2.8 SHOTCRETE EQUIPMENT

- A. Mixing Equipment: Capable of thoroughly mixing shotcrete materials in sufficient quantities to maintain continuous placement.
- B. Dry-Mix Delivery Equipment: Capable of discharging aggregate-cement mixture into delivery hose under close control and maintaining continuous stream of uniformly mixed materials at required velocity to discharge nozzle. Equip discharge nozzle with manually operated water-injection system for directing even distribution of water to aggregate-cement mixture.
 1. Provide uniform, steady supply of clean, compressed air to maintain constant nozzle velocity while simultaneously operating blow pipe for cleaning away rebound.
 2. Provide water supply with uniform pressure at discharge nozzle to ensure uniform mixing with aggregate-cement mix. Provide water pump to system if line water pressure is inadequate.
- C. Wet-Mix Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously.

2.9 BATCHING AND MIXING

- A. Dry-Mix Process: Measure mixture proportions by weight batching according to ASTM C 94/C 94M or by volume batching complying with ASTM C 685/C 685M requirements.
 1. In volume batching, adjust fine-aggregate volume for bulking. Test fine-aggregate moisture content at least once daily to determine extent of bulking.
 2. Prepackaged shotcrete materials may be used at Contractor's option. Predampen prepackaged shotcrete materials and mix before use.
- B. Wet-Mix Process: Measure, batch, mix, and deliver shotcrete according to ASTM C 94/C 94M and furnish batch ticket information.
 1. Comply with ASTM C 685/C 685M when shotcrete ingredients are delivered dry and proportioned and mixed on-site.

2.10 RELATED MATERIALS

- A. Latex Bonding Agent: ASTM C 1059/C 1059M, Type II.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following;
 - a. Latex Bonding Agent, Type II (Non-Redispersible):
 - 1) Dayton Superior Corporation; Conspec Strong Bond.

- 2) Euclid Chemical Company (The), an RPM company; Flex-Con.
- 3) W. R. Meadows, Inc.; Sealtight Acry-Lok.
- 4) Kaufman Products, Inc.; Surebond

2.11 REPAIR MATERIALS

- A. Concrete Patching Mortar: Chemical treatment for waterproofing concrete.
 1. Xypex Concrete Waterproofing by Crystallization, Xypex Chemical Corporation.
 - a. Xypex Concentrate.

2.12 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 1. Available Manufacturers:
 - a. Bometals, Inc.
 - b. Greenstreak.
 - c. Meadows, W. R., Inc.
 - d. Murphy, Paul Plastics Co.
 - e. Progress Unlimited, Inc.
 - f. Tamms Industries, Inc.
 - g. Vinylex Corp.
 2. Profile: Ribbed without center bulb.
 3. Dimensions: 4 inches by 3/16 inch thick (150 mm by 10 mm thick); nontapered.
- B. Non-Expanding Plastic Adhesive Waterstops: Manufactured rectangular or trapezoidal strip, single-component, self-sealing adhesive compound, for adhesive bonding to concrete, 5/8 by 1-1/2 inch.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Synko-Flex SF302, Henry Company.
 - 1) Synko-Flex SF311 Solvent Based Primer.

2.13 DRAINAGE FILL

- A. Drainage Course under bottom slabs: Narrowly graded mixture of frost-free, washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with

100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Concrete: Before applying shotcrete, remove unsound or loose materials and contaminants that may inhibit shotcrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces to saturated, surface-dry condition before shotcreting.
 - 1. Abrasive blast or hydroblast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper shotcrete bonding.
- B. Earth: Compact and trim to line and grade before placing shotcrete. Do not place shotcrete on frozen surfaces. Dampen surfaces to saturated, surface-dry condition before shotcreting.
- C. Rock: Clean rock surfaces of loose materials, mud, and other foreign matter that might weaken shotcrete bonding. Dampen surfaces to saturated, surface-dry condition before shotcreting.
- D. Steel: Clean steel surfaces by abrasive blasting according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.2 FORMS

- A. General: Design, erect, support, brace, and maintain forms, according to ACI 301, to support shotcrete and construction loads and to facilitate shotcreting. Construct forms so shotcrete members and structures are secured to prevent excessive vibration or deflection during shotcreting.
 - 1. Fabricate forms to be readily removable without impact, shock, or damage to shotcrete surfaces and adjacent materials.
 - 2. Construct forms to required sizes, shapes, lines, and dimensions using ground wires and depth gages to obtain accurate alignment, location, and grades in finished structures. Construct forms to prevent mortar leakage but permit escape of air and rebound during shotcreting. Provide for openings, offsets, blocking, screeds, anchorages, inserts, and other features required in the Work.
- B. Form openings, chases, recesses, bulkheads, keyways, and screeds in formwork. Determine sizes and locations from trades providing such items. Accurately place and securely support items built into forms.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.

- C. Securely embed reinforcing anchors into existing substrates, located as required.
- D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports, bolsters, chairs, spacers, and other devices as required to maintain minimum concrete cover.
- E. Set wire ties with ends directed into shotcrete, not toward exposed shotcrete surfaces.

3.4 WATERSTOPS

- A. Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions. Prevent displacement during shotcrete application.

3.5 JOINTS

- A. General: Construct joints at locations indicated or as approved by Architect.
- B. Construction Joints: Locate and install construction joints tapered to a 1:1 slope where joint is not subject to compression loads and square where joint is perpendicular to main reinforcement. Continue reinforcement through construction joints unless otherwise indicated.

3.6 ALIGNMENT CONTROL

- A. Ground Wires: Install ground wires to establish thickness and planes of shotcrete surfaces. Install ground wires at corners and offsets not established by forms. Pull ground wires taut and position adjustment devices to permit additional tightening.

3.7 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by shotcrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.8 APPLICATION

- A. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.
- B. Moisten wood forms immediately before placing shotcrete where form coatings are not used.
- C. Apply shotcrete according to ACI 506.2.
- D. Apply dry-mix shotcrete materials within 45 minutes after predampening and wet-mix shotcrete materials within 90 minutes after batching.
- E. Deposit shotcrete continuously in multiple passes, to required thickness, without cold joints and laminations developing. Place shotcrete with nozzle held perpendicular to receiving surface. Begin shotcreting in corners and recesses.
 - 1. Remove and dispose of rebound and overspray materials during shotcreting to maintain clean surfaces and to prevent rebound entrapment.

- F. Maintain reinforcement in position during shotcreting. Place shotcrete to completely encase reinforcement and other embedded items. Maintain steel reinforcement free of overspray, and prevent buildup against front face during shotcreting.
 - G. Do not place subsequent lifts until previous lift of shotcrete is capable of supporting new shotcrete.
 - H. Do not permit shotcrete to sag, slough, or dislodge.
 - I. Remove hardened overspray, rebound, and laitance from shotcrete surfaces to receive additional layers of shotcrete; dampen surfaces before shotcreting.
 - J. Do not disturb shotcrete surfaces before beginning finishing operations.
 - K. Remove ground wires or other alignment-control devices after shotcrete placement.
 - L. Shotcrete Core Grade: Apply shotcrete to achieve mean core grades not exceeding 2.5 according to ACI 506.2, with no single core grade exceeding 3.0.
 - M. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117, increased by a factor of two.
 - N. Cold-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 306.1 and as follows. Protect shotcrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. Discontinue shotcreting when ambient temperature is 40 deg F (4.4 deg C) and falling.
 - 2. Uniformly heat water and aggregates before mixing to obtain a shotcrete shooting temperature of not less than 50 deg F (10 deg C) and not more than 90 deg F (32 deg C).
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place shotcrete on frozen surfaces or surfaces containing frozen materials.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
 - O. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to recommendations of ACI 305R when hot-weather conditions and high temperatures would seriously impair quality and strength of shotcrete, and as follows:
 - 1. Cool ingredients before mixing to maintain shotcrete temperature at time of placement below 100 deg F (38 deg C) for dry mix or 90 deg F (32 deg C) for wet mix.
 - 2. Reduce temperature of reinforcing steel and receiving surfaces below 100 deg F (38 deg C) before shotcreting.
- 3.9 SURFACE FINISHES
- A. General: Finish shotcrete according to descriptions in ACI 506R.
 - B. Natural Finishes:
 - 1. Gun Finish: Natural undisturbed finish as sprayed.

2. Rod Finish: Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set. Do not push or float with flat part of trowel.
 3. Broom Finish: Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set; followed by uniform brooming.
- C. Flash-Coat Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply up to 1/4-inch (6-mm) coat of shotcrete using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 (4.75-mm) sieve to provide a finely textured finish.
- D. Flash-Coat with Final Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply up to 1/4-inch (6-mm) coat of shotcrete using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 (4.75-mm) sieve, and apply wood-float finish.
- 3.10 CURING
- A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.
- B. Begin curing immediately after placing and finishing but not before free water, if any, has disappeared from shotcrete surface.
- C. Curing Exposed Surfaces: Cure shotcrete by one 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. Water-saturated absorptive covers or moisture-retaining covers. Lap and seal sides and ends of covers with 12-inch (300-mm) lap over adjacent covers.
 2. Curing Compound: Apply uniformly in continuous operation by power spray 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.
 - a. Apply curing compound to natural gun finish or flash-coat shotcrete at rate of 1 gal./100 sq. ft. (1 L/2.5 sq. m).
- D. Curing Formed Surfaces: Cure formed shotcrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- 3.11 FORM REMOVAL
- A. Forms not supporting weight of shotcrete may be removed after curing for 24 consecutive hours at not less than 50 deg F (10 deg C), provided shotcrete is hard enough not to be damaged by form-removal operations and provided curing and protecting operations are maintained.

1. Leave forms supporting weight of shotcrete in place until shotcrete has attained design compressive strength. Determine compressive strength of in-place shotcrete by testing representative field-cured specimens of shotcrete.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are unacceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- 3.12 FIELD QUALITY CONTROL
- A. Testing Agency: Owner will engage a qualified testing agency to sample materials, visually grade cores, perform tests, and submit reports during shotcreting.
- B. Air Content: ASTM C 173/C 173M, volumetric method or ASTM C 231, pressure method; one test for each compressive-strength test for each mixture of air-entrained, wet-mix shotcrete measured before pumping.
- C. Shotcrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
- D. Test Panels: Make a test panel, reinforced as in structure, for each shotcrete mixture and for each workday or for every 50 cu. yd. (38 cu. m) of shotcrete placed, whichever is less. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of thickness and reinforcing layout of shotcrete work on project. Testing agency will obtain sets of test specimens from each test panel.
1. Compressive Strength Testing: One set of three unreinforced specimens. Test each set of unreinforced specimens for compressive strength according to ASTM C 1140 and construction testing requirements in ACI 506.2.
 2. Visual Core Grading: One set of three reinforced specimens. Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.
- E. In-Place Shotcrete Testing: : Only if samples obtained in item D indicate unsatisfactory shotcrete, and only if directed by Owner, Architect or Engineer, take a set of 3 unreinforced cores for each mix and for each workday or for every 50 cu. yd. (38 cu. m) of shotcrete placed; whichever is less. Do not cut steel reinforcement.
- F. Strength of shotcrete will be considered satisfactory according to the following:
1. Specimen Cores: Mean compressive strength of each set of three unreinforced cores equals or exceeds 85 percent of specified compressive strength, with no individual core less than 75 percent of specified compressive strength.
 2. Specimen Cubes: Mean compressive strength of each set of three unreinforced cubes shall equal or exceed design compressive strength with no individual cube less than 88 percent of specified compressive strength.

3.13 REPAIRS

- A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets exceeding limits for specified core grade of shotcrete.
 - 1. Remove unsound or loose materials and contaminants that may inhibit bond of shotcrete repairs.
 - 2. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders.
 - 3. Dampen surfaces and apply new shotcrete.
- B. Repair core holes from in-place testing according to repair provisions in ACI 301, except do not use shotcrete. Match adjacent color and finish.

3.14 CLEANING

- A. Immediately remove and dispose of rebound and overspray materials from final shotcrete surfaces and areas not intended for shotcrete placement.

END OF SECTION

WATERSLIDES

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 the work specified in this section.

1.2 SUMMARY

- A. Furnish all labor, material, equipment and services for installation of the fiberglass waterslides including all foundations, anchor bolts and support structure.
- B. The outdoor waterslides shall have an approximate slide length of 102.26' and 82.50' lineal feet respectively at the centerline, a vertical drop of approximately 14.58' feet and consist of multiple turns, entry sections and straight sections as shown on the project plans.
- C. Provide minimum interior cross section, 36 inch wide x 28 inch deep, with the side riser on the outside of curves forming a 230 degree enclosure. Splashguards on the outside of slide high wall, as necessary, must be an integral part of slide section. Bolt-on sections are not permitted.
- D. Design, furnish and install foundation system, structural supports and all other related work to meet specified and indicated criteria.
- E. Furnish and install fiberglass waterslides as indicated on the Drawings, specified herein, and as necessary for proper completion including, but is not necessarily limited to:
 - 1. All fiberglass flume components.
 - 2. All flume structural support systems including foundations and support columns.
 - 3. All tower, platforms, stairways and related supports.
 - 4. Installation supervision, ride testing and certification.
 - 5. Labor, materials and equipment to complete the installation.
 - 6. Operations and maintenance manuals.
 - 7. On site startup training.
 - 8. Proper signage as required.
- F. Related work specified elsewhere
 - 1. All demolition and repairs to decks, fences and landscaping.
 - 2. Construction of concrete drilled pier or spread footer foundations, columns and flatwork as required.
 - 3. All electrical works, buildings, permits and modifications if any to the pool.
 - 4. Supply and installation of mechanical equipment and pool piping as necessary for slide operation.

1.3 QUALITY ASSURANCE

- A. Supplier shall demonstrate their specific experience and competency in the manufacturing and installation of waterslides.
- B. The supplier shall have completed at least five installations comparable to the system specified herein within the last 5 years. Submit a list of such projects with name, address and current telephone number of the Owner's operator and Architect of Record to the Architect with bid on bid date.
- C. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligation of the contract and to complete work described or if bidder does not have the qualifications stated herein.

1.4 REGULATORY AGENCY REQUIREMENTS AND ENGINEERING SERVICES

- A. In addition to complying with all applicable codes and regulations, comply with pertinent recommendations contained in:
 - 1. Waterslide flumes shall comply with "WWA Considerations for Operating Safety", 1989, as published by the World Waterpark Association.
 - 2. "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.
 - 3. "Code for Welding in Building Construction" of the American Welding Society.
 - 4. "Specifications for Architecturally Exposed Structural Steel" of the American Institute of Steel Construction.
 - 5. "Manual of Standard Practice for Detailing Reinforced Concrete Structures", Publication ACI 315-92 of the American Concrete Institute.
 - 6. "Structural Concrete for Buildings", Publication ACI 301-96 of the American Concrete Institute.
 - 7. "ASTM" requirements for all steel components, of the American Society of Testing Materials.
- B. Where provisions of pertinent codes and standards conflict with this specification, the more stringent shall govern.

1.5 COORDINATION AND CLARIFICATION

- A. Coordinate with other trades affecting and affected by work in this section.
- B. The CONTRACTOR must establish with the selected waterslide installer and with other trades having related work in this Section that all work necessary to complete the installation is included in his bid to the General Contractor. Further the waterslide supplier in his bid to the CONTRACTOR will list specifically those items of related work not included in his proposal.
- C. When in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the CONTRACTOR and/or supplier shall notify the Architect and request a clarification prior to the bid date.

1.6 CONTRACTORS ALTERNATIVE PROPOSAL

- A. Suppliers to submit their bid based on materials, equipment and methods as specified in this section. Any substitutions of material, equipment or method must be submitted in accordance with the specified procedure described in Division 1. Any required changes to the construction documents shall be described in writing and any costs or changes must be included in the price quoted to complete the installation.
- B. Pool Alternate
 - 1. Alternate #1: Provide 76' Poolside Waterslide, item #65-370, in lieu of the fiberglass waterslides and tower structure detailed on the drawings and specified in section 131413. The feature pumps and piping shall be replaced with a single 2" Schedule 80 PVC supply off of the recirculation pump capable of 20 GPM flow. Water depth to be modified from 3.5' in the base bid at the slide plunge area to 4.0' per manufacturer's requirements.

1.7 SUBMITTALS

- A. Division 1 requirements.
- B. Shop Drawings
 - 1. Provide a complete set of checked shop drawings required to fabricate and assemble all systems that is signed and sealed by a Licensed Professional Engineer in the State of Michigan.
 - 2. Statements
 - a. Furnish the Owner with copies of all permits and receipts for fee payments.
 - 3. Test Reports
 - a. Submit a sample form of any performance test reports that will be used by the installer following slide erection, prior to beginning slide installation.
- C. Include complete product data indexed, tabbed and referenced to specifications.
- D. Include complete shop drawings, directly from the manufacturer at appropriate scale, illustrating the fabrication and installation of the waterslide and support structure.
- E. Submit engineering design calculations that are prepared and sealed by a Professional Engineer licensed in the State of Michigan, with shop drawings for waterslide layouts, structures and footings. Provide rough-in information for interfacing mechanical and electrical work. Shop drawings shall include plans, elevations, cross sections, details, sleeves, inserts and anchors to be cast into concrete, and calculations required to construct the waterslide and associated feature footing structures. Structural drawings shall clearly identify all reinforcement, construction joints, embedded items including waterstops, excavation lines and finish concrete elevations, under drainage requirements, under drain routing, clean out locations and location dimensions of all accessory items provided under this section. A licensed professional engineer shall utilize existing soils and geotechnical data in the preparation of the structural design criteria. Provide all design calculations and support data required to show compliance with performance requirements specified, including design assumptions concerning element restraint. All calculations shall be certified and sealed by the licensed professional engineer. Provide a design in response to actual site conditions.
- F. Installation of the waterslide and associated feature footings shall not commence until detailed plans and specifications are approved by the department of Building and Safety. The

responsibility for all costs associated with obtaining such approval shall be part of the General Construction contract.

- G. Specify water supply requirements and required pump characteristics to Architect, for approval, prior to preparation of fabrication drawings.
- H. Guarantee / Warranty
 - 1. All work of this section shall be warranted against all defects of material and/or application for a period of one (1) year from date of acceptance. Any failures that may occur within this warranty period, due to defective installation and/or materials, shall upon written notification of such failure be immediately repaired or replaced.

1.8 MAINTENANCE MANUALS AND CLOSE-OUT SUBMITTALS

- A. Submit six (6) bound volumes of complete operating and maintenance instructions covering all installed equipment. Include wiring diagrams, lubrication and user maintenance instructions.
- B. Include manufacturer's recommended maintenance schedule, parts lists, piping diagram and troubleshooting information.
- C. Include one set of approved submittals as a part of each O & M manual.
- D. Certification letter: Provide a certification letter from the slide manufacturer to the owner stating that the slide has been installed properly and is functioning according to the slide manufacturer's recommendations.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver material in manufacturer's original, unopened containers and crates with all labels intact and legible.
- B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.
- C. Handle materials in a manner to prevent damage.
- D. Store all materials on clean raised platforms with weather protective covering when stored outdoors. Provide continuous protection of materials against damage or deterioration.

PART 2 - PRODUCTS

2.1 SLIDE CONFIGURATIONS

- A. The preliminary slide layouts have been developed utilizing a slide path design provided by Splashtacular, La Quinta, California 1-800-844-5334.
- B. Slides by WhiteWater, Columbus, OH 614-485-9500 or 800-775-4337 and AquBlue International, Cornelius, NC 800-270-1029 are acceptable provided they meet deck accessibility and support tower requirements without design changes.

2.2 FIBERGLASS FLUME SLIDE COMPONENTS

- A. Fiberglass Laminate Materials
 - 1. Gel Coat

- a. Interior gel coat shall be high quality isophthalic polyester with U.V. inhibitors. 18 to 20 mil thick ride surface, 20 mils exterior coating. Translucent fiberglass shall also have exterior UV protection clear coat.
 2. Resins
 - a. Thixotropic promoted low profile polyester resin with alternate layers of continuous roving chop and 18 oz. woven roving.
 3. Structure
 - a. Fiberglass lamination with sandwich panel centerline reinforcement. Standard flume section shall be 3/16 inch thick, minimum weight 20 oz. per square foot. Flanges shall be minimum 1/4 inch thick and extend at least 4-3/4 inch from the slide surface, "L" type.
 4. No fill material to fiberglass slide other than aforementioned products shall be allowed without written approval prior to erection.
- B. Joints, Connections and Seams
1. Flume to flume joints shall be fastened with 3/8 inch stainless steel bolts, washers (2 per bolt) and self-locking nuts.
 2. Flume to support system connections shall be made with galvanized hardware, and shall be connected separately from waterslide section connections to the exterior flange of the flume.
 3. All connections shall be external to flume interior. No connection, hardware or penetration shall be made to flume interior.
 4. Fiberglass joint connections shall be made using waterproof, non-shrink caulking with suitable adhesion to fiberglass. Silicone sealants will not be permitted. The slide manufacturer shall supply caulking material.
 5. Using fiberglass over seams within the riding surface is not permitted. Sanding within the slide surface should be minimized to maintain adequate gel coat thickness and gloss. Any sanded areas shall be polished to a high gloss until undetectable.
- C. Color
1. Shall be integral to the fiberglass. The color shall be selected by the Architect and Owner from all available colors submitted with the bid in the form of color chart or color chips. Color variations within the inside and outside of slide shall be an option to the Owner.
- D. Waterslide shall be furnished with the following components:
1. Entry tray shall be pre-plumbed for water injection down stream of the rider entry point. Rider entry area shall be a non-skid surface, with no steps permitted.
 2. Waterslide shall be constructed so that water loss does not occur. Risers or built-up sections are required for ride safety and to control water loss, shall be provided on all curved flume sections. Risers shall be integral to the flume, and bolt-on sections will not be acceptable.
 3. Riser ends to provide a smooth transition at the beginning and ending of each riser shall be provided integral to the flume section.

4. Factory pre-drilling of all sections.
5. Waterproof joint sealant
6. Stainless steel assembly hardware

2.3 FLUME SLIDE STRUCTURAL SUPPORT SYSTEM

- A. The flume support towers, tower foundations and stair systems shall consist of all elements necessary to safely and securely support the fiberglass flume or tube from starting platform to the plunge pool and consist of:
1. Concrete footings and foundations, including excavation, backfill and compaction.
 2. Steel support columns.
 3. Structural steel tower and stair system.
 4. Guard railing, balustrades and handrails shall be painted galvanized steel tubing. Stainless steel railings are acceptable.
 5. All connecting hardware.
- B. Design of all slide supports and footings shall be certified by a Licensed Structural Engineer in the State of Michigan. Design shall accommodate the local soil conditions as indicated, and the stresses generated by the water flume ride during use.
- C. Concrete
1. Cast-in-place
 - a. Minimum compressive strength shall be 3,000 psi at 28 days. Maximum size aggregate shall be $\frac{3}{4}$ inch. Slump shall not be more than 3 inches. Concrete shall be vibrated but not excessively so as to cause segregation of materials. Check all applicable drawings for locations of block-outs, anchors, inserts, etc. before concrete is placed.
 2. Reinforcing Steel
 - a. $F_y = 60,000$ psi min. for: ASTM A615 (deformed bar) or equivalent. ASTM A82 (welded wire fabric) or equivalent.
 3. Unless otherwise noted, concrete cover to reinforcing shall be as follows; Footing 3 in. and walls, pedestals and columns 1 $\frac{1}{2}$ in.
 4. All concrete procedures to conform to latest ACI Building Code.
 5. Steel reinforcing lap splices for concrete slab shall be a minimum of #6 bar diameter.
- D. Structural Steel
1. Shall consist of radial arms with end yoke type fastening assembly for each support point. (Note: A central column support with radial arms may be used to support circular sections of 180 degrees or greater.)
 2. Structural steel shall be new material of sizes and shapes listed in current AISC handbooks and as indicated on drawings.

3. Shapes and plates
 - a. ASTM A36 or equivalent minimum $F_y = 36,000$ psi (248.2 MpA)
4. Square structural section
 - a. ASTM A500 minimum $F_y = 46,000$ psi (317 MpA).
5. Round steel pipes
 - a. ASTM A53 Grade B minimum $F_y = 35,000$ psi (241.3 MpA).
6. Cast steel: ASTM A27 minimum $F_y = 35,000$ psi or equivalent.
7. Tension rods, bolts and anchor bolts: ASTM A36 minimum allowable tensile stress F_t -19,100 psi (131.7 MpA).
8. Structural bolts
 - a. ASTM A325, friction type or equivalent minimum allowable shear stress, F_v -21,000 psi (144.8 MpA). Minimum allowable tensile stress, F_t -44,000 psi (303.4 MpA).
9. Welding electrodes
 - a. E480XX electrode (E70XX). Minimum allowable shear stress, F_v -21,000 psi (144.8 MpA).
10. Grout
 - a. Masterflow 713 or approved equal non-shrink, non-metallic grout. Use as recommended by manufacturer.
11. All plates, shapes and tubes in contact are to be welded with $\frac{1}{4}$ inch minimum fillet welds all around unless otherwise indicated.
12. Unless otherwise noted all steel structure shall be galvanized.
13. CONTRACTOR shall supply temporary bracing to take care of all loads on the structure during erection to ensure the safety of the structure, leave as long as it is required, and remove when safety is assured.
14. All flumes and support arms shall be properly set and installed prior to installation of permanent column bracing. Additional column bracing as required by the engineer, in addition to those noted on the drawing, shall be provided upon site inspection.
15. All hollow structural sections shall be closed airtight with end plates sealed with welds.
16. All steel shall be thoroughly cleaned of all loose mill scale, loose rust, oil and dirt.
17. Surface to be welded shall be free from loose scale, rust, paint or other foreign matter. Care shall be taken to minimize stresses due to heat expansion, contraction and distortion by using proper sequence in welding and by other approved methods.
18. Fabrication and erection shall conform to the latest editions of the ASTM Specifications and Code of Practice; welding shall be done by welders certified with AWS-D-1.1
19. Equivalent structural steel sizes listed in current AISC or CISC Handbook may be used upon approval of the Architect/Engineer.

20. Definitions
 - a. ASTM – American Society of Testing Materials.
 - b. AISC – American Institute of Steel Construction
 - c. CISC – Canadian Institute of Steel Construction
- E. Column Systems
 1. A single or multiple steel post system shall be used.
- F. Starting Towers/Stairways/Railings
 1. The starting tower/stairway shall consist of:
 - a. A steel top deck, stair and support system supporting the starting chute for the outdoor slides. Guard railing, balustrades and handrails shall be galvanized steel tubing.
 - b. Painted galvanized steel or stainless steel handrails.
 - c. Bracing and structural support (non-corrodible).
 - d. Concrete Foundation, columns and flatwork as required by the design.
 2. Design
 - a. An Engineer licensed in the State of Michigan shall certify the structure design. Structure shall be sized to handle the user volumes, the height required by the flume length, and the location on the existing topography.
 - b. Stair design shall follow current UBC Code per State Building Codes.
 - c. Coordinate with slide manufacturer.
 3. Concrete Footings and Piers
 - a. Shall be designed and constructed to support the design loads.
 - b. All concrete shall have a minimum twenty-eight (28) day compressive strength of 4000 psi.
 - c. All footings shall be on undisturbed soil.
 - d. Vertical members shall be on concrete footings, above grade and be secured with flange plates and anchor bolts.
 4. Hardware
 - a. Steel hardware, ASTM A-7 or A-36 (hot dipped galvanized).
 - b. Bolts, Federal Specification FF-B-SC1.
 5. Starting Tower
 - a. Starting tower structure shall be constructed of a galvanized steel support deck with a slip resistant finish surface consisting of either a broom finish concrete or vinyl tread inserts. Coordinate design with building structural engineer and slide manufacturer.
 - b. Awning structure to cover upper slide platform that is designed for local wind loads shall be provided. Awning shall be high density knitted polyethylene cloth, with an

epoxy painted steel frame to support the structure. Bottom of awning shall be no less than 7.6 feet above platform. Awning color shall be selected by Architect.

6. Stairs and Railings
 - a. Prefabricated stairway sections shall include stringers constructed of hot dip galvanized steel. Stair treads and landings shall be of non-corrosive and impervious fiberglass or vinyl with appropriate non-slip surface. Colors to be chosen from waterslide manufacturer color chart. Stairway systems, handrails and guardrails shall comply with all applicable codes.
 - b. Rail system shall be a minimum of 42 inch high at any point, including height above starter tub section, non-climbable and designed to prevent accidental exit. Guard railing, balustrades and handrails shall be painted galvanized steel tubing. Stainless steel railings are acceptable. Handrails shall be provided to meet all code requirements. Color selection by Architect/Engineer and Owner.
 - c. Railing must surround top platform on all sides (except at slide start area). Railings must be provided along stair section and continue from the top platform area, down to the bottom of the finish deck.
 - d. Stair system from finish deck to top platform shall be a minimum of 36 inches in clear width.
 - e. A chain with removable self-closing hook and sign labeled "CLOSED" shall be provided across the entry of each waterslide at the top of the waterslide platform.
 - f. A swing gate with self-closing hook and sign labeled "CLOSED" shall be provided across the stair entry point on the deck of the waterslide.
 - g. Rules Signage: Provide two (2) rules signs with all manufacture's recommended waterslide rules. Mount one sign at the top platform and one (1) at the stair base. Both slide rule signs shall be clearly visible to the slide users.

7. Finish
 - a. All ferrous metal parts (All steel components of waterslide are to be factory painted with field touch-up as required.)
 - 1) Surface Preparation
 - a) Blast all surfaces to be coated to the extent of an SSPC-SP6 commercial-grade level of cleanliness. Create a 1.5 – 2.0 mil profile and prime before any rust bloom forms on the surface.
 - 2) Primer
 - a) Spray apply in the shop, one full coat of Tnemec Series 90-97 Aromatic Urethane Zinc-Rich or Amercoat 68 HS primer to a DFT of 4.0 mils. Allow to cure as per data sheet (4 hours at 75 deg. F.) before applying top coat.
 - 3) Top Coat
 - a) Spray apply in the shop one even finish coat of Tnemec Series 74-Color Endura-Shield. Acrylic Polyurethane or Ameron PSX-700 finish to a minimum DFT of 5.0 mils. Allow to cure as per data sheet (6 hours at 75 deg. F.) before handling/loading in the shop.
 - 4) Field Touchup
 - a) If the broken area of the shop applied film is rough from scaring, disc-abrade that area smooth and then solvent clean it as per an SSPC-

SP1, level of cleanliness. Brush or roller apply one coat of Tnemec Series 135 Chembuild or Ameron epoxy primer. Allow to cure as per data sheet. Brush or roller apply one coat of Tnemec Series 74 or Ameron PSX-700 shop applied color to bring the film up to specification thickness.

- b. Fiberglass handrail posts
 - 1) Finish
 - a) Tnemec Series 74 or Ameron PSX-700 shop applied at 5.0 mils DFT.
 - 2) Field Touchup
 - a) Tnemec Series 74 or Ameron PSX-700 shop applied at 5.0 mils DFT.
 - 3) Manufacturer
 - a) Tnemec 816/483-3400 or Amercoat 800/244-0025 or pre-approved equal.
- c. Piping
 - 1) All above grade plumbing to be Schedule 80 PVC, unless otherwise noted. Refer to drawings for sizes and connection details.
 - 2) All above grade waterslide piping to be painted to match waterslide tower color. Paint and primer to be approved for painted PVC application. Primer to be Pro Shield Waterborne Primer/Sealer (05-208) as manufactured by Columbia Paint & Coating; paint to be Industrial Acrylic DTM Polyurethane (05-502) as manufactured by Columbia Paint & Coating or approved equal. Contractor to confirm color with Architect on site prior to painting.
- d. Top deck and landing shall have a non-slip finish.
- e. The stair system and treads shall consist of galvanized steel pans with vinyl tread inserts. All stair treads and platform shall have a slip-resistant finish.
- f. All exposed concrete vertical surfaces shall have an exposed aggregate finish.
- g. Seal all concrete with a minimum of two (2) coats of H&C silicone acrylic concrete sealer, FLR Paints, Inc., 6104 31st St., East, Bradenton, FL.
- h. Colors shall be as selected by the Owner and Architect/Engineer.

PART 3 - EXECUTION

3.1 SYSTEMS INSTALLATION

- A. The waterslide installer shall assemble and install all equipment, special parts and accessories in accordance with these specifications and detailed layouts and shop drawings of equipment supplier.
- B. Installer shall furnish and install all anchors and inserts to be imbedded including all fittings, inserts, structure sleeves and required anchorage.
- C. Install all equipment and systems in accordance with manufacturer's directions.
- D. The waterslide shall be as described in the specifications. Items are detailed and specified as a guide reference and for dimensional purposes. The CONTRACTOR must make provisions accordingly and submit shop drawings and submittals based on that data.

- E. Installer shall coordinate, supervise and approve work by other trades responsible for work related to this section. All work in this section shall be performed by the waterslide installer except as noted.

3.2 SITE CONDITIONS

A. Inspection

1. Prior to installation of the work of this section, carefully inspect the installed work of other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that fiberglass slide and structural support systems may be fabricated and erected in strict accordance with the original design, the approved shop drawings and the referenced standards.

B. Discrepancies

1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies are fully resolved.

3.3 FABRICATION

- A. Fabricate the waterslide and structural support systems in strict accordance with the approved shop drawings and referenced standards.

3.4 INSTALLATION OF FOOTINGS AND FOUNDATIONS

- A. Foundations shall be installed in strict accordance with the approved shop drawings prepared by Professional Engineer registered in the State of Michigan.

3.5 WELDING

A. General

1. For details of joints, comply with requirements for AWS joints accepted without qualification tests.
2. Use ASTM A-233, E-70XX series electrodes.
3. Follow applicable sections of AWS specifications.

B. Types of welds unless otherwise noted

1. Make all fillet welds 1/4 inch minimum.
2. Make all butt welds full penetration welds.

3.6 ERECTION

A. General

1. Erect the fiberglass waterslides and structural support systems in strict accordance with the approved shop drawings and all pertinent regulations and standards.
- B. Tolerance
1. Align all structural steel straight, plumb and level with a tolerance of 1 in 500.
- C. Fiberglass Joints
1. All flange to flange connections shall be made utilizing the waterproof caulking supplied by the fiberglass manufacturer and shall be joined in such a way as to provide for a safe and matless ride. All joints shall be aligned for a completely smooth riding surface, that is, alignment must be within 1/64 inch and in no case shall the downstream side of the joint be above the upstream side of the joint.
- D. Steel Finishes
1. Any field welds or scarred surfaces shall be cleaned and cold galvanized with zinc rich paint.
- 3.7 CLEAN-UP
- A. Upon completion of the work of this Section, immediately remove all fiberglass, debris and rubbish occasioned by this work to the approval of the Architect and at no additional cost to the Owner.
- 3.8 START-UP AND INSTRUCTION
- A. Supply the services of an experienced operator/instructor after waterslides have been completed and initially placed in operation. During this period, the Owner's representatives who will be operating the pool shall be thoroughly instructed in all phases of the slide operation. Prior to leaving the job, obtain written certification from the designated Owner's representative acknowledging that the instruction period has been completed and all necessary operating information provided. A minimum of one (1) 2-hour session is required.
- 3.9 CONCLUSION
- A. It is the intention of these specifications to provide a complete installation of the waterslides as described. All accessory construction and apparatus necessary or advantageous in the operation or testing or high performance of the work shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving the waterslide supplier or installer from furnishing and installing such parts. Any such omission or clarification shall be brought to the attention of the Architect prior to bidding.

****END OF SECTION****

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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 work of this Section.

1.2 SUMMARY

- A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
3. ABMA - American Boiler Manufacturers Association; www.abma.com.
4. AGA - American Gas Association; www.aga.org.
5. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.

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6. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
7. ANSI - American National Standards Institute; www.ansi.org.
8. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
9. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
10. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
11. ASTM - ASTM International; www.astm.org.
12. AWS - American Welding Society; www.aws.org.
13. AWWA - American Water Works Association; www.awwa.org.
14. CDA - Copper Development Association; www.copper.org.
15. CGA - Compressed Gas Association; www.cganet.com.
16. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
17. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
18. CSI - Construction Specifications Institute (The); www.csiresources.org.
19. HI - Hydraulic Institute; www.pumps.org.
20. ICC - International Code Council; www.iccsafe.org.
21. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
22. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
23. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org
24. NADCA - National Air Duct Cleaners Association; www.nadca.com.
25. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
26. NEBB - National Environmental Balancing Bureau; www.nebb.org.
27. NECA - National Electrical Contractors Association; www.necanet.org.
28. NEMA - National Electrical Manufacturers Association; www.nema.org.
29. NETA - InterNational Electrical Testing Association; www.netaworld.org.
30. NFPA - National Fire Protection Association; www.nfpa.org.

31. NSF - NSF International; www.nsf.org.
 32. NSPE - National Society of Professional Engineers; www.nspe.org.
 33. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
 34. STI - Steel Tank Institute; www.steeltank.com.
 35. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
 36. UL - Underwriters Laboratories Inc.; www.ul.com.
 37. USGBC - U.S. Green Building Council; www.usgbc.org.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 PERFORMANCE REQUIREMENTS

- A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.5 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.
1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.
1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
 2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.
- C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

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- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.
- G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.6 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.
- D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.7 DRAWINGS

- A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.
- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.8 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.
- C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.
- D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
 - 1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.9 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
- B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 - 1. Equipment to be considered for prior approval shall be equal in quality, durability,

appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 SUBMITTALS

- A. Submit project specific submittals for review in compliance with Division 01.
- B. Prepare shop drawings to scale for the Architect/Engineer for review. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.
- C. All submittals shall be submitted in groupings of similar and/or related items. Plumbing fixture submittals shall be submitted as one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit shop drawing with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
- D. All submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned "Rejected".
- E. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
- F. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
 1. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
 2. Contractor is responsible for:
 - a. Dimensions, which shall be confirmed and correlated at the job site.
 - b. Fabrication processes and techniques of construction.
 - c. Quantities.
 - d. Coordination of Contractor's work with all other trades.
 - e. Satisfactory performance of Contractor's work.
 - f. Temporary aspects of the construction process.
- G. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.

1.12 COORDINATION DRAWINGS

- A. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
- B. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
- C. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- D. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
 - 1. Routine maintenance procedures.
 - 2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
 - 3. Trouble-shooting procedures.
 - 4. Contractor's telephone numbers for warranty repair service.
 - 5. Submittals.
 - 6. Recommended spare parts lists.
 - 7. Names and telephone numbers of major material suppliers and subcontractors.
 - 8. System schematic drawings.

1.14 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 01.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on

field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.15 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
- E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.16 WARRANTY

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 - PRODUCTS

- A. Not Applicable

PART 3 - EXECUTION

3.1 WORK INVOLVING OTHER TRADES

- A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.2 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.
- B. The Contractor shall demonstrate operation of equipment and control systems, including each

individual component, to the Owner and Architect/Engineer.

- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.
- D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
- E. Operation of the following systems shall be demonstrated:
 - 1. Air Handling Systems.
 - 2. Refrigeration Systems.
 - 3. Domestic Hot Water Heaters.
 - 4. Domestic Hot Water Mixing Stations.
 - 5. Exhaust Systems.
- F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

****END OF SECTION****

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 22 Section "Domestic Water Piping" for flushing and cleaning of potable water piping.

3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for flushing and cleaning of HVAC piping.

1.2 SUMMARY

- A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheetmetal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 1. CPVC: Chlorinated polyvinyl chloride plastic.
 2. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 1. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
- B. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable

water for human consumption.

- B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- D. Comply with NSF 372, "Drinking Water System Components – Lead Content" for potable domestic water piping and components.
- E. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- G. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- H. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."
- I. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
 - 1. Protect equipment and materials from theft, injury or damage.
 - 2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
 - 3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
 - 4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
 - 5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of

dirt, debris, and moisture.

6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
- D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
 1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.
- B. Unions: Pipe Size 2 Inches and Smaller:
 1. Ferrous pipe: Malleable iron ground joint type unions.
 2. Unions in galvanized piping system shall be galvanized.

3. Copper tube and pipe: Bronze unions with soldered joints.
- C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
 2. Copper tube and pipe: Slip-on bronze flanges.
- D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.
- H. Brazing Filler Metals: Alloys meeting AWS A5.8.
1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
 2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.
- I. 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.
- J. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- K. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
- L. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- 2.4 PIPE THREAD COMPOUNDS
- A. Pipe thread compounds for the fluid service compatible with piping materials provided.
 - B. Compounds for potable water service and similar applications acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.

- C. Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds for galvanized carbon steel systems to coat raw carbon steel surfaces, in lieu of subsequent painting.
 - 1. Manufacturers:
 - a. Carboline "Carbo-Zinc 12."
 - b. Tnemec.
 - c. Koppers.
- D. Use tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for natural gas system threaded joints.
 - 1. Manufacturers:
 - a. Cadillac Plastic.
 - b. Permacel.
 - c. Other approved.

2.5 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. IPEX Inc. (formerly Eslon Thermoplastics).
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:

- a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
- 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.
 - e. Can-Tex Industries Division of Harsco Corp. "CT-Adaptors".
 - f. Joint Inc., "Caulder".

2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F .
- D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Capitol Manufacturing Co.
 - d. Central Plastics Company.
 - e. Epco Sales, Inc.
 - f. Pipeline Seal and Insulator, Inc.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. Zurn Industries, Inc.; Wilkins Div.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.
 - 1. Manufacturers:
 - a. Anvil International, Inc.; Gruvlok Manufacturing; DI-LOK Nipples.
 - b. Elster Group; Perfection Corp.; ClearFlow.
 - c. Precision Plumbing Products, Inc.; ClearFlow.
 - d. Sioux Chief Manufacturing Co., Inc.
 - e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
 - f. Victaulic Co. of America; Style 47 ClearFlow.

2.7 MODULAR MECHANICAL SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.
1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Innerlynx.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

- A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.9 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.11 LEAK DETECTOR SOLUTION

- A. Commercial leak detector solution for pipe system testing.
- B. Manufacturers:
 - 1. American Gas and Chemicals Inc.; Leak Tec.
 - 2. Cole-Parmer Inst. Co.; Leak Detector.
 - 3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

2.12 PIPE ROOF PENETRATION ENCLOSURES

- A. Manufacturers:
 - 1. Pate Company (The); pca Series.
 - 2. Portals Plus, Inc.
 - 3. Thybar Corporation; Thycurb.
- B. Prefabricated roof curb with:
 - 1. Minimum 18 gage welded galvanized steel construction.
 - 2. Integral base plate.
 - 3. Factory installed insect and decay resistant wood nailer.
 - 4. Factory installed 1-1/2 inch thick, 3 pounds per cubic foot density rigid insulation.
 - 5. EPDM compression molded rubber cap for single or multiple pipes as required.
 - 6. Stainless steel draw-band clamps.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Refer to piping application schedules on the Drawings.
- B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer's instructions.
- C. 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. The Drawings shall be followed as closely as elements of construction will permit.
- D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.
- E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous

materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.

- F. Clean and lubricate elastomer joints prior to assembly.
- G. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- H. Install piping to conserve building space and not interfere with use of space.
- I. Group piping whenever practical at common elevations.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 - 1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.
- K. Slope piping and arrange systems to drain at low points.
- L. Slope horizontal piping containing noncondensable gases 1 inch per 100 feet, upward in the direction of the flow.
- M. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- N. 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.
- O. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.
- P. Do not penetrate building structural members unless specifically indicated on drawings.
- Q. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
- R. Install valves with stems upright or horizontal, not inverted.
- S. Provide clearance for installation of insulation and access to valves and fittings.
- T. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
- U. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.
- V. Install piping free of sags and bends.
- W. Install fittings for changes in direction and branch connections.
- X. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:

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1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
 2. Branch connected to top of main for plumbing systems and compressible gasses.
- Y. Install piping to allow application of insulation.
- Z. Select system components with pressure rating equal to or greater than system operating pressure.
- AA. Install escutcheons for penetrations of walls below ceiling, and ceilings.
- BB. Sleeves are not required for core-drilled holes in poured concrete walls.
- CC. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.
- DD. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
 - b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
 - c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
 - d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
 - e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
 4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
 5. Seal sleeves in plaster/gypsumboard partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
 6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- EE. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in

diameter.

2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
 3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- FF. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- GG. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.
 2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.
- HH. Pipe Roof Penetration Enclosures:
1. Coordinate delivery of roof penetration enclosures to jobsite.
 2. Locate and set curbs on roof.
 3. Framing, flashing, and attachment to roof structure are specified under Division 07.
 4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.
- II. Verify final equipment locations for roughing-in.
- JJ. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.
- B. Cut piping square.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.

SECTION 200510
BASIC MECHANICAL MATERIALS AND METHODS

- E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.
- G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.
- H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.
- I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.
- J. Provide temperature sensing device thermal wells and similar piping specialty connections.
- K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.
- L. Locate instrument connections in accordance with manufacturer's instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.
- M. 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."
- N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- O. 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.
- P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
 - 1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
 - 1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores

concentric; center gaskets on the flange faces without projection into the bore.

2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
- R. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- S. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.
- T. Plastic 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
 5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- U. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- V. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.3 ACCESS DOORS

- A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section "Access Doors and Frames" for manufacturers and model numbers and additional information.
- B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.4 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.

1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.
- B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
 2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.
- F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
- G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer's name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.7 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CONCRETE BASES

- A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by

Architectural Trades.

- B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.9 JACKING OF PIPE

- A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.10 CUTTING, CORING AND PATCHING

- A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and finishing work necessary for the installation of mechanical work.
- B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.11 EXCAVATION AND BACKFILLING

- A. Refer to Division 31 Specification Sections.
- B. Provide all excavation, trenching, tunneling and backfilling required for the mechanical work.
- C. Provide all pumping and/or well pointing required for the mechanical work.
- D. Provide foundations if required to support underground piping.
- E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.12 FLASHING

- A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.13 LUBRICATION

- A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.14 FILTERS

- A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.
- B. Immediately prior to final building acceptance by the Owner, Contractor shall:
 - 1. Replace all disposable type air filters with new units.

3.15 CLEANING

- A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.
- B. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."
- C. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
- D. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION

MOTORS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 "Mechanical General Requirements."
 - 2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
 - 3. Division 20 Section "Variable Frequency Controllers".
 - 4. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.2 SUMMARY

- A. This Section includes basic requirements for factory-installed motors.

1.3 DEFINITIONS

- A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)
- B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

- C. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.
- D. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.6 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Compatible with the following:
 - a. Variable frequency controllers.
 - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 3. Matched to torque and horsepower requirements of the load.
 - 4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate electrical scope of work to be provided by Division 20, 21, 22, and 23 with this Section, related Division 20, 21, 22, and 23 Specifications, Division 26 Specifications and the Drawings.
- C. Electrical work provided under Division 20, 21, 22, and 23: Furnish UL Listed components in accordance with this section, Division 26, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
- D. Furnished, installed and wired under Division 20, 21, 22, and 23 unless otherwise indicated:

1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.
- E. Furnished and installed under Division 20, 21, 22, and 23 and wired under Division 26 unless otherwise indicated:
1. Motors required for mechanical equipment
 2. Packaged Self-Contained Equipment:
 - a. Provide equipment ready to accept a single electrical service connection.
 - b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.
 3. Variable frequency controllers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
1. Dayton.
 2. Toshiba Intl.
 3. Baldor Electric/Reliance.
 4. Rockwell Automation/Allen-Bradley.
 5. Nidec Motor Corporation; U.S. Electrical Motors.
 6. Regal Beloit/GE Commercial Motors.
 7. Regal Beloit/Leeson.
 8. Regal Beloit/Marathon.
 9. Siemens.

2.2 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed motors except as follows:
1. Different ratings, performance, or characteristics for a motor are specified in another Section.
 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.
- B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.
- C. Electrical Power System Characteristics: As scheduled on the Drawings.
- D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.3 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.
- B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. 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.
- H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.
- I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

1800 RPM
OPEN DRIP-PROOF MOTORS
4 POLE

1800 RPM
ENCLOSED MOTORS
4 POLE

<u>HP</u>	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

1200 RPM
OPEN DRIP-PROOF
MOTORS
6 POLE

3600 RPM
OPEN DRIPPROOF
MOTORS
2 POLE

<u>HP</u>	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

- C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

- D. Stator: Copper windings, unless otherwise indicated.
1. Multispeed motors shall have separate winding for each speed.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.

- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation:
 - 1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.
 - 2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
 - 3. Fire Pump Motors: NEMA starting Code (KVA Code) B.
- J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Gray enamel.
- K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
- B. Shaft Grounding: Provide a means to protect motor from common mode currents.
 - 1. Required for:
 - a. Motors used with variable frequency controllers.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Electro Static Technology, Inc.; Aegis SGR Conductive Microfiber.
- C. Severe-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.
 - 1. Finish: Chemical-resistant paint over corrosion-resistant primer.
- D. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

2.6 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.7 FIELD QUALITY CONTROL

- A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.
- B. Prepare for acceptance tests as follows:
 - 1. Check motor nameplates for horsepower, speed, phase and voltage.
 - 2. Check coupling alignment and shaft end play.
 - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - 4. Test interlocks and control features for proper operation.
 - 5. Verify that current in each phase is within nameplate rating.
- C. Testing: Perform the following field quality-control testing:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
 - 2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
 - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

2.8 ADJUSTING

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

2.9 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

****END OF SECTION****

METERS AND GAGES

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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. Related Sections include the following:
 - 1. Division 22 Section "Water Distribution" for domestic and fire-protection water service meters outside the building.
 - 2. Division 21 Section "Fire-Suppression Piping" for listed or approved pressure gages.
 - 3. Division 20 Section "Mechanical General Requirements."
 - 4. Division 20 Section "Basic Mechanical Materials and Methods."
 - 5. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
 - 6. Division 23 Section "Fuel Gas Piping" for gas utility meters.

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers indicating manufacturer's number, scale range, and location for each.

- C. Product Certificates: For each type of thermometer, signed by product manufacturer.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

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 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Miljoco Corporation.
 - 3. REOTEMP Instrument Corporation.
 - 4. Trerice, H. O. Co.
 - 5. Weiss Instruments, Inc.
 - 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.
- C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F (178 degrees C); ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.4 PRESSURE GAGES

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Cambridge.
 - 3. Dwyer Instruments, Inc.
 - 4. Marsh Bellofram.
 - 5. Miljoco Corporation.
 - 6. Terice, H. O. Co.
 - 7. Weiss Instruments, Inc.
 - 8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Stainless steel, aluminum, or FRP, 6-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red or other dark-color metal.
 - 7. Window: Glass or plastic.
 - 8. Ring: Stainless steel or chrome plated metal.
 - 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 - 10. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.
 - 11. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.

- C. Pressure-Gage Fittings:
 - 1. Valves: NPS 1/4 brass ball type.
 - 2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
 - 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

- A. Manufacturers:
 - 1. Peterson Equipment Co., Inc.
 - 2. Miljoco Corporation.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F for cold services, and 500 psig at 275 deg F for hot services.
- D. Core Inserts: One or two self-sealing rubber valves.
 - 1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be Neoprene.
 - 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be Nordel.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
 - 1. Inlet and outlet of each thermal storage tank.
- B. Provide the following temperature ranges for thermometers:
 - 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 - 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages on inlet and outlet of each pressure-reducing valve.
- B. Install dry-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- E. Install test plugs in tees in piping.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.5 ADJUSTING

- A. Adjust faces of gages to proper angle for best visibility.

****END OF SECTION****

HANGERS AND SUPPORTS

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PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - B. Related Sections include the following:
 - 1. Division 21 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."
 - 4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
 - 5. Division 20 Section "Pipe Expansion Fittings and Loops" for pipe guides and anchors.
 - 6. Division 23 Section(s) "Metal Ducts for duct hangers and supports.
- 1.2 DEFINITIONS
 - A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
 - B. MFMA: Metal Framing Manufacturers Association.

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

1.5 QUALITY ASSURANCE

- A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
 - 1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture.
 - 2. MSS SP-69, Pipe Hangers and Supports – Selection and Application.
 - 3. MSS SP-89, Pipe Hangers and Supports – Fabrication and Installation Practices.

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 HANGER ROD MATERIAL

- A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
 - 1. Rod continuously threaded.
 - 2. Use of rod couplings is prohibited.

2.3 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-69, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.
 - 1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.
- B. Manufacturers:
 - 1. Anvil International, Inc.

2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.
 4. Hilti USA.
 5. Pentair Electrical & Fastening Solutions; CADDY.
 6. PHD Manufacturing, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic 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.

2.4 METAL INSULATION SHIELDS

- A. Manufacturers:
1. Anvil International, Inc.
 2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.
 4. Pentair Electrical & Fastening Solutions; CADDY.
 5. PHD Manufacturing, Inc.
- B. Description: MSS SP-69, Type 40, protective shields. Shields shall span an arc of 180 degrees.
- C. Shield Dimensions for Pipe: Not less than the following:
1. NPS 1/4 to NPS 2:12 inches long and 0.048 inch thick.

2.5 PIPE COVERING PROTECTION SADDLES

- A. Manufacturers:
1. Anvil International, Inc.
 2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.
 4. Pentair Electrical & Fastening Solutions; CADDY.
 5. PHD Manufacturing, Inc.
- B. Description: MSS SP-69, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.
1. Saddles shall match insulation thickness.

2. Saddle length: 12 inches.
3. Furnish with center rib for pipe sized NPS 12 and larger.

2.6 PLASTIC INSULATION SHIELDS

A. Manufacturers:

1. B-Line by Eaton; Snap'N Shield.
2. Hydra-Zorb Company; Bronco.

B. Description: Polypropylene copolymer protective shields designed to snap directly onto strut channel. Shields shall span an arc of 180 degrees.

1. Operating Temperature Range: Minus 40 deg F to plus 178 deg F .

C. Certifications:

1. UL Classified for USA: UL-723 (ASTM E 84).
2. UL listed for Canada: ULC-S102.2.
3. Meets UL94 HB flammability standards.

D. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 2: 12 inches long.

2.7 THERMAL-HANGER SHIELDS

A. Manufacturers:

1. American Mechanical Insulation Sales Inc. (AMIS).
2. B-Line by Eaton.
3. Pentair Electrical & Fastening Solutions; CADDY.
4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

B. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:

1. Manufacturer:

- a. B-Line by Eaton/Armacell; Armafix IPH.

2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:

- a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.

- C. Thermal-Hanger Shields for Small Diameter Piping:
 - 1. Manufacturer:
 - a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.
 - 2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
 - a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Refer to application schedules on the Drawings.
- B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.
- C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- D. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- E. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.
- F. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.
- G. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. MSS Type 8 or spring type to meet system requirements.
- J. 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.
- K. Hanger-Rod Attachments for Wood Construction: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. All Steel Ceiling Plates: UL listed and suitable for attachment to wood beams. For pipe sizes NPS 1/2 to NPS 2. Install in accordance with manufacturer's instructions to maintain listing.
 2. Threaded Side Beam Brackets: UL listed and FMG approved, suitable for attachment to wood beams. For pipe sizes NPS 2 to NPS 4. Install in accordance with manufacturer's instructions to maintain listing.
- L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:
 - a. Provide spring supports at point of support where vertical movement will occur.
 - b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.
 - c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.
 - d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.
 - e. Sway braces; TYPE 50.
 - f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.
- M. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. 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 structural frame.
- B. 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, other pipe, duct or equipment.

- C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.
- D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.
- E. File and paint cut ends and shop or field prime paint supporting element components.
- F. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.
- G. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.
- H. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.
- I. Where necessary, brace piping and supports against reaction, sway and vibration.
- J. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.
- K. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.
- L. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
- M. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.
- N. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.
- O. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.
- P. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.
- Q. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.

- R. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.
- S. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
- T. Building structure shall not be reinforced except as approved by the Architect in writing.
- U. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
- V. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- W. Install hangers and supports to allow controlled thermal [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.
- X. Install lateral bracing with pipe hangers and supports to prevent swaying.
- Y. 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.
- Z. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- AA. 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.
- BB. Refer to individual piping sections for hanger spacing and hanger rod sizes.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

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.

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- 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 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device.

1.3 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Installation of these items is specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION EQUIPMENT BASES

A. **Type A:** Direct Isolator Attachment

- 1. Unit to be isolated is so constructed that vibration isolators of the type specified may be

directly attached, provided that the edge deflection of the isolated unit base over unsupported span between mountings does not exceed specified or manufacturer's limits. If units to be isolated will not meet required deflection provisions, Type B bases shall be provided.

2.2 VIBRATION ISOLATORS

- A. **Type 1a** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type W, Super W, WSW, and WSWSW or comparable products by one of the following:
 - a. Amber/Booth; a VMC Group Company..
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company..
 - f. Vibro-Acoustics.
 2. Material: Standard neoprene for indoor applications.
 3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.
- B. **Type 1b** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, single layer, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and 1/4 inch steel load bearing plate. Factory cut to sizes that match requirements of supported equipment.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type Super WMSW and MBSW or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company..
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company..
 - f. Vibro-Acoustics.
 2. Material: Standard neoprene for indoor applications.
 3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.
- C. **Type 2** Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason

Industries, Inc.; Type ND or a comparable product by one of the following:

- a. Amber/Booth; a VMC Group Company..
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company..
 - f. Vibro-Acoustics.
2. Durometer Rating: Selected for maximum possible static deflection with the loading of each piece of equipment.
 3. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
 4. Neoprene: Bridge-bearing neoprene as defined by AASHTO.

2.3 VIBRATION ISOLATION HANGERS

- A. **Type 8a** Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type 30N or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company..
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company..
 - f. Vibro-Acoustics.
 2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- B. **Type 8b** Spring Hangers with Vertical-Limit Stop: Precompressed combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type PC30N or a comparable product by one of the following:

- a. Amber/Booth; a VMC Group Company..
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company..
 - f. Vibro-Acoustics.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 1. Powder coating on springs and housings.
 2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07

Section "Roof Accessories."

3.3 APPLICATION

- A. Refer to Vibration Isolator Application Schedule on the drawings for isolator application and minimum deflection.

3.4 CONNECTIONS

- A. Provide flexible electrical connections in the form of large radius, 360 degree loop of flexible conduit for all vibrating isolated equipment. Any cooling water lines, compressed air, or other piping services (except inlet and outlet water connections for pumps, chillers or cooling tower) shall be made with 360 degree loops of reinforced neoprene hose, which are attached using nipples of appropriate gender. All service connections made with neoprene hose shall have shut-off valves between the hose and the supply service.
- B. Vibration isolate piping connected to vibration isolated equipment using Type 8a or 8b spring hangers, and with distance to be isolated as scheduled on the Drawings. Maximum spacing between isolators same as maximum distance between pipe hangers and supports.
- C. Vibration isolate ductwork connected to air handling units, return air fans, and vibration isolated equipment using Type 8a or 8b spring hangers, and in accordance with isolation distances scheduled on the Drawings.

3.5 EQUIPMENT BASES

- A. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.6 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. Isolator deflection.
 - 2. Snubber minimum clearances.

3.7 ADJUSTING

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust active height of spring isolators.
- E. Adjust snubbers according to manufacturer's written recommendations.

3.8 CLEANING

- A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.4 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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
 - 1. Seton.
 - 2. Brady.
 - 3. EMED.
 - 4. Craftmark.
 - 5. Brimar Industries, Inc.
 - 6. Marking Services Inc. (MSI).
 - 7. Kolbi Pipe Marker Co.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.

2.3 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
 - 2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
 - 3. Legends: Spelled out in full or commonly used and accepted abbreviations.

4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- C. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.4 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect/Engineer. Provide 5/32-inch hole for fastener.
1. Material: 0.032-inch- thick brass.
 2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.6 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 2. Frame: Finished hardwood or extruded aluminum.
 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units, including boilers.
 - 2. Pumps and similar motor-driven units.
 - 3. Evaporators and similar equipment.
 - 4. Fans and blowers.
- B. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 - 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 markers.
- C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.4 DUCT IDENTIFICATION

- A. Identify ductwork with vinyl markers and flow direction arrows.

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; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: Minimum 1-1/2 inches, round or square.
 - b. Hot Water: Minimum 1-1/2 inches, round or square.
 - c. Gas: Minimum 1-1/2 inches, round or square.

3.6 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.9 SCHEDULES

- A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>
Sanitary Sewer	SAN	White on Green
Sanitary Vent	V	White on Green
Domestic Cold Water	CW	White on Green
Domestic Hot Water	HW	Black on Yellow
Domestic Hot Water Return	HWR	Black on Yellow
Natural Gas	G	Black on Yellow
Refrigerant Liquid	RL	Black on Yellow
Refrigerant Suction	RS	Black on Yellow
Fire Protection	FP	White on Red

<u>Service</u>	<u>Abbrev.</u>	<u>Labels</u>
Exhaust Systems	Exhaust Air	Black on Yellow
Outside Air Intake	Outside Air	White on Green
Ventilation Air	Ventilation Air	White on Green

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Materials and Methods."
 - 3. Division 20 Section "Hanger and Supports" for thermal hanger shield inserts.

4. Division 22 Section "Plumbing Fixtures: for protective shielding guards.

5. Division 23 Section "Metal Ducts" for duct liners.

1.2 SUMMARY

A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.3 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. PVC: Polyvinyl Chloride.

D. SSL: Self-sealing lap.

1.4 OUTDOOR, ABOVEGROUND PIPING INSULATION SYSTEMS DESCRIPTION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

1.5 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.6 EQUIPMENT INSULATION SYSTEMS DESCRIPTION

A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.7 FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION

A. Acceptable field-applied jacketing materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe specialty.

1.8 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1. ESR Report: For fire-rated grease duct insulation.

B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

3. Removable insulation at piping specialties, equipment connections, and access panels.

4. Application of field-applied jackets.

5. Application at linkages of control devices.

6. Field application for each equipment type
7. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.9 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting 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.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer's original packaging.

1.11 COORDINATION

- A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."
- 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.

1.12 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, GENERAL REQUIREMENTS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable

according to ASTM C 795.

- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.2 PIPE INSULATION MATERIALS

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Armacell LLC; AP Armaflex.
 - b. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
- B. Glass-Fiber, Preformed Pipe Insulation, Type I:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.3 DUCTWORK INSULATION MATERIALS

- A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite EQ.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap FSK.
 - e. Owens Corning; All-Service Duct Wrap.

2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Armacell LCC; 520 Adhesive.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - c. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - f. Vimasco Corporation.
- D. 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 products specified.
 - a. Childers Products, H.B. Fuller Company; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 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.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, 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.

2.6 FACTORY-APPLIED JACKETS

A. Insulation systems 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.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Zeston and Ceel-Co.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated tank heads and tank side panels.

C. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Zeston and Ceel-Co.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers:
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.

3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

- A. Bands:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; ITW Insulation Systems; Pab-Bands and Fabstraps.
 - b. RPR Products, Inc.; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed 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. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.

2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

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. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON 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.
- 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 the 4 o'clock or 8 o'clock position on 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 as recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. 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 thermal hanger 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 thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of

strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape 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. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
- 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 below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.

- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations that Are Not Fire Rated: Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations:
 - 1. Terminate ductwork insulation at angle closure of fire damper sleeves.
 - 2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."
- F. 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 angle closure of fire damper sleeves.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform

contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate 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, 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. 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.

3.6 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 GLASS-FIBER AND MINERAL WOOL PIPE 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 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 PVC fitting covers when available.
2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:

- a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install PVC fitting covers when available.
 2. When PVC fitting covers 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 PVC fitting covers when available.
 2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.8 DUCT AND PLENUM INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.
1. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 2. 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 .
3. 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.
 4. 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.
 5. 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.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. 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.
- 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 manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.10 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.
- 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.

END OF SECTION

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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 work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Motors."

1.2 REFERENCES

- A. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/NEMA MG 1 - Motors and Generators.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. EMI: Electromagnetic interference.
- C. LED: Light-emitting diode.

- D. RFI: Radio-frequency interference.
- E. THD: Total harmonic disturbance.
- F. VFC: Variable frequency controller. Variable frequency controllers may also be referred to as variable speed drives, variable frequency drives, VSDs, or VFDs in other Specification Sections or on the Drawings.

1.4 SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include dimensions and finishes for VFCs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Indicating power, control and instrument wiring including ladder diagrams for field work as well as factory assembled work. Manufacturer's drawings are acceptable only when modified and supplemented to reflect project conditions. The drawings shall include:
 - 1. Overall schematic (elementary) diagram in JIC form of the entire system of power and control circuitry. Indicate interfaces with control wiring by temperature controls contractor.
 - 2. Wiring diagrams showing the wiring layout of component assemblies or systems.
 - 3. Interconnection wiring diagrams showing terminations of interconnecting conductors between component assemblies, systems, control devices, and control panels complete with conductor identification, number of conductors, conductor and conduit size.
 - 4. Sequence of operation for components, assemblies or systems.
 - 5. Dimensional data.
- C. Product Certificates: For each VFC from manufacturer.
- D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.
- E. Coordination Data for Motor-Driven Equipment: Accompanied by complete information concerning the respective motors including the following.
 - 1. Principal dimensions.
 - 2. Weights.
 - 3. Horsepower.
 - 4. Voltage, phase, frequency.
 - 5. Speed.
 - 6. Class of insulation.

7. Enclosure type.
 8. Frame.
 9. Bearings including ABMA Rating Life (L-10 basis).
 10. Design letter.
 11. Manufacturer.
 12. Service Factor
- F. Descriptive data shall include catalogues, guaranteed performance data with efficiency and power factor indicated at 75 percent and 100 percent of rated load and verification of conformance with other requirements of the Contract Documents. The information enumerated under NEMA MG1 Paragraph MG1-10.38, shall be arranged on one sheet for each motor.
- G. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Product Options for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Refer to Division 01 Section "Product Requirements."
- 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.
- E. Comply with IEEE 519 - Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.
- F. Store VFCs in permanently enclosed and conditioned spaces.
- G. If stored in space that is not permanently enclosed and conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.6 COORDINATION

- A. For Electrical Work Provided under Division 20, 22, and 23 Specifications: Furnish UL Listed components, in accordance with Division 26 Specifications and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
- B. Provide Electrical Work required for the operation of components and assemblies provided as part of the Work under Division 20, 22, and 23 Specifications.

- C. Coordinate with temperature controls contractor for interfaces with temperature controls wiring.
- D. Mount line voltage (120 VAC) control components specified as part of the Work under Division 20, 22, and 23 Specifications.
- E. Refer to ELECTRICAL DRAWINGS and Division 26 Specifications for specified information regarding provisions for the arrangement of electrical circuits and components and for interface with Work specified under Division 20, 22, and 23 Specifications.
- F. The mechanical contractor shall furnish and install the variable frequency controller. Electrical trades shall make power connections to both load and line side of the VFC.

1.7 WARRANTY

- A. Warranty shall be 36 months from date of project acceptance. The warranty shall include all parts, labor, travel time and expenses.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Electrical Power Supply Characteristics: 480 volts, 3 phase, 60 hertz (Hz).
- B. Controller(s) shall be suitable for use with standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor. At any time in the future, it shall be possible to substitute standard motor (equivalent horsepower, voltage and RPM) in the field.

2.2 VARIABLE FREQUENCY CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. ABB Group.
 - 2. Danfoss.
 - 3. Eaton Corporation.
 - 4. General Electric.
 - 5. Hitachi America, Ltd.
 - 6. Johnson Controls Incorporated (Private labeled ABB).
 - 7. Mitsubishi Electric Automation, Inc.
 - 8. Square D; Schneider Electric.
 - 9. Toshiba International Corporation.

10. Yaskawa Electric America, Inc.
- B. Provide variable frequency controllers as scheduled including coasting motor restart, and step over frequency.
 1. The ratio of the total impedance to common system impedance shall be greater than or equal to 10.
 2. The voltage notch area shall be limited to 16-400 volt microseconds.
 3. The total harmonic disturbance (THD) as a result of voltage notching shall be 3 percent or less at the point of common coupling.
 4. The THD as a result of current notching shall be 100 percent or less at the point of common coupling.
- C. Provide 3 percent AC input line reactors sized appropriate for each current rating variable frequency controller.
- D. Variable frequency controller (VFC) shall comply with all applicable provisions of the National Electrical Code.
- E. Line side of the VFC shall have a displacement power factor of 0.95 or greater when motor is operating at 50 to 100 percent motor speed.
- F. VFC shall have efficiency greater than 85 percent when motor is operating at 50 to 100 percent motor speed.
- G. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- H. Unit Operating Requirements:
 1. Input AC Voltage Tolerance: Plus 10 and minus 5 percent of VFC input voltage rating.
 2. Input Frequency Tolerance: Plus 2 percent of VFC frequency rating.
- I. Each variable frequency controller shall consist of an adjustable frequency converter which shall convert input power into an adjustable frequency output in an ambient temperature of zero to 40 deg C. Output power shall be suitable capacity and waveform to provide stepless speed control of the specified horsepower motor throughout the required speed range under variable torque load not exceeding the motor's full-load rating.
- J. Provide fault detection and trip circuits to protect itself and the connected motor against line voltage transients, power line under voltage, output overvoltage and overcurrent. A disconnect with padlockable door interlocked external handle shall be supplied to disconnect the incoming power.
 1. Minimum SCCR according to UL 508 shall be as required by electrical power distribution system, but not less than 42,000 A.
 2. Minimum short circuit design shall be in accordance with Electrical Contractor provided short circuit analysis.

- K. Criteria in Paragraph B shall be met without the use of isolation transformers. Variable frequency controller will be accepted only if criteria can be met without isolation transformers.
- L. Minimum output frequency shall be the lowest frequency at which the connected motor can be operated without overheating.
- M. Inverter shall contain current limiting circuitry, adjustable to 100 percent of motor full-load current to provide soft start, acceleration, and running without exceeding motor rated current. The current limit circuit shall be of the type for variable torque load, which acts to diminish output frequency while limiting, without directly causing shutdown.
- N. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts. For safety, drive shall shut down and require manual reset and restart if automatic reset/restart function is not successful within three attempts.
- O. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- P. Isolate signal circuits from the power circuits and design to accept a speed signal from a remote process controller in the automatic mode and from the speed control potentiometer in the manual mode. A door-mounted switch shall provide mode selection. The selected signal shall control the motor speed between the adjustable minimum and maximum speed settings. Maximum speed shall be field adjustable to 100 percent of rated speed. The speed signal shall follow a linear time ramp, adjustable from 4-20 seconds to provide acceleration from zero to minimum speed. When minimum speed is reached, the speed signal shall follow the linear time ramp for acceleration and deceleration control.
- Q. Mount the adjustable frequency inverter and other electrical components that provide the operation specified in a NEMA 1 enclosure. Equipment shall have external heat sinks, or air filters on all vents. The enclosure shall have hinged front access doors with latch. Cabinet to cabinet interconnecting wiring shall be factory dressed, tagged and harnessed, and shipped with one end attached.
- R. Controller shall have the ability to step-over certain set frequencies that may cause a system to resonate. The controller shall have at least two manually set points of frequency in which the controller shall step-over during operation.
- S. Operating and monitoring devices for the inverter shall be door mounted and shall include the following:
 - 1. Manual Speed Control to set speed in the hand (manual) mode.
 - 2. Speed indicating meter, either in revolutions per minute, proportional to the applied frequency and voltage to indicate speed of the converter-powered motor or frequency (hertz).
 - 3. VFC "fault/reset" pilot light pushbutton combination with dry contact for external alarm. Fault alarm shall not actuate upon normal shutdown.
 - 4. Inverter "control power" indicator.
 - 5. Motor "running" indicator and two dry contacts that close when motor is running.

6. Output current meter calibrated in "AC amps."
 7. Operating selector switches and indicating light to perform the following functions:
 - a. One hand-off-auto switch for the VFC with indicating lights (red-running, green-energized). In hand position, unit (VFC or bypass starter) shall start. In auto position, unit (VFC or bypass starter) shall start when remote dry contact is closed.
 - b. Unit shall be capable of being padlocked in the off position.
 8. Output voltmeter (0 - 600 VAC) (analog or digital).
- T. The VFC is to be provided with isolated 4-20 mA DC output signals proportional to speed, current and voltage for connection by others.
- U. The VFC shall be provided with the ability to communicate (monitoring) through RS485 connector.
- V. Remote speed control shall be 4-20 mA control signal from a remote controller.
- W. Variable frequency controller shall not cause motor to produce noise levels exceeding 80 dBA measured at a distance of 3 feet from the motor. If noise level of motor exceeds this amount, the contractor shall be responsible for correcting the problem.
- X. Provide connection points for system safety controls such as smoke detectors, freeze stats, damper end switches, etc. as shown on mechanical temperature control drawings. Opening of a contact on safety controls wired to the drive shall shut down the motor(s).
- Y. VFCs specified on the drawings to have contactor motor selection, in order to operate "either one or both" motors connected to the VFC, shall have the separate motors controlled by horse power rated contactors. These contactors shall be capable of being controlled locally (by a switch in the panel door) or remotely. The contactors shall also have two convertible auxiliary contacts in order to sense contactor position.
- Z. VFCs specified on the drawings to operate "either" motor with contactor motor selection shall have separate horse power rated contactors to control each motor.
- AA. The contactors shall be interlocked in order that only one motor may run at a time. These contactors shall be capable of being controlled locally (by a switch in the panel door) or remotely. The contactors shall also have two convertible auxiliary contacts in order to sense contactor position.
- BB. Provide in each VFC, a relay, that upon loss of the automatic speed control signal shall:
 1. Automatically set the motor rpm to half speed. This loss of signal relay shall be manually adjustable to be able to set default speed to some other value than half speed if required later in the field.
- CC. Coordinate with the Temperature Controls Contractor for the interface of control wiring to the drive as required to meet the requirements of the temperature control drawings. Drive shall be furnished with internal control wiring configured in the factory to allow single connections of field wiring to terminal blocks in the drive by the Temperature Controls Contractor.
- DD. All indicating lights shall be push to test or LED.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:
 - 1. Power transistors, SCRs and diodes shall be tested to ensure correct function and highest reliability.
 - 2. All printed circuit boards shall be tested at 50 deg C for 50 hours. The VFC manufacturer shall provide certification that the tests have been completed.
 - 3. Every controller will be functionally tested with a motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install and adjust materials and equipment in accordance with the manufacturer's instructions.
- B. Obtain the manufacturer's instructions for materials and equipment provided under the Contract in detail necessary to comply with the requirements of the Contract Documents.
- C. If unit is free standing, provide a concrete housekeeping pad.
- D. FIELD QUALITY CONTROL
- E. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- F. Upon completion of each installation, conduct complete acceptance tests in the presence of duly notified authorities having jurisdiction and the Owner to demonstrate component, assembly or system performance in accordance with the requirements of the Contract Documents.
- G. In the event that a test demonstrates that a component assembly or system performance is deficient, the Owner may require additional tests after corrective work.

- H. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
- I. Component assembly and systems acceptance is predicated upon completion of specified work and receipt by the Owner of data specified under "Submittals."
- J. Electrical testing of motors is specified in Division 20 Section "Motors."

3.3 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges.
- F. Set field-adjustable pressure switches.

3.4 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.5 DEMONSTRATION

- A. The VFC supplier/support group shall provide the following additional services:
 - 1. On-site training of customer personnel in operation and maintenance of variable frequency controllers.
 - 2. Provide four copies of a troubleshooting manual and factory training manuals to help the building operator determine what steps must be taken to correct any problem that may exist in the system.

3. Coordinate enrollment of customer personnel in factory-held service schools.

****END OF SECTION****

FIRE-SUPPRESSION SYSTEM

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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. Provisions of Division 20 Section "Mechanical General Requirements" apply to this Section.
- C. Related Sections include the following:
 - 1. Division 33 Section "Water Distribution" for piping outside the building.
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Hangers and Supports."

1.2 DEFINITIONS

- A. Underground Service-Entrance Piping: Underground service piping below the building.
- B. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.3 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. 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.

1.4 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Fire-suppression 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, for bidding purposes, as follows:
 - a. Solvent Cleaning Areas: Extra Hazard, Group 2.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Extra-Hazard, Group 2 Occupancy: 0.40 gpm/sq. ft. over 2500-sq. ft. area.
 - 4. Maximum Protection Area per Sprinkler:
 - a. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
- D. Water velocity in the piping system shall not exceed the following:
 - 1. Aboveground mains: 32 ft./sec.
 - 2. Sprinkler branch lines: 24 ft./sec.

1.5 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: 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. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - E. Qualification Data: For qualified Installer.
 - F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, the Owner's insurance underwriter including hydraulic calculations, if applicable.
 - 1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification number (SIN) or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
 - 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 operation and maintenance manuals.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
 - B. The provisions and requirements of the NFPA and the Owner's insurance underwriter constitute mandatory minimum requirements for the work of this Section.
 - C. NFPA Standards: Fire-suppression-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."

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.
 - a. Bolts And Nuts.

2.2 COPPER TUBE AND FITTINGS

- A. Plain-End, Hard Copper Tube: ASTM B 88, Type K or ASTM B 88, Type L, water tube, drawn temper.
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match tubing system.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket metal-to-metal seating surfaces, and solder-joint or threaded ends.
 4. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4.

2.3 CPVC PIPE AND FITTINGS

- A. Manufacturers:
1. Harvel Plastics, Inc.; BlazeMaster.
 2. IPEX Inc.; Blazemaster.
 3. NIBCO; BlazeMaster.
 4. Spears Manufacturing Company; FlameGuard.
 5. Tyco Fire & Building Products; BlazeMaster.
 6. Viking Corporation; BlazeMaster.
- B. CPVC Pipe: ASTM F 442/F 442M and UL 1821, FM approved, SDR 13.5, for 175-psig rated pressure at 150 deg F, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
- C. CPVC Fittings: UL listed or FM approved, for 175-psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
1. NPS 3/4 to NPS 1-1/2: ASTM F 438 and UL 1821, Schedule 40, socket type.
 2. NPS 2 to NPS 3: ASTM F 439 and UL 1821, Schedule 80, socket type.

3. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
4. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
5. Flanges: CPVC, one or two pieces.

2.4 COVER SYSTEM FOR SPRINKLER PIPING

- A. Manufacturers:
 1. DecoShield Systems, Inc.
- B. Description: System of support brackets and covers made to protect sprinkler piping.
- C. Brackets: Glass-reinforced nylon.
- D. Covers: Extruded PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.5 DIELECTRIC FITTINGS

- A. Refer to Division 20 Section "Mechanical General Requirements."

2.6 BACKFLOW PREVENTION DEVICES

- A. Double-Check, Detector-Assembly Backflow Preventers:
 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 Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1048 and FMG approved or UL listed.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Size and Capacities: As scheduled on the drawings.
 6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.
 7. End Connections: Flanged.
 8. Configuration: Designed for horizontal, straight through flow.

2.7 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig working-pressure rating if fittings are components of high-pressure piping system.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 - 1. Manufacturers:
 - a. Tyco Fire & Building Products LP.
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
 - 1. Manufacturers:
 - a. Elkhart Brass Mfg. Co., Inc.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
 - 1. Manufacturers:
 - a. AGF Manufacturing Co.
 - b. Tyco Fire & Building Products LP.
 - c. G/J Innovations, Inc.
 - d. Triple R Specialty of Ajax, Inc.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
 - 1. Manufacturers:
 - a. CECA, LLC.
 - b. Merit.

2.8 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Valves shall have pressure rating if valves are components of high-pressure piping system.
- B. Gate Valves with Wall Indicator Posts:
 - 1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
 - 2. Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. NIBCO.

- c. Crane Co.; Crane Valve Group; Stockham Valves.
- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
- 1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 3. NPS 3: Ductile-iron body with grooved ends.
 - 4. Manufacturers:
 - a. NIBCO.
 - b. Victaulic Co. of America.
- D. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
- 1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch .
 - 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
 - a. Manufacturers:
 - 1) Milwaukee Valve Company.
 - 2) NIBCO.
 - 3) Victaulic Co. of America.
- 2.9 SPRINKLERS
- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- B. Manufacturers:
- 1. Reliable Automatic Sprinkler Co., Inc.
 - 2. Tyco Fire & Building Products.
 - 3. Victaulic Co. of America.
 - 4. Viking Corp.
- C. Automatic Sprinklers:
- 1. With heat-responsive glass bulb element complying with the following:
 - a. UL 199, for nonresidential applications.
 - b. UL 1767, for early-suppression, fast-response applications.
 - c. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
 - d. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.
- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for 165 deg F "Ordinary" 212 deg F

Intermediate temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Recessed sprinklers, including escutcheon.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers. Escutcheons listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 3/4-inch vertical adjustment.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Sprinkler guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.10 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge.

2. Ashcroft Inc.

3. Marsh Bellofram.

4. Viking Corp.

5. Weiss Instruments, Inc.

B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.

1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.

2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

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 Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping

connections before installation.

- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, grooved-joint couplings, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints; or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.4 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Wet-Pipe Sprinklers: Use the following:

Pipe Type	1 ½" & Smaller	2"	2 ½" – 3 ½"	4"	5" – 6"
Type K copper, brazed fittings	NO	NO	NO	NO	NO
Type L copper, brazed fittings	NO	NO	NO	NO	NO
Type K copper, brazed fittings	NO	NO	NO	NO	NO
Type L copper, grooved fittings	NO	NO	NO	NO	NO
CPVC pipe, solvent cement fittings	YES	YES	YES	NO	NO

3.5 VALVE APPLICATIONS

- A. The following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed or FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use ball or gate valves.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Use of saddle style tees is not acceptable.

- D. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. All grooved couplings, fittings, gaskets, valves, and specialties shall be the product of a single manufacturer.
 - 2. Copper Tube: Roll-groove tubing. Use grooved-end fittings and grooved-end-tube couplings.
- E. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for additional requirements.

3.7 WATER-SUPPLY CONNECTION

- A. Connect fire-suppression piping to building's interior water distribution piping.
- B. Install shutoff valve, backflow prevention device, pressure gage, drain, and other accessories indicated at connection to water distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.8 PIPING INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- D. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- E. Install sprinkler piping with drains for complete system drainage.
- F. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- G. Install alarm devices in piping systems.
- H. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 - 1. Install standpipe system piping according to NFPA 14.
 - 2. Install sprinkler system piping according to NFPA 13, except use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting pipes larger than NPS 2-1/2.
 - 3. Refer to Division 20 Section "Hangers and Supports" for additional requirements.
- I. Fill wet-pipe sprinkler system piping with water.

3.9 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty 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. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.
- D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
- E. Specialty Valves:
 - 1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.10 SPRINKLER APPLICATIONS

- A. Use the following sprinkler types:
 - 1. Rooms with Suspended Ceilings: Concealed sprinklers Recessed sprinklers.
 - 2. Sprinkler Finishes:
 - a. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - 3. Sprinkler Guards: For exposed sprinkler heads subject to damage.

3.11 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
- C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

3.12 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 20 Section "Mechanical Identification."

3.13 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

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FIRE-SUPPRESSION SYSTEM

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. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 5. Verify that equipment hose threads are same as local fire department equipment.
 6. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.
- B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
 - C. Verify that specified tests of piping are complete.
 - D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
 - E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
 - F. Verify that potable-water supplies have correct types of backflow preventers.
 - G. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- 3.14 CLEANING AND PROTECTION
- A. Clean dirt and debris from sprinklers.
 - B. Remove and replace sprinklers with paint other than factory finish.
 - C. Protect sprinklers from damage until Substantial Completion.
- 3.15 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION

DOMESTIC WATER PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods" for materials and methods common to mechanical piping systems.
 - 3. Division 20 Section "Hangers and Supports."
 - 4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
 - 5. Division 22 Section "Plumbing Valves" for general duty plumbing valves.
 - 6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.2 SUMMARY

- A. This Section includes domestic water piping inside the building.
- B. Water meters will be furnished and installed by utility company.

1.3 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.4 SYSTEMS DESCRIPTION

- A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.
- B. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 - 2. Drain Duty: Hose-end drain valves.
 - 3. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2 and Smaller: Class 150, bronze.
 - 4. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.
- C. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Water Samples: Specified in Part 3 "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. Compressed air piping.
 - 4. HVAC hydronic piping.
- D. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of

Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

- C. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

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 PIPING MATERIALS

- A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L , water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Copper or Bronze Pressure-Seal Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Viega North America; ProPress System.
 - b. NIBCO Inc.; Press System.
 - c. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
 - d. Apollo Valves; by Conbraco Industries; ApolloXpress.
 - 2. Housing: Copper.
 - 3. O-Rings and Pipe Stops: EPDM.
 - 4. Tools: Manufacturer's special tools.

5. Maximum 200-psig working-pressure rating at 250 deg F.

2.4 PEX PIPE AND FITTINGS

- A. PEX Distribution System: ASTM F 876 and ASTM F 877, SDR 9 tubing.
 1. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper crimp rings and matching PEX tube dimensions; or plastic-insert type cold expansion fittings and corresponding rings, material meeting requirements of ASTM F 1960.
 2. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877 and with plastic or corrosion-resistant-metal valve for each outlet.

2.5 CPVC PIPING

- A. CPVC Schedule 40 and 80 Pipe: ASTM F 441/F 441M.
 1. CPVC Schedule 40 Fittings: ASTM F 438, socket type.
 2. CPVC Schedule 80 Fittings: ASTM F 439, socket type or ASTM F 437, threaded type.

2.6 VALVES

- A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."
- B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

2.7 SPECIALTY VALVES

- A. Bronze Gate Valves: MSS SP-80, with malleable-iron handwheel.
 1. Class 150, Rising-Stem, Bronze Gate Valves: ASTM B-62 bronze body, bonnet, and wedge, copper-silicone bronze stem, screw-in bonnet, threaded end connections; and having 300 psig CWP rating.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Crane Valve Group; Crane Valves.
 - 2) Hammond Valve.
 - 3) Milwaukee Valve Company; Model 1150.
 - 4) NIBCO INC.; Models T-131, S-134 or T-134.
 - 5) Watts Water Technologies, Inc.; Series B-3110.
- B. Cast-Iron Gate Valves: MSS SP-70, with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.
 1. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim, and solid-wedge disc; and having 200 psig CWP rating.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Crane Valve Group; Crane Valves.

- 2) Hammond Valve.
 - 3) Milwaukee Valve Company; Model F-2885.
 - 4) NIBCO INC.; Model F-617-O.
 - 5) Watts Water Technologies.
- C. CPVC Union Ball Valves: MSS SP-122, with full-port ball, socket or threaded detachable end connectors, and pressure rating not less than 125 psig at 73 deg F.
- D. CPVC Non-Union Ball Valves: MSS SP-122, with full- or reduced-port ball, socket or threaded ends, and pressure rating not less than 125 psig at 73 deg F.
- E. CPVC Butterfly Valves: With lever handle and pressure rating not less than 150 psig at 73 deg F.
- F. CPVC Check Valves: Swing or ball-check design and pressure rating not less than 150 psig at 73 deg F.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.2 PIPING SYSTEM INSTALLATION

- A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- 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. Pressure gages are specified in Division 20 Section "Meters and Gages," and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."
- E. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.
- F. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
1. Install hose-end drain valves at low points in water mains, risers, and branches.
 2. Install stop-and-waste drain valves where indicated.
- G. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water

Piping Specialties."

- H. Install domestic water piping level with 0.25 percent slope downward toward drain without pitch and plumb.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. PEX Piping Joints: Join according to ASTM F 1807.

3.4 WATER METER INSTALLATION

- A. Rough-in domestic water piping for water meter installation according to utility company's requirements.
- B. Water meters will be furnished and installed by utility company.

3.5 HANGER AND SUPPORT INSTALLATION

- 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
- 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
- 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. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for drawn-temper 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.

- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 - 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
 - 3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 - 4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 5. NPS 6: 48 inches with 3/4-inch rod.
 - 6. NPS 8: 48 inches with 7/8-inch rod.
- H. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- I. Alternate support for plastic piping: Continuous support 18 gauge v-shaped galvanized steel channel, maximum hanger spacing 8 feet.
- J. 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 domestic water piping to distribution side of water meter with shutoff valve.
- C. Install piping adjacent to equipment and machines to allow service and maintenance.
- D. Connect domestic water piping to the following:
 - 1. Water Heaters: Cold-water supply 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 required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. 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:

- a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. 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.
 3. 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.
 4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 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.

3.8 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling 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 flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for

application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.9 CLEANING AND DISINFECTION

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable and non-potable domestic water piping as follows:
 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.

****END OF SECTION****

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 4. Division 22 Section "Domestic Water Piping" for water meters.
 - 5. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Flow Reports and Settings: For calibrated balancing valves.
- E. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
 - 3. Comply with NSF 372, "Drinking Water System Components – Lead Content" for components with wetted surfaces in contact with potable water.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - 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.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Y-Pattern strainer and soft-seated check valve.

B. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining

complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.

7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.3 BALANCING VALVES

A. Calibrated Balancing Valves NPS 1/2 :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Apollo Valves; by Conbraco Industries, Inc.
 - d. Bell & Gossett; Xylem Inc.
 - e. Flo Fab Inc.
 - f. Flow Design Inc.
 - g. Griswold Controls.
 - h. NIBCO INC.
 - i. IMI Indoor Climate; Tour & Andersson.
 - j. Taco, Inc.
 - k. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Minimum Flow Rate: 0.3 gpm.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Calibrated Balancing Valves NPS 3/4 to NPS 2 :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Apollo Valves; by Conbraco Industries, Inc.
 - d. Bell & Gossett; Xylem Inc.
 - e. Flo Fab Inc.
 - f. Flow Design Inc.
 - g. Griswold Controls.
 - h. NIBCO INC.
 - i. IMI Indoor Climate; Tour & Andersson.
 - j. Taco, Inc.
 - k. Watts Water Technologies, Inc.; Watts Regulator Co.

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.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; ST70.
 - b. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
 - c. Bradley Corporation.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company; Series 170-LF and 270-LF.
 - f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: 1/2-inch union or 3/8-inch compression; with integral check valves.
7. Accessories: Adjustable temperature-control knob.
8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F .
9. Minimum Flow Rate: 0.5 gpm.
10. Valve Finish: Rough bronze.

2.5 PREPIPED TEMPERED WATER MIXING SYSTEM

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International.
 - b. Armstrong International, Inc. (RADA).
 - c. Bradley Corporation.
 - d. Lawler Manufacturing Company, Inc.; Prepipd 802 Hi-Low Tempered water Mixing System.
 - e. Leonard Valve Company.

- f. Symmons Industries, Inc.
 - g. Watts Water Technologies, Inc.; Powers Division.
 - h. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Description: Completely assembled and tested prepiped manifold system including mixing valve(s), recirculation pump, circuit setting balancing valve, aquastat, circulator switch box, thermometers, isolation valves, mounting strut, and test connection.
 3. Standard: ASSE 1017.
 4. Mixing Valve: Exposed-mounting, thermostatically controlled water mixing valve.
 - a. Material: Bronze body with corrosion-resistant interior components.
 - b. Connections: Threaded union inlets and outlet.
 - c. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - d. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - e. Size, Settings, and Capacities: As scheduled on the drawings.
 - f. Valve Finish: Rough bronze.
 5. Pump: Meeting requirements in Division 22 Section "Domestic Water Circulation Pumps."
 6. Mounting Strut: Meeting requirements in Division 20 Section "Hangers and Supports."

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Keckley.
 - c. Metraflex.
 - d. Mueller Steam Specialty.
 - e. NIBCO, Inc.
 - f. Spence.
 - g. SSI Equipment, Inc.
 - h. Watts Water Technologies, Inc.
 - i. Yarway.
2. CWP: 200 psig minimum, unless otherwise indicated.
3. SWP: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Screen: Stainless steel with round perforations, unless otherwise indicated.
7. Perforation Size:

- a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
8. Drain: Pipe plug.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

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.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Water Technologies, Inc.; Watts Regulator co.
 - f. Woodford Manufacturing Company.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze or chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish Rough bronze.
12. Operating Keys(s): One with each wall hydrant.

2.9 POST HYDRANTS

A. Nonfreeze, Draining-Type Post Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.5961
 - b. MIFAB
 - c. Tyler Pipe; Wade Div.
 - d. Woodford Manufacturing Company.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, exposed-outlet post hydrant.
4. Operation: Turning handle.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Outer Casing: Black iron pipe with a heavy grade of oil based enamel.
7. Inlet: NPS 1.
8. Outlet: Garden-hose thread complying with ASME B1.20.7.
9. Drain: Designed with hole to drain into ground when shut off.

2.10 HOSE CONNECTIONS

A. Manufacturers:

1. Elkhart Brass Mfg. Co., Inc.
2. Potter-Roemer; Fire-Protection Div.

B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type
2. Finish: Rough chrome-plated.

2.11 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - 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.

B. Water Hammer Arresters (Metal Bellows Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Precharged stainless steel bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.12 AIR VENTS

- A. Bolted-Construction Automatic Air Vents:
 - 1. Body: Bronze.
 - 2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
 - 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.
- 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
 - 4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.
- C. Install balancing valves in locations where they can easily be adjusted.

- D. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve and pump.
- F. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- G. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.
- H. Install water hammer arresters in water piping according to PDI-WH 201.
- I. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.

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. Reduced-pressure-principle backflow preventers.
 - 3. Double-check backflow-prevention assemblies.
 - 4. Calibrated balancing valves.
 - 5. Primary, thermostatic, water mixing valves.
 - 6. Manifold, thermostatic, water-mixing-valve assemblies.
- 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 Division 20 Section "Mechanical Identification."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

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 as follows:
 - 1. Set calibrated balancing valves at calculated presettings.
 - 2. Record settings and mark balancing devices.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

DOMESTIC WATER CIRCULATION PUMPS

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PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
- 1.2 SUBMITTALS
- A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.
 - B. Shop Drawings: Diagram power, signal, and control wiring.
 - C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.
- 1.3 QUALITY ASSURANCE
- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

- C. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
- E. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

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 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS (SMALL)

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett; Xylem Inc.; Series PL.
 - 3. Grundfos Pumps Corp.
 - 4. Taco, Inc.; Series 1400.
- B. Description: Factory-assembled and –tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
 - 1. Pump Construction: All bronze.
 - a. Casing: Radially split, bronze, with threaded companion-flange connections.
 - b. Impeller: Glass-reinforced corrosion-resistant material; keyed to shaft.
 - c. Shaft: High-strength alloy steel.
 - d. Seal: Mechanical, carbon/silicon carbide seal.
 - e. Bearings: Permanently oil-lubricated type.
 - 2. Motor-Single speed, with oil-lubricated bearings, unless otherwise indicated; and directly mounted to pump casing. Comply with requirements in Division 20 Section "Motors."

- C. Capacities and Characteristics: Refer to Schedule on Drawings.

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Manufacturers:
 - a. Honeywell International, Inc.
 - b. Square D.
 - c. White-Rodgers Div.; Emerson Electric Co.
 - 2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
 - 3. Range: 50 to 125 deg F.
 - 4. Operation of Pump: On or off.
 - 5. Transformer: Provide if required.
 - 6. Power Requirement: 24 V, ac.
 - 7. Settings: Start pump at 115 deg F and stop pump at 125 deg F.

2.4 FLEXIBLE CONNECTORS

- A. Refer to Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping. Do not use pump motors as a support point.
- D. Install centrifugal pumps with motor and pump shafts horizontal.

3.3 CONTROL INSTALLATION

- A. Install immersion-type thermostats in hot-water return piping.
- B. Install timers where indicated on Drawings.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Separately coupled, in-line centrifugal pumps.
 - b. Separately coupled, horizontally mounted, in-line centrifugal pumps.
 - c. Close-coupled, horizontally mounted, in-line centrifugal pumps.
 - d. Close-coupled, vertically mounted, in-line centrifugal pumps.
 - 2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 20 Section "Valves" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
 - 3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 20 Section "Meters and Gages" for pressure gages and gage connectors.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."
- F. Connect thermostats to pumps that they control.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set thermostats for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains, and prepare pump for

operation.

7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain pumps.

****END OF SECTION****

SANITARY WASTE AND VENT PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements".
 - 2. Division 20 Section "Basic Mechanical Materials and Methods".
 - 3. Division 22 Section "Drainage Piping Specialties".
 - 4. Division 22 Section "Sanitary Sewage" for piping outside building.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. PVC: Polyvinyl chloride plastic.

1.3 SYSTEMS DESCRIPTIONS

- A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
- C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

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 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers:
 - a. ANACO-Husky; McWane Plumbing Group.
 - b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
 - c. IDEAL-TRIDON.
 - d. Mission Rubber Company; a division of MCP Industries, Inc.
 - e. Tyler Pipe; McWane Plumbing Group.
 - 2. Standards: CISPI 310.
 - 3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated 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: Schedule 40, ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.4 SPECIALTY PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

- a. Dallas Specialty & Mfg. Co.
- b. Fernco, Inc.
- c. Logan Clay Products Company (The).
- d. Mission Rubber Co.
- e. NDS, Inc.
- f. Plastic Oddities, Inc.

2. Sleeve Materials:

- a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
- b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
- c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

- a. Cascade Waterworks Mfg. Co.
- b. Mission Rubber Co.

- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

- D. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

- a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING SYSTEM 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 to layout are approved on coordination drawings.
- B. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- E. 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."
- F. 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 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment 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.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

- 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
- 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 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. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 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.
- 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 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. 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.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary 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.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. 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.

END OF SECTION

DRAINAGE PIPING SPECIALTIES

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PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Plumbing Fixtures" for hair interceptors.
 - 4. Division 22 Section "Medical Plumbing Fixtures" for plaster sink interceptors.
- 1.2 DEFINITIONS
 - A. PVC: Polyvinyl chloride plastic.
- 1.3 SUBMITTALS
 - A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.
 - B. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

1.5 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CAST-IRON CLEANOUTS

- A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches . For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.
- B. Exposed Cast-Iron Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Series 58910.
 - b. MIFAB, Inc.; C1460.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.
- C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.; C1220-R.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M.
 - 3. Type: Adjustable housing.

4. Body or Ferrule: Cast iron.
 5. Clamping Device: Not required.
 6. Outlet Connection: Spigot.
 7. Closure: Brass, bronze, or plastic plug with tapered threads.
 8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
 10. Frame and Cover Shape: Round.
 11. Top Loading Classification: Medium Duty.
 12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- D. Cast-Iron Floor Cleanouts (Not-On-Grade Interior Floor Areas):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.; C-1100-C-R-34.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4333C.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M.
 3. Type: Adjustable housing.
 4. Body or Ferrule: Cast iron.
 5. Clamping Device: Required.
 6. Outlet Connection: Spigot.
 7. Closure: Brass, bronze, or plastic plug with tapered threads.
 8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
 10. Frame and Cover Shape: Round.
 11. Top Loading Classification: Medium Duty.

12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- E. Cast-Iron Wall Cleanouts (Finished Wall Areas):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Model 58790-20.
 - b. MIFAB, Inc.; C1460-RD.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
 4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
 5. Wall Access: Round, deep, chrome-plated bronze flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains (Toilet Rooms) FD-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.3.
 3. Pattern: Floor drain.
 4. Body Material: Gray iron.
 5. Seepage Flange: Required.
 6. Clamping Device: Required.
 7. Outlet: Bottom unless otherwise noted.
 8. Coating on Interior and Exposed Exterior Surfaces: Enamel.

9. Top or Strainer Material: Nickel bronze.
 10. Top of Body and Strainer Finish: Nickel bronze.
 11. Top Shape: Round, with vandal proof screws.
 12. Dimensions of Top or Strainer: 7 inch diameter.
 13. Top Loading Classification: Light Duty.
 14. Inlet Fitting: Gray iron, with spigot outlet.
- B. Cast-Iron Floor Drains (Mechanical Rooms) FD-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2142.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.3.
 3. Pattern: Floor drain.
 4. Body Material: Gray iron.
 5. Seepage Flange: Required.
 6. Clamping Device: Required.
 7. Outlet: Bottom unless otherwise noted.
 8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
 9. Sediment Bucket: 3-3/4 inches deep, slotted sediment bucket with lift bar.
 10. Top or Strainer Material: Cast-iron.
 11. Top Shape: Round.
 12. Dimensions of Top or Strainer: 11-1/2 inch diameter tractor grate, 29 square inches of free area.
 13. Top Loading Classification: Heavy Duty.
 14. Outlet Fitting: Gray iron, with spigot outlet.
- C. Large Capacity Floor Drains FD-3:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2450-SSB.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
 3. Pattern: Floor drain.
 4. Body Material: Fabricated steel.
 5. Seepage Flange: Required.
 6. Clamping Device: Required.
 7. Outlet: Bottom.
 8. Coating on Interior and Exposed Exterior Surfaces: Galvanized coating.
 9. Sediment Bucket: Perforated stainless steel sediment bucket with lift bar.
 10. Top or Strainer Material: Cast iron.
 11. Top of Body and Strainer Finish: Gray iron.
 12. Top Shape: Rectangular.
 13. Dimensions of Top or Strainer: 12-3/4 inch by 10-3/4 inch.
 14. Top Loading Classification: Heavy Duty.
 15. Outlet Connection: Spigot outlet.

2.3 CHANNEL DRAINAGE SYSTEMS

- A. PP or HDPE Plastic Channel Drainage Systems (TD-1):
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lighthouse Industries; Quick-Trench.
 - b. MIFAB, Inc.; T1400 Proformer.
 - c. NDS Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Interlocking-joint, PP or PE modular units, with end caps. Include flat, rounded, or inclined bottom, with sloped-invert, or combination of sloped and neutral invert sections, and with outlets in number, sizes, and locations indicated.

- 1) Dimensions: 4 inches wide. Include number of units required to form total lengths indicated.
 - b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
 - 1) Materials: PP or Polyolefin.
 - c. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - d. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- B. PP or PE Catch Basins:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lighthouse Industries; Quick-Trench.
 - b. MIFAB, Inc.; CB620 Proformer.
 - c. NDS Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 2. Description: PP or PE body, with outlets in number and sizes indicated. Include PP, polyolefin, or ductile iron slotted grate.

2.4 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.
- B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 10 inches from pipe, with boot reinforcement and counterflashing fitting.
1. Low-Silhouette Vent Cap: With vandal-proof vent cap.

2.5 TRAP SEAL PROTECTION DEVICES

- A. Barrier Type Trap Seal Protection Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
 - b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.
 2. Standard: ASSE 1072-2007.
 3. Sealing Element: Neoprene rubber or chemically resistant elastomer.

4. Size: 2 inch , 3 inch , 3-1/2 inch , or 4 inch.
5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.7 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Hub Outlets:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches 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.
- D. 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.
- E. 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.

2.8 FLASHING MATERIALS

- A. 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.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. 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.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

- E. 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.
 - F. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
 - G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
 - H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
 - I. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
 - J. Assemble open drain fittings and install with top of hub 2 inches above floor.
 - K. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.
 - L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
 - M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
 - N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
 - O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
 - P. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- 3.2 CONNECTIONS
- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to equipment to allow service and maintenance.

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 Division 07 Section "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 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.5 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

CONDENSING, FUEL-FIRED DOMESTIC WATER HEATERS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Section includes the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Breechings, Chimneys, and Stacks."

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail water heater 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 systems. Differentiate between manufacturer-installed and field-installed wiring.
- C. Product Certificates: For each type of water heater, signed by product manufacturer.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For water heaters to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
 - 3. Where ASME-code construction is indicated, fabricate and label commercial direct-fired storage water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV, HLW.
- E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
 - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

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 COMMERCIAL, GAS WATER HEATERS

- A. Commercial, Dual-Component, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
 - 1. Manufacturers:
 - a. Lochinvar Corporation; Armor AWN Series with Lock-Temp Storage Tank.

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CONDENSING FUEL-FIRED DOMESTIC WATER HEATERS

- b. Laars Heating Systems; a Subsidiary of Bradford White Corporation; Summit and Neotherm Series with Custom ASME Jacketed and Insulated Tank.
2. Description: Manufacturer's proprietary design with boiler, storage tank, pump, piping, and controls to provide at least 95 percent thermal efficiency at optimum operating conditions. Following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.
 3. Boiler Construction: ASME code with 160-psig working-pressure rating for hot-water-boiler-type water heater.
 - a. Modulating, Condensing Heat Exchanger: Stainless steel, built to ASME Section IV requirements.
 - b. Connections: Factory fabricated of materials compatible with boiler. Attach to boiler before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 4. Boiler Appurtenances:
 - a. Insulation: Comply with ASHRAE/IESNA 90.1.
 - b. Jacket: Steel with enameled finish.
 - c. Burner: For use with finned-tube water heaters and for natural-gas fuel.
 - d. Temperature Control: Adjustable, storage tank temperature-control fitting and flow switch, interlocked with circulator and burner.
 - e. Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - f. Automatic Ignition: Intermittent electronic ignition complying with ANSI Z21.20.
 5. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
 6. Support: Leveling legs, certified for installation on combustible floors.
 7. Sealed Combustion/Direct Vent: Combustion air is ducted to the combustion chamber from the outdoors.
 8. Hot-Water Storage Tank: Connected with piping to circulating pump and water heater.
 - a. Construction: According to ASME Boiler and Pressure Vessel Code: Section VIII, steel with 150-psig working-pressure rating.
 - b. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.

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- e. Jacket: Steel with enameled finish.
 - f. Anode Rods: Factory installed, magnesium.
 - g. Drain Valve: Corrosion-resistant metal complying with ASSE 1005, factory installed.
 - h. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
9. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, 125-psig minimum working-pressure rating, and 225 deg F continuous-water-temperature rating.
10. Piping: Copper tubing; copper, solder-joint fittings; and brazed or flanged joints.
11. Capacity and Characteristics: Refer to Schedule on Drawings.

2.3 EXPANSION TANKS

- A. Description: Steel, pressure-rated tank, ASME-code constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- 1. Manufacturers:
 - a. AMTROL Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Taco, Inc.
 - e. Wessels Co.
 - 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - 3. Capacity and Characteristics: Refer to Schedule on Drawings.

2.4 WATER HEATER ACCESSORIES

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
- B. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
- 1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
 - 2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.

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- C. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.
 - 1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
 - 2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.
- D. Flue Side Condensate Neutralizer:
 - 1. Description: Designed to raise the PH level of flue side condensate to near neutral prior to condensate entering the sanitary drainage system.
 - 2. Materials: Neutralizer constructed of PVC pipe and fittings mounted on channel strut base with galvanized or stainless steel clamps and hardware; and charged with calcium carbonate.
 - 3. Manufacturers:
 - a. BKI Industries, Inc.; Acid Neutralizer Kits.
 - b. J.J.M. Boiler Works; JM Neutralizing Tubes.
 - c. Neutrasafe Corporation; Neutra-Safe Condensate Neutralizers.
 - d. Any of the approved water heater manufacturers.

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install gas water heaters according to NFPA 54.
- D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
- E. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater,

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relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

- F. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 20 Section "Valves" for hose-end drain valves.
- G. Install thermometer on outlet piping of water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.
- H. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 20 Section "Valves" for general-duty valves and to Division 20 Section "Meters and Gages" for thermometers.
- I. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- J. Fill water heaters with water.
- K. Install expansion tanks with isolation and drain valves. Charge expansion tanks with air.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Connect vent to full size of water heater flue outlet. Refer to Division 23 Section "Breechings, Chimneys, and Stacks" for venting materials.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

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3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION

PLUMBING FIXTURES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet and Bath Accessories."
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."
 - 4. Division 22 Section "Drinking Fountains and Water Coolers."
 - 5. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
 - 6. Division 22 Section "Drainage Piping Specialties" for floor drains, and specialty fixtures not included in this Section.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- D. PVC: Polyvinyl chloride plastic.
- E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.
- D. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

A. Water Closets, WC-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Madera 16-1/2 Elongated Toilet.
 - b. Kohler Co.; K-4405.
 - c. Sloan Valve Company.
 - d. Zurn Plumbing Products Group.
- 2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: Flushometer valve.
 - 1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - 2) Supply Spud Location: Top.
 - 3) Height: 16-1/2 to 16-3/4 inches, universal/accessible.
 - 4) Design Consumption: 1.6 gal./flush.
 - 5) Color: White.
 - b. Flushometer: FV-2-1.
 - c. Toilet Seat: TS-1.
 - d. Fixture Support: Existing water-closet support combination carrier.

2.2 WATER CLOSET FLUSHOMETERS

A. Flushometers, FV-2-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
- 2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm or piston operation.
 - b. Style: Exposed.
 - c. Inlet Size: NPS 1.
 - d. Trip Mechanism: Oscillating, low-force ADA compliant lever-handle actuator.
 - e. Consumption: 1.6 gal./flush.

- f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.

2.3 TOILET SEATS

A. Toilet Seats, TS-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company; 1955SSC/1955SSCT.
 - b. Centoco Manufacturing Corp.
 - c. Church Seats; 295SSC/295SSCT.
 - d. Ferguson Enterprises, Inc.; ProFlo PFTSCOF2000WH.
 - e. Olsonite Seat Company; Model 10SSC/10SSCT.
 - f. Sanderson Plumbing Products, Inc.; Beneke Div.
 - g. Zurn Plumbing Products Group; 5955STS-WH.
- 2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SC, self-sustaining, check.
 - e. Class: Standard commercial.
 - f. Color: White.

2.4 LAVATORIES

A. Lavatories, LAV-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Lucerne Model 0355.012.
 - b. Ferguson Enterprises, Inc.; ProFlo PF5504.
 - c. Kohler Co.; K 2005 Kingston.
 - d. Sloan Valve Company.
 - e. Zurn Plumbing Products Group; Z5344.
- 2. Description: Accessible, wall-mounting, vitreous-china fixture.
 - a. Type: With contoured back and side shields.
 - b. Size: 20 by 18 inches rectangular.
 - c. Faucet Hole Punching: Three holes, 2-inch centers.
 - d. Color: White.
 - e. Faucet: LF-1.
 - f. Water Temperature Limiting Device: Required.
 - g. Drain: Grid with offset waste.
 - h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
 - i. Fixture Support: Lavatory with concealed arms.

2.5 LAVATORY FAUCETS

A. Lavatory Faucets, LF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Reliant 3 Model 7385.003/7385.043.
 - b. Chicago Faucets.
 - c. Delta Faucet Company; Model 523-WFHDF.
 - d. Kohler Co.
 - e. Moen Commercial.
 - f. Speakman Company; Model S-3561.
 - g. T & S Brass and Bronze Works, Inc.; B-2711.
 - h. Zurn Plumbing Products Group; Z7440.

2. Description: Single handle mixing faucet, vandal resistant, 2 or 3 holes, with metal grid strainer, no lift rod hole, high temperature limit stop.
 - a. Body Material: Commercial, all metal construction meeting NSF 61.
 - b. Finish: Polished chrome plate.
 - c. Centers: 4 inches.
 - d. Mounting: Deck, concealed.
 - e. Inlet(s): NPS 1/2.
 - f. Spout Outlet:
 - 1) Vandal resistant aerator.
 - 2) Laminar flow or plain end for patient care areas.

 - g. Maximum Flow Rate:
 - 1) 0.5 gpm for faucets in public restrooms.

2.6 COUNTER-MOUNTING SINKS

A. Sinks, SK-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Franke Consumer Products, Inc., Commercial Div.
 - c. Just Manufacturing Company.
 - d. Moen Commercial.

2. Description: Single-bowl, counter-mounting, lay-in stainless-steel sink.
 - a. Overall Dimensions: 22 inches left to right by 19 inches front to back.
 - b. Metal Thickness: 18 gage, with sound dampened underside.
 - c. Bowl:
 - 1) Dimensions: 18 inches by 14 inches by 6 inches deep.
 - 2) Drain: 3-1/2-inch grid with offset waste.

 - d. Sink Faucet: SF-1.
 - e. Water Temperature Limiting Device: Required.
 - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).

- g. Disposer: Not required.
- h. Dishwasher Air-Gap Fitting: Not required.
- i. Hot-Water Dispenser: Not required.

2.7 SERVICE SINKS

A. Service Sinks, SS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Florwell Cast Iron Service Sink.
 - b. Kohler Co.; Whitby K 6710.
 - c. Zurn Plumbing Products Group; Z5850.
2. Description: Floor-mounting, enameled, cast-iron fixture with front apron, raised back, and coated, wire rim guard.
 - a. Size: 28 by 28 inches.
 - b. Color: White.
 - c. Faucet: Sink SF-2.
 - d. Drain: Grid with NPS 3 outlet.

2.8 SINK FAUCETS

A. Sink Faucets, SF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets; No. 201-G8AE3-317AB.
 - c. Delta Faucet Company; Model 23C632-R7LS.
 - d. Kohler Co.
 - e. Moen Commercial.
 - f. Speakman Company.
 - g. T & S Brass and Bronze Works, Inc.
 - h. Zurn Plumbing Products Group; Z831C4-140.
2. Description: Sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Mixing Valve: Two handle.
 - d. Centers: 8 inches.
 - e. Mounting: Deck.
 - f. Handle(s): Wrist blade, 4 inches.
 - g. Operation: Noncompression, manual.
 - h. Inlet(s): NPS 1/2.
 - i. Spout Type: 70-degree restricted swing gooseneck.
 - j. Spout Outlet: Aerator.
 - 1) Aerator.
 - 2) Laminar flow or plain end for patient care areas.

k. Maximum Flow Rate:

1) 1.5 gpm.

B. Sink Faucets, SF-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Standard Companies, Inc.
- b. Chicago Faucets; Model 305-VBCP.
- c. Delta Faucet Company; Model 28C2083-AC.
- d. Kohler Co.
- e. Moen Commercial.
- f. Speakman Company; SC5821-PC-LEV-5H-WH.
- g. T & S Brass and Bronze Works, Inc.
- h. Zurn Plumbing Products Group.

2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.

- a. Body Material: Commercial, solid brass.
- b. Finish: Polished chrome plate.
- c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
- d. Mixing Valve: Two handle.
- e. Centers: 8 inches.
- f. Mounting: Back/wall.
- g. Handle(s): Lever.
- h. Inlet(s): NPS 1/2.
- i. Spout Type: Rigid, solid brass with pail hook.
- j. Spout Outlet: Hose thread.
- k. Vacuum Breaker: Required.
- l. Operation: Noncompression, manual.

2.9 SHOWERS

A. Shower Faucets, (SH-1):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Bradley Corporation; WS-1X
- b. American Standard Companies, Inc.
- c. Acorn Controls: Morris Group International
- d. Chicago Faucets.
- e. Delta Faucet Company.
- f. Kohler Co.
- g. Lawler Manufacturing Co., Inc.
- h. Leonard Valve Company.
- i. Moen Commercial.
- j. Powers; a Watts Water Technologies Co.
- k. Speakman Company.
- l. Symmons Industries, Inc.
- m. Zurn Plumbing Products Group.

2. Description: Completely preassembled ready to mount to the wall, individual pivoting shower wall with single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange.
 - a. Shower Panel: Stainless steel Type 300, all exposed parts are stainless steel or chrome plated brass, supply inlets are flexible stainless steel hose.
 - b. Hinges: All hinges are stainless steel
 - c. Body Material: Solid brass.
 - d. Finish: Polished chrome plate.
 - e. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
 - f. Operation: Compression, manual.
 - g. Antiscald Device: ASSE 1016, integral with mixing valve.
 - h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 - i. Supply Connections: NPS 1/2.
 - j. Shower Head Type: Ball joint.
 - k. Shower Head Material: Chrome plated brass finish.
 - l. Spray Pattern: Adjustable.
 - m. Integral Volume Control: Required.
 - n. Shower-Arm Flow-Control Fitting: 1.5 gpm.
 - o. Accessories: Wall mounted soap dish

B. Shower Faucets, (SH-2-ADA):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation; WS-1WCA-BF
 - b. American Standard Companies, Inc.
 - c. Acorn Controls: Morris Group International
 - d. Chicago Faucets.
 - e. Delta Faucet Company.
 - f. Kohler Co.
 - g. Lawler Manufacturing Co., Inc.
 - h. Leonard Valve Company.
 - i. Moen Commercial.
 - j. Powers; a Watts Water Technologies Co.
 - k. Speakman Company.
 - l. Symmons Industries, Inc.
 - m. Zurn Plumbing Products Group.
2. Description: Completely preassembled ready to mount to the wall, individual pivoting shower wall with single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; hand held spray arm, and flange. Single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and flange.
 - a. Shower Panel: Stainless steel Type 300, all exposed parts are stainless steel or chrome plated brass, supply inlets are flexible stainless steel hose.
 - b. Hinges: All hinges are stainless steel
 - c. Body Material: Solid brass.
 - d. Finish: Polished chrome plate.
 - e. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
 - f. Diverter Valve: Integral with mixing valve.
 - g. Backflow Protection Device for Hand-Held Shower: Required.
 - h. Operation: Compression.

- i. Antiscald Device: ASSE 1016, integral with mixing valve.
- j. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
- k. Supply Connections: NPS 1/2.
- l. Shower Head Type: Hand held, slide-bar mounted with stainless steel hose, minimum hose length of 60". Hand held shower head must have nonpositive shut-off control.
- m. Integral Volume Control: Required
- n. Shower-Arm Flow-Control Fitting: 2.0 gpm.
- o. Temperature Indicator: Not required.
- p. Hand held shower must be operable with one hand without tight grasping or twisting.
- q. Recessed soap dish

2.10 FIXTURE SUPPLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BrassCraft; a Masco Company.
 - 2. McGuire Mfg. Co., Inc.
 - 3. Any of the approved plumbing fixture manufacturers.
- B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers (PSG-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products; SG-200BV.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Z8946-3-NT.
 - 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 (PSG-2):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Co.
 - b. TRUEBRO, Inc.
 - c. Zurn Plumbing Products Group; Z6900-VG

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.12 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Josam Company.
 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.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Lavatory Supports:
 1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- C. Sink Supports:
 1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.
 - a. Type I, sink carrier with exposed arms and tie rods.
 - b. Type II, sink carrier with hanger plate, bear studs, and tie rod.
 - c. Type III, sink carrier with hanger plate and exposed arms.

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 plumbing fixture installation.
- B. Examine cabinets, counters, floors, 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. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports without waste fitting for fixtures with tubular waste piping.

2. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- D. Install wall-mounting fixtures with tubular waste piping attached to supports.
- E. Install counter-mounting fixtures in and attached to casework.
- F. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.
- H. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section "Domestic Water Piping Specialties."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.
- L. Install toilet seats on water closets.
- M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- O. Install traps on fixture outlets.
 1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- P. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- Q. Set service basins in leveling bed of cement grout. Grout is specified in Division 20 Section "Basic Mechanical Materials and Methods."
- R. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 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. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

****END OF SECTION****

EMERGENCY PLUMBING FIXTURES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers and water filters.
 - 4. Division 22 Section "Drainage Piping Specialties" for floor drains and cleanouts.
 - 5. Division 22 Section "Plumbing Fixtures" for laboratory faucets with integral eyewash.

1.2 DEFINITIONS

- A. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- B. Tepid: Moderately warm.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- B. ASSE Standard: Comply with ASSE 1071 "Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment" for emergency mixing valves.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

- A. Combination Units, (EES-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Guardian Equipment Co.
 - c. Haws Corporation.
 - d. Speakman Company.
 - e. Stingray Systems.
 - 2. Description: Plumbed, freestanding, with emergency shower and eyewash equipment.
 - a. Piping: Plastic .
 - 1) Unit Supply: NPS 1-1/4 minimum from top or side.
 - 2) Unit Drain: Outlet at side near bottom.
 - 3) Shower Supply: NPS 1 with flow regulator and stay-open ball valve.
 - 4) Eyewash Supply: NPS 1/2 with flow regulator and stay-open ball valve.
 - b. Shower Capacity: Deliver potable water at rate not less than 20 gpm for at least 15 minutes.
 - 1) Valve Actuator: Pull rod.
 - 2) Shower Head: 8-inch minimum diameter, stainless steel or plastic.
 - c. Eyewash Equipment: With capacity to deliver potable water at rate not less than 0.4 gpm for at least 15 minutes.
 - 1) Valve Actuator: Paddle and Treadle.
 - 2) Receptor: Stainless-steel bowl.

2.2 WATER-TEMPERING EQUIPMENT

- A. Water-Tempering Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acorn Controls; Morris Group International; ET71 Series.
 - b. Armstrong International, Inc. (RADA)
 - c. Bradley Corporation.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Lawler Manufacturing Co., Inc.; Model 911.
 - g. Leonard Valve Company.
 - h. Powers, a Watts Industries Co.; Model ES 400.
 - i. Speakman Company.
 - j. Stingray Systems; SV160.
2. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.
- a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at multiple emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

2.3 SOURCE QUALITY CONTROL

- A. Certify performance of emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 20 Section "Valves."
 1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
 2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of

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EMERGENCY PLUMBING FIXTURES

different metals. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."

- F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 20 Section "Meters and Gages."
- G. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 22 Section "Sanitary Waste and Vent Piping."
- H. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- I. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 20 Section "Mechanical Identification."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
- C. Connect cold water and electrical power to electric heating water-tempering equipment.
- D. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.

3.4 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.
- B. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements.
 - 1. Test and adjust controls and safeties.
- C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- D. Report test results in writing.

3.5 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION

DRINKING FOUNTAINS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 DEFINITIONS

- A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- C. Fitting: Device that controls flow of water into or out of fixture.
- D. Fixture: Drinking fountain or water cooler.

1.3 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL 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"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains, (DF-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.; EDFP217C.
 - b. Halsey Taylor; HRFSEBP.
 - c. Haws Corporation; 1119.
 - d. Murdock Manufacturing; A Member of Morris Group International; A152400B.
 - e. Oasis Corporation; MSSLPM.
 - f. Sunroc Corp.; SF-3700.
 - 2. Description: Accessible, Style W, dual-height, wall-mounting drinking fountain.
 - a. Material: Stainless steel.
 - b. Receptor Shape: Rectangular.
 - c. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - d. Bubblers: One for each receptor, flexible or elastomeric overmolded, with adjustable stream regulator.
 - e. Control: Push button.
 - f. Supply: NPS 3/8 with ball, gate, or globe valve.
 - g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
 - h. Support: Refer to "Fixture Supports" Article.

2.2 FIXTURE SUPPORTS

- A. 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.; A Member of Morris Group International.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to 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 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. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to 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 Division 20 Section "Valves."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in

Division 20 Section "Basic Mechanical Materials and Methods."

- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 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."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.6 CLEANING

- A. After completing fixture installation, 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.

END OF SECTION

COMMON WORK RESULTS FOR HVAC

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing."

1.2 SUMMARY

- A. This Section includes common requirements for fans and air moving equipment.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Fan bearings.
 - 2. Direct drive couplings.

1.4 QUALITY ASSURANCE

- A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- B. Fan Performance Data: AMCA Standard 210.
- C. Sound Power Level Ratings:
 - 1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
 - 2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 FAN SHAFTS

- A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.3 FAN POWER TRANSMISSION

- A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.
- B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.
- C. Base horsepower rating of drive on minimum pitch diameter of small sheave.
- D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.
- E. Adjust belt tension in accordance with the manufacturer's recommendations.
- F. Perform alignment and final belt tensioning in the presence of the Architect.

2.4 SHEAVES

- A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.
- B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.
- C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.
- D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.
- E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.
- F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.5 V-BELT FAN DRIVES

- A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.
- B. Manufacturers:
 - 1. Emerson Power Transmission; Browning.
 - 2. Rockwell Automation; Dodge.
 - 3. T.B. Wood's Incorporated.

2.6 FAN DRIVE, SHAFT, AND COUPLING GUARDS

- A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.
- B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.
- C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.
- D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage

material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

- E. Centrifugal exhaust fans shall be provided with shaft seals.

2.7 BELT DRIVE GUARDS

- A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.
- B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.8 V-BELTS

- A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.
- B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.
- C. Manufacturers:
 - 1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
 - 2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
 - 3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.

2.9 V-BELT DRIVE MOTOR BASES

- A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.
- B. Provide for adjustment of both belt tension and alignment.

2.10 AIR HANDLING SYSTEM BALANCING PROVISIONS

- A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.11 MOTOR REQUIREMENTS

- A. Furnish motors in accordance with Division 20 Section "Motors."

2.12 FAN BEARINGS

- A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L₁₀ minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.
 - 1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
 - 2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L₁₀ life requirements.

2.13 IDENTIFICATION

- A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.14 ACCESSORIES

- A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
- B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.
- C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION

TESTING, ADJUSTING, AND BALANCING

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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. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Common Work Results for HVAC."

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
- B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

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. AHJ: Authority having jurisdiction.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. 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.
- E. 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.
- F. NC: Noise criteria.
- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- H. RC: Room criteria.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. 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.
- K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- M. 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.
- N. TAB: Testing, adjusting, and balancing.
- O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- P. Test: A procedure to determine quantitative performance of systems or equipment.
- Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within **30** days from Contractor's Notice to Proceed, submit **2** copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within **30** days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit **2** copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Approved Balancing Agencies.
 - 1. The TAB firm selected shall be from the following list:
 - a. Absolut Balance Company, Inc.; South Lyon, MI.
 - b. Air Solutions, Inc.; Lapeer, MI.
 - c. Airflow Testing Inc.; Lincoln Park, MI.
 - d. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
 - e. Control Solutions, Inc.; Byron Center, MI.
 - f. Ener-Tech Testing; Holly, MI.
 - g. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
 - h. International Test & Balance Inc.; Southfield, MI.
 - i. Quality Air Service; Portage, MI.
- 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 AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.
- F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards

for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

- 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.

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 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: If AABC standards are used, 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: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB 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 system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- B. Examine system and equipment test reports.
- C. Examine HVAC 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.
- D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- E. Examine equipment for installation and for properly operating safety interlocks and controls.
- F. 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.
- G. 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. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.
- C. 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 AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. 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.
- C. 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, or use reduced scale contract documents with notations.

- 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. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.
- G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- H. Verify that motor starters are equipped with properly sized thermal protection.
- I. Check dampers for proper position to achieve desired airflow path.
- J. Check for airflow blockages.
- K. Check condensate drains for proper connections and functioning.
- L. Check for proper sealing of air-handling unit components.
- M. 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.
 - 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. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.

5. Do not recommend 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 airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow 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 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. Power factor.
 6. Nameplate and measured voltage, each phase.
 7. Nameplate and measured amperage, each phase.
 8. Starter size.
 9. Starter thermal-protection-element rating.

10. Fuse number and size.

- 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.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Air handling equipment and outlets: Plus or minus 5 percent.
 - a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
 2. Heating-Water Flow Rate: 0 to minus 10 percent.
 3. Cooling-Water Flow Rate: 0 to plus 5 percent.

3.9 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.

3.10 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. Notes to explain why certain final data in the body of reports varies from indicated values.
 14. 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:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water flow rates.
 3. Terminal units.
 4. Balancing stations.
- 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.
 - g. Power factor efficiency.
 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. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btuh.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btuh.
 - i. High-fire fuel input in Btuh.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btuh.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btuh.

- 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. 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.
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. Voltage at each connection.
 - m. Amperage for each phase.
 - n. Kilowatt input.
 - o. Crankcase heater kilowatt.

- p. Number of fans.
 - q. Condenser fan rpm.
 - r. Condenser fan airflow rate in cfm.
 - s. Condenser fan motor make, frame size, rpm, and horsepower.
 - t. Condenser fan motor voltage at each connection.
 - u. Condenser fan motor amperage for each phase.
- K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- L. Instrument Calibration Reports:
- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.11 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 Owner.
 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
 3. Owner 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.

3.12 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

TEMPERATURE CONTROLS

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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 work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section “Mechanical General Requirements.”
 - 2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DEFINITIONS

- A. CAD: Computer Aided Design.
- B. TC: Temperature Control.

1.4 SYSTEM DESCRIPTION

- A. Temperature and ventilation control system consisting of digital and electric thermostats, sensors, dampers, damper operators, duct smoke detectors, controls conduit and/or raceway systems, relays, switches, etc., and all associated control and interlock wiring.
- B. Gauges, indicating devices, electric and electronic control accessories, and other control system devices.

1.5 SEQUENCE OF OPERATION

- A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.6 SUBMITTALS

- A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.
- B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valve and automated dampers shall be incorporated with the complete temperature controls submittal.
- C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control
- D. 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.
- E. Shop Drawings:
 - 1. Shop drawings shall be done on CAD. Minimum size 11" x 17".
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
 - 5. Written sequence of operation for each controlled system.

6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
 7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
 8. Complete bill of materials to identify and quantify all control components
- F. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
1. Dampers:
 - a. Component tag.
 - b. Equipment served/function.
 - c. Overall damper size (inch width x inch height).
 - d. Quantity of damper sections with respective size(s):
 - e. Material and gauge of thickness.
 - f. Mounting orientation (horizontal or vertical).
 - g. Blade configuration (parallel or opposed)
 - h. Pressure drop (in. WG).
 - i. Shut-off rating/differential pressure rating (in. wg).
 - j. Leakage rating (CFM/sq.ft. at 4 in. wg).
 - k. Normal position (normally open, normally closed, floating).
 - l. Actuator spring range (where applicable).
 - m. Actuator power requirement.
 - n. Actuator torque requirement.
 - o. Actuator quantity.
 - p. Damper manufacturer/model number.
 - q. Actuator manufacturer/model number.
- G. Wall mounted thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- I. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- J. Project Record Documents: Include the following:
1. Revise Shop Drawings to reflect actual installation and operating sequences.
 2. Record actual locations of control components, including control units, thermostats, and sensors.
 3. Submit the electronic files for all as-built shop drawings on diskette in pdf format.
- K. Maintenance Manuals: Include the following:
1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.

2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

1.7 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
- C. ANSI/ASTM B32 - Solder Metal.
- D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- F. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- G. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.
- H. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- I. NEMA DC 3 - Low-Voltage Room Thermostats.
- J. ASTM E1 - Specification for ASTM Thermometers.
- K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature and ventilation control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

- A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.
- B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
- D. Ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
- F. Provide duct smoke detectors (as specified herein) with power and control interlock wiring as shown on M8-series contract documents.
- G. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.
- H. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

- A. Provide warranty per Division 20 Section "General Mechanical Requirements" and as supplemented in this section.
- B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.
- C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Provide two (2) four-hour service calls scheduled with the Owner. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

1.12 POSTED OPERATING INSTRUCTIONS

- A. Provide temperature-and ventilation control system as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

- A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, not including PC laptop.

1.14 PROTECTION OF PROPRIETARY INFORMATION

- A. All proprietary manuals and software that are subject to a non-disclosure agreement shall be

submitted by the proprietary equipment manufacturer to the Owner for signed approval during the warranty period.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF THE TEMPERATURE AND VENTILATION CONTROL (TCS)

- A. The TCS shall be fully installed, complete, and operational system incorporating control ventilating HVAC equipment and other related systems.
- B. Approved Manufacturer:
 - 1. Alerton.
 - 2. American Auto-Matrix.
 - 3. Automated Logic Controls.
 - 4. Distech.
 - 5. Honeywell.
 - 6. Johnson Controls.
 - 7. Schneider Electric.
 - 8. Siemens.
- C. Approved Installer:
 - 1. An installer who is experienced with the approved control system manufacturer for both installation and maintenance of products required for this Project.

2.2 CONTROL AND INSTRUMENTATION TUBING

- A. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
 - 1. Fittings: ANSI/ASME B16.22, wrought copper.
 - 2. Joints: ANSI/ASTM B32, 95-5 tin antimony.
- B. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
 - 1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
 - 2. Joints: Ball Sleeve compression type.
- C. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.
 - 1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
 - 2. Joints: Compression or barbed type.

2.3 DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED

- A. Performance: AMCA certified for Air Performance and Air Leakage.
- B. Frames: Extruded aluminum, .080-inch thickness minimum, 4 inches deep minimum, thermally broken, and insulated with polystyrene or polyurethane foam insulation.
- C. Blades: Extruded aluminum, internally insulated, and thermally broken. Maximum blade size 8 inches wide, 60 inches long.
- D. Shafts: Minimum 7/16 inch hexagonal or square corrosion resistant zinc plated steel.
- E. Blade Seals: Extruded EPDM, silicone, or synthetic elastomeric, mechanically attached.
- F. Jamb Seals: Silicone, or synthetic elastomeric, mechanically attached.
- G. Bearings: Dual bearing assembly of durable synthetic polymer resulting in no metal-to-metal contact. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
- H. Linkage: Linkage shall be installed in the frame side and shall be constructed of aluminum and/or corrosion resistant zinc plated steel.
- I. Leakage: Less than 3 CFM per square foot at 1 inch W.G. pressure differential at minus 40 deg F.
- J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4 inches W.G.
- K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
- L. Temperature Limits: Minus 40 to 155 deg F.
- M. Manufacturers:
 - 1. Greenheck ICD-45.
 - 2. Ruskin CDTI-50BF.
 - 3. Tamco Series 9000 BF

2.4 DAMPER OPERATORS - ELECTRIC

- A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.
- B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.
- C. Manufacturers:

1. Belimo.
2. Delta Control Products.
3. Honeywell.
4. Schneider Electric Controls.
5. Johnson Controls.
6. Siemens.

2.5 LIMIT SWITCHES

- A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.
- B. Manufacturers:
 1. Allen-Bradley.
 2. General Electric.
 3. Square D.
 4. Westinghouse.
 5. Micro-switch.

2.6 LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
- B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
- C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24" (unless space requirements are minimal).

2.7 THERMOSTATS – ELECTRIC

- A. Line Voltage Thermostats: Maximum deadband of 2-degrees F, concealed temperature adjustment, locking cover, rated for load, single-pole or two-pole as required. Provide with integral manual On/Off/Auto selector switch where indicated. Provide with locking guards in all areas.
- B. Room Thermostat Accessories:
 1. Thermostat Covers and Guards: Manufacturer's standard with finish as selected by Architect.
 2. Insulating Bases: Provide one inch insulating base for thermostats located on exterior walls.

3. Adjusting Key: As required for thermostats.
 4. Keys: As required for locking guards.
- C. Strap-on Aquastat: UL listed, with a suitable removable spring clip attaching aquastat to pipe, and a snap-acting, SPDT switch.
- D. Manufacturers:
1. Honeywell.
 2. Schneider Electric Controls.
 3. Johnson Controls.
 4. Siemens.
- 2.8 DUCT SMOKE DETECTORS:
- A. Photoelectric Smoke Detectors:
1. Sensor: LED or infrared light source with matching silicon-cell receiver.
 2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
- B. UL 268A listed, operating at 24Vdc nominal.
- C. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
- D. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
- E. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where required.
- F. Each sensor shall have multiple levels of detection sensitivity.
- G. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
- H. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.
- 2.9 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK
- A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.
- B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.
- C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum

rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

- D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.
- E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.
- F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.
- G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION - CONTROL SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.
- C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
- D. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports.
- E. Provide conduit and electrical wiring where required.
- F. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize "wiremold" routing.
- G. Splicing of sensor cabling at junction boxes shall not be acceptable.
- H. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instrument air tubing as required.
- K. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
- L. Locate, size, and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.

- M. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.
- N. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
- O. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.
- P. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.

3.2 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS

- A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TCS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.
- B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.
- C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include
 1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
 2. Owner training agenda and scheduling.
 3. TCS system acceptance procedures.

3.3 IDENTIFICATION AND MARKING

- A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.
- B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.
- C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.
- D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate

permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.

3.4 OWNER INSTRUCTION AND TRAINING

- A. Provide eight (8) hours of on-site training to the Owner on the operation of the control systems for the initial installation.
- B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance, and calibration.
- C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.
- D. Provide 5 sets of literature pertaining to the operation and maintenance of the TCS control components provided.

3.5 CALIBRATION AND START-UP

- A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.
- B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.6 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION

FUEL GAS PIPING

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PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
- 1.2 SUMMARY
- A. This Section includes facility fuel gas piping and service meter assemblies.
 - B. Service meter assemblies will be furnished and installed by utility company.
 - C. Service meter assemblies will be furnished by utility company for installation by Contractor.
- 1.3 DEFINITIONS
- A. Gas Main: Utility's natural gas piping.

- B. Gas Distribution: Piping from gas main to individual service-meter assemblies.
- C. Service-Meter Assembly: Piping, valves, service regulator, service meter, and specialties.
- D. Point of Delivery: Piping outlet from service regulator assembly.
- E. Fuel Gas Piping: Piping that conveys fuel gas from point of delivery to fuel gas utilization devices inside the building.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: Performance requirements are scheduled on the Drawings.
 - 2. Exception: Fuel Gas Piping Installed within Ceilings Used as Plenums: 150 psig .

1.5 SYSTEMS DESCRIPTIONS

- A. Fuel gas piping system materials are scheduled on the Drawing.

1.6 SUBMITTALS

- A. Product Data: For the following:
 - 1. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 2. Service meters. Include pressure rating and capacity of selected models.
 - 3. Pressure regulators. Include pressure rating, capacity, and settings of selected models.
- B. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For natural gas specialties and accessories to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Gas System Pressure: Not more than 5.0 psig.

C. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu. ft.
2. Nominal Specific Gravity: 0.6.

1.9 COORDINATION

A. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

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 BLACK STEEL PIPE AND FITTINGS

A. Black Steel Pipe: ASTM A 53/A 53M; Type E or S; Grade B; Schedule 40. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
6. Joint Compound and Tape: Suitable for natural gas.
7. Steel Flanges and Flanged Fittings: ASME B16.5.
8. Gasket Material: Thickness, material, and type suitable for natural gas.

2.3 PIPING SPECIALTIES

A. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods."

2.5 SPECIALTY VALVES

- A. Valves, NPS 3 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
- B. Natural Gas Valves, NPS 3 and Smaller: Use the following:
 - 1. Ball Valves: Bronze or brass body with AGA or CSA stamp, UL listed or FM approved for service, with chrome-plated brass ball and lever handle; 125-psig minimum pressure rating.
 - a. Manufacturers:
 - 1) Apollo Valve; Conbraco Industries, Inc.
 - 2) Jomar International Ltd.
 - 3) Legend Valve and Fitting, Inc.
 - 4) NIBCO INC.
 - 5) Watts Water Technologies, Inc.; Watts Regulator Co.

2.6 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

2.7 SERVICE-METER ASSEMBLY INSTALLATION

- A. Service meter assembly will be installed by the fuel gas utility company.
- B. Include gas valve or plug valve, service pressure regulator, and service meter for each assembly.
- C. Install service meters downstream from service pressure regulators.
 - 1. Service meters with connections larger than NPS 1 supported from piping or set on concrete bases.

2.8 PIPING SYSTEM INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.
- E. Concealed Locations:

1. Above Inaccessible Ceiling Locations: Gas piping with welded joints may be installed in inaccessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above inaccessible ceilings.
 2. Above Accessible Ceiling Locations: Gas piping with welded joints may be installed in accessible ceiling spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above ceilings used as plenums.
 3. In Floor Channels: Gas piping may be installed in floor channels, subject to approval of authorities having jurisdiction. Channels must have cover and be open to space above cover for ventilation.
 4. In Partitions: Do not install concealed piping in solid partitions, unless installed in a chase or casing.
 - a. Exception: Piping passing through partitions or walls.
 5. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.
 6. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
- F. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- G. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- H. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- I. Connect branch piping from top or side of horizontal piping.
- J. Install strainer on inlet of each automatic and electrically operated valve.
- K. Locate valves for easy access.
- L. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- M. Install flanges when connecting to valves, specialties, and equipment having NPS 2-1/2 and larger connections.
- N. Install gas valve or plug valve and strainer upstream from each line pressure regulator or appliance pressure regulator.

2.9 JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Use materials suitable for fuel gas.

2.10 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 20 Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet.

2.11 CONNECTIONS

- A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
- B. Install piping adjacent to appliances to allow service and maintenance.
- C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

2.12 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.
 - 1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 - 2. Nameplates, pipe identification, and signs are specified in Division 20 Section "Mechanical Identification."
 - 3. Trace Wire: Yellow insulated, minimum 18 AWG wire, having copper or other approved conductor, with insulation suitable for direct burial, installed adjacent to underground nonmetallic piping, with aboveground access to tracer wire at each end of pipe.

2.13 PAINTING

- A. Use materials and procedures in Division 09 painting Sections.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel semigloss.
 - d. Color: Gray.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

2.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections during business hours.
- B. Allow Owner access to field quality-control testing of fuel gas system. Notify Owner 7 days in advance of testing.
- C. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- D. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

2.15 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, and maintain lubricated plug valves.

END OF SECTION

METAL DUCTS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
 - 3. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

1.3 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

- B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.

1.4 SUBMITTALS

- A. Shop Drawings: Drawn to scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Duct layout indicating sizes and pressure classes.
 - 3. Elevations of top and bottom of ducts.
 - 4. Dimensions of main duct runs from building grid lines.
 - 5. Fittings.
 - 6. Reinforcement and spacing.
 - 7. Seam and joint construction.
 - 8. Penetrations through fire-rated and other partitions.
 - 9. Equipment installation based on equipment being used on Project.
 - 10. Duct accessories, including access doors and panels.
 - 11. Hangers and supports, including methods for duct and building attachment.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Other systems installed in same space as ducts.
 - 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 - 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.6 COORDINATION

- A. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."
 - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- B. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

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 SHEET METAL 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
- C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 coating designation. Factory-applied PVC coatings shall be 4 mils thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 4 mils thick on opposite surfaces.
- D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Reinforcement Shapes and Plates:
 - 1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
 - 2. Compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods:
 - 1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.
 - 2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches .

2.3 SEALANTS 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. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
 - 1. Manufacturers:
 - a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.
- C. Water-Based Joint and Seam Sealant:
 - 1. Manufacturers:
 - a. Design Polymerics; DP1010 Water Based Duct Sealant.
 - b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
 - c. Polymer Adhesives; No. 11.
 - d. United McGill.
 - 2. Application Method: Brush on.
 - 3. Solids Content: Minimum 63 percent.
 - 4. Shore A Hardness: Minimum 20.
 - 5. Water resistant.
 - 6. Mold and mildew resistant.
 - 7. VOC: Maximum 75 g/L (less water).
 - 8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 9. Service: Indoor or outdoor.
 - 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
 - 1. Manufacturers:
 - a. Hardcast; Sure-Grip 404.
 - b. United McGill.
 - 2. Application Method: Brush on.
 - 3. Base: Synthetic rubber resin.
 - 4. Solvent: Toluene and heptane.
 - 5. Solids Content: Minimum 60 percent.
 - 6. Shore A Hardness: Minimum 60.

7. Water resistant.
 8. Mold and mildew resistant.
 9. VOC: Maximum 395 g/L.
 10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 11. Service: Indoor or outdoor.
 12. Substrate: Compatible with galvanized sheet steel, 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.
- F. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
 2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
 4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 - 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
- E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
 - 1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
 - a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
 - b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
 - 2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
 - 3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
 - 4. Manufacturers:
 - a. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - b. Duro Dyne Corp.; Dyna-Tite System.
 - c. Gripple Inc.; Hang-Fast System.
- F. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
 - 1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.
 - a. Stainless steel complying with ASTM A 492.
 - 2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
 - 3. End Fixings:
 - a. Loop End: Type 316L/A4 stainless steel.
 - b. Stud or Toggle End: Type 304L/A2 stainless steel.
 - c. Plain end suitable for stainless steel wire rope beam clamp.
 - 4. Manufacturers:
 - a. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - b. Duro Dyne Corp.; Dyna-Tite System.
 - c. Gripple Inc.; Hang-Fast System.

2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - 3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.6 ROUND DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round Spiral Lock-Seam Ducts:
 - 1. Manufacturers:
 - a. Eastern Sheet Metal (ESM).
 - b. LaPine Metal Products.
 - c. Linx Industries (previously Lindab USA); a DMI Company.
 - d. McGill AirFlow Corporation.
 - e. SEMCO Incorporated.
 - f. SET Duct Manufacturing, Inc.
 - g. Tangent Air, Inc.
 - h. Universal Spiral Air.
- C. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
 - 1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- D. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 3. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - a. Manufacturers:
 - 1) AccuDuct Mfg. Inc.
 - 2) Ductmate Industries, Inc.
 - 3) Eastern Sheet Metal (ESM).
 - 4) Linx Industries (previously Lindab USA); a DMI Company.
 - 5) Universal Spiral Air.
- E. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
 2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- F. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 2. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 3. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

4. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 5. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
 6. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 7. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
 8. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.
- I. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
1. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
 2. Round Elbows 9 to 26 Inches in Diameter: Standing-seam construction.
 3. Round Elbows 28 to 60 Inches in Diameter: Standard gored construction, riveted and bonded.
 4. Other Fittings: Riveted and bonded joints.
 5. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

PART 3 - EXECUTION

3.1 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
 - 1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.
- O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
 - 1. Intermediate level.

3.3 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.

3.4 PVC-COATED DUCT, SPECIAL INSTALLATION REQUIREMENTS

- A. Repair damage to PVC coating with manufacturer's recommended materials.

3.5 DUCT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and

sealed in strict accordance with sealant manufacturer's instructions.

1. Seal Class: Refer to Application Schedule on the Drawings.
2. Seal ducts before external insulation is applied.
3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. 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.
- D. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.
- E. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- F. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.
- G. Use load rated cable suspension system for round duct in exposed locations.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 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.

3.9 FIELD QUALITY CONTROL

- A. Duct System Cleanliness Tests:
 1. Visually inspect duct system to ensure that no visible contaminants are present.
- B. Duct system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."

1.2 SUMMARY

- A. Section Includes:
 - 1. Factory or shop-fabricated, field-assembled, double-wall casings for HVAC equipment.

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula $Btu \times in./h \times sq. \ ft. \times \ deg \ F$ at temperature differences specified. Values are expressed as Btu.
 - 1. Example: Apparent Thermal Conductivity (k-Value): 0.26.

1.4 PERFORMANCE REQUIREMENTS

- A. Static-Pressure Classes:
 - 1. Upstream from Fan(s): 2-inch wg.
 - 2. Downstream from Fan(s): 2-inch wg.
- B. Acoustical Performance:

1. NRC: 1.09 according to ASTM C 423.
2. STC: 40 according to ASTM E 90.

C. Structural Performance:

1. Casings shall be fabricated to withstand 133 percent of the indicated static pressure without structural failure. Wall and roof deflection at the indicated static pressure shall not exceed 1/8 inch per foot of width.

1.5 SUBMITTALS

- A. Product Data: For factory-fabricated casings, sealant materials, and acoustic liner materials.
- B. Product Certificates: For factory-fabricated casings, signed by product manufacturer.
 1. Show sound-absorption coefficients in each octave band lower than those scheduled when tested according to ASTM C 423.
 2. Show airborne sound transmission losses lower than those scheduled when tested according to ASTM E 90.

1.6 COORDINATION

- A. Coordinate sizes and locations of steel supports. Supports are specified in Division 05 Section "Metal Fabrications."
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 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 SHEET METAL MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Exterior Surface Galvanized Coating Designation: G90.
 2. Interior Surface Galvanized Coating Designation:
 - a. Sections Not Exposed to Moisture: G90.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet steel casings.
- C. Miscellaneous Materials and Products: Types and sizes required to comply with HVAC casing system requirements, including proper connection of ducts and equipment.

2.3 SEALANT MATERIALS

- 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. 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. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 - 7. Service: Indoor or outdoor.
 - 8. Substrate: Compatible with galvanized sheet steel or stainless steel.
- C. 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.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.4 GENERAL CASING FABRICATION REQUIREMENTS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 9, "Equipment and Casings," for acceptable materials, material thicknesses, and casing construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
 - 1. Fabricate casings with more than 3-inch wg negative static pressure according to SMACNA's "Rectangular Industrial Duct Construction Standards."
 - 2. Casings with more than 2-inch wg positive static pressure may be fabricated according to SMACNA's "Rectangular Industrial Duct Construction Standards."
- B. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the interior sheet metal surfaces of casing in contact with the airstream. Apply untreated clear coating 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 according to UL 723; certified by an NRTL.
 - 5. Applied Coating Color: Black.
- C. Sealing Requirement: SMACNA's "HVAC Duct Construction Standards - Metal and Flexible,"

Seal Class A. Seal all seams, joints, connections, and abutments to building.

- D. Penetrations: Seal all penetrations airtight. Cover with escutcheons and gaskets, or fill with suitable compound so there is no exposed insulation. Comply with requirements for escutcheons specified in Division 20 Section "Basic Mechanical Materials and Methods." Provide shaft seals where fan shafts penetrate casing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine steel supports for compliance with requirements for conditions affecting installation and performance of HVAC casings.
- B. Examine casing insulation materials and liners before installation. Reject casings that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install casings according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with recommended spacing of sheet metal screws and with requirements for casing sealing and trim positioning.
- B. Support casings on floor or foundation system. Secure and seal to base.
- C. Equipment Mounting: Install HVAC casings on concrete base. Comply with requirements for concrete base specified in Division 03.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported casings, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Apply sealant to joints, connections, and mountings.
- E. Field-cut openings for pipe and conduit penetrations; insulate and seal according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- F. Support components rigidly with ties, braces, brackets, and anchors of types that will maintain housing shape and prevent buckling.
- G. Align casings accurately at connections, with 1/8-inch misalignment tolerance and with smooth interior surfaces.
- H. Maintain duct seal class integrity throughout casings.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 2. Determine leakage from entire system or section of system by relating leakage to surface area of test section. Comply with requirements for leakage classification of ducts connected to casings.
 3. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.4 CLEANING

- A. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
1. Intermediate level.

END OF SECTION

DUCT ACCESSORIES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Testing, Adjusting, and Balancing" for duct test holes.
 - 3. Division 23 Section "Temperature Controls" for motorized control dampers.
 - 4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.2 DEFINITIONS

- A. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For turning vanes, include data for pressure loss generated sound power levels.

- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

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 SHEET METAL 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.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
- D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
- E. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

2.3 LOW PRESSURE MANUAL VOLUME DAMPERS

- A. Manufacturers:
 - 1. American Warming and Ventilating.
 - 2. Arrow United Industries.
 - 3. Greenheck.
 - 4. Krueger.
 - 5. Louvers and Dampers.
 - 6. Nailor Industries Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Company, Inc.
 - 9. Young Regulator Company.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.
- C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- F. Damper Materials:
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 - 5. Tie Bars and Brackets: Galvanized steel.

- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 LOW PRESSURE MANUAL VOLUME DAMPERS (STAINLESS STEEL)

- A. Manufacturers:
 - 1. American Warming and Ventilating.
 - 2. Arrow United Industries.
 - 3. Greenheck.
 - 4. Krueger.
 - 5. Louvers and Dampers.
 - 6. Nailor Industries Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Company, Inc.
 - 9. Young Regulator Company.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.
- C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- F. Damper Materials:
 - 1. Steel Frames: Hat-shaped, stainless sheet steel channels, minimum of 0.064 inch

thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

2. Roll-Formed Steel Blades: 0.064-inch- thick, stainless sheet steel.
 3. Blade Axles: Stainless steel.
 4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 5. Tie Bars and Brackets: Aluminum.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 TURNING VANES

- A. Manufactured Turning Vanes:
1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
 2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
 3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.
 4. Manufacturers:
 - a. Aero/Dyne Company; H-E-P Turning Vanes.
 - b. Ductmate Industries, Inc.
 - c. Duro Dyne Corp.
 - d. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

2.6 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
1. Manufacturers:
 - a. Air Balance, Inc.
 - b. Greenheck.
 - c. Nailor Industries Inc.
 - d. Ruskin Company.

2. Frame: Galvanized or Stainless sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two compression locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers:
 1. ADSCO Manufacturing LLC.
 2. Duro Dyne Corp.
 3. Senior Flexonics Pathway.
 4. Ventfabrics, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 20 to plus 200 deg F.
- E. 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.

2.8 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

- A. Manufacturers:
 1. Flexmaster U.S.A., Inc.; a Masterduct Company; Type 1M Acoustical.
 2. Hart & Cooley.

- 3. Thermaflex; part of the Flexible Technologies Group.
- B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.
- C. Insulated Flexible Ducts: UL 181, Class 1, flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F.
- D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self-generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

- E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.
- F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.9 FLEXIBLE DUCTS HIGH PRESSURE

- A. Manufacturers:
 - 1. Flexmaster U.S.A., Inc.; a Masterduct Company; Type 3M.
 - 2. Hart & Cooley.
 - 3. Thermaflex; part of the Flexible Technologies Group.
- B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 12 inches WG positive and 4 inches WG negative for medium and high pressure ducts.

- C. Insulated Flexible Ducts: UL 181, Class 1, flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 deg F .
- D. Flexible Duct Fittings: Galvanized steel, twisted-in design with damper. Size as indicated.
- E. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.10 STAINLESS STEEL FIRE DAMPERS (CURTAIN STYLE)

- A. Manufacturers:
 - 1. Air Balance, Inc.
 - 2. Greenheck.
 - 3. NCA Manufacturing, Inc.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
- B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.
- C. Fire Rating:
 - 1. 3 hours for 4 hour rated walls.
- D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, stainless steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, stainless sheet steel.
 - 1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.025-inch- thick, stainless sheet steel. In place of interlocking blades, use full-length, 0.025-inch- thick, stainless steel blade connectors.
- H. Fusible Links: Replaceable, 212 deg F rated.

2.11 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Manufacturer:
 - 1. Thermaflex; part of the Flexible Technologies Group; FlexFlow Elbow.
 - 2. Smart Air & Energy Solutions; SMART Flow Elbow.

- B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.
- C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.12 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.13 FINISHES

- A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 - EXECUTION

3.1 APPLICATION AND 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. Provide 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 PVC coated 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 stainless steel volume dampers in PVC coated ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install fire dampers according to UL listing.
- G. Install duct access doors on ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Upstream from duct filters.
 - 2. At outdoor-air intakes and mixed-air plenums.
 - 3. Downstream from control dampers and duct mounted equipment.
 - 4. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links.
 - 5. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.

6. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.
- J. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- K. Connect flexible ducts to metal ducts with draw bands.
- L. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
- M. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
 1. Use manufactured double-vane turning vanes unless otherwise specified.
 2. Seat outboard-most vane in heel of duct elbow.
 3. Provide vanes for all runner punchings, practice of eliminating every other vane is prohibited.
 4. Use single-vane turning vanes in low pressure square elbows.

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. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Motors."
 - 3. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.

1.2 PERFORMANCE REQUIREMENTS

- A. Classify according to AMCA 99.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.

4. Material thickness.
 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.
- C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Roof framing and support members relative to duct penetrations.
 2. Ceiling suspension assembly members.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For power ventilators to include in operation and maintenance manuals.
- 1.4 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
 - B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
 - C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
 - D. UL Standard: Power ventilators shall comply with UL 705.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
 - B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
 - C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

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. Belts: One set for each belt-drive unit.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

- 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. Greenheck; SQ/BSQ Series.
 - 4. Loren Cook Company.
 - 5. Moffitt Corporation, Inc.
 - 6. PennBarry; a unit of Tomkins PLC.
- B. Description: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Casing: Rectangular or cylindrical, flanged.
- D. Throat and Mounting Assembly: One-piece spun aluminum or continuously welded assembly.
 - 1. Stiffeners: Continuously welded.
 - 2. Bolts, nuts, rivets, and washers: Cadmium plated.
 - 3. Nuts: Self-locking type, vibration proof.
- E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum, backward curved airfoil blades welded to aluminum hub.
- G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
4. Filter Box Assembly

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

I. Vibration Isolators: Refer to Division 20 Section "Mechanical Vibration [**and Seismic**] Controls."

J. Spark Arrestance Class: **C**.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Mfg. Corp.; Models PRN and PV.
2. Aerovent; a Twin City Fan Company.
3. Greenheck; Models G and GB.
4. Loren Cook Company; Models ACED and ACEB.
5. Moffitt Corporation, Inc.
6. PennBarry; a unit of Tomkins PLC; Domex.

B. Description: Direct- or 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.

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. Sheaves: Cast-iron, adjustable-pitch motor sheave.
4. Fan and motor isolated from exhaust airstream.
5. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

G. Provide prefabricated roof curbs for each fan.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.3 UPBLAST 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. Greenheck; CUE Series.
4. Loren Cook Company.
5. Moffitt Corporation, Inc.
6. PennBarry; a unit of Tomkins PLC; Fumex.

B. Description: Direct -driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Spun-aluminum construction with square, one-piece, aluminum base with venturi inlet cone. Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

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. Sheaves: Cast-iron, adjustable-pitch motor sheave.
4. Fan and motor isolated from exhaust airstream.
5. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.

F. Provide coating for corrosive environments on fan components and fasteners.

G. Accessories:

1. Variable-Speed Controller (ECM or VFC): Solid-state control to reduce speed from 100 to less than 50 percent.

2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

H. Provide prefabricated roof curbs for each fan, match flashing and curb with roofing material.

I. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.4 ROOF CURBS AND ACCESSORIES

A. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. Pate.
 - c. Roof Products & Systems.
 - d. ThyCurb.
 - e. Any of the approved roof mounted exhaust fan manufacturers.
2. Configuration: Built-in raised cant with step dimension matching insulation thickness, with mounting flange, and suitable for sloped roofs with uniform insulation thickness.
3. Height: Curb shall extend a minimum 12 inches above top surface of roof insulation.
4. Pitch Mounting: Manufacture curb for roof slope, top of curb shall be level.
5. Flashing: Match flashing with roof construction; refer to Architectural Trades for materials.
6. Metal Liner: Galvanized steel.
7. Mounting Pedestal: Galvanized steel with removable access panel.

2.5 MOTORS

A. Comply with requirements in Division 20 Section "Motors."

2.6 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. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

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 "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."
- D. Connect wiring according to Division 26 Section "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.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor sheaves as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION

BREECHINGS, CHIMNEYS, AND STACKS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Metal Ducts" for double-wall factory fabricated grease duct.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Special gas vents.
- B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers, and location and size of each field connection.
 - 2. Provide engineered sizing data.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.4 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.
- B. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 40 Pipe.
 - 1. CPVC Schedule 40 Fittings: ASTM F 438, socket type.
 - 2. CPVC Solvent Cement: ASTM F 493.

2.2 LISTED (INDUSTRIAL) DOUBLE-WALL STACKS (1400/1800 DEG F)

- A. Manufacturers:
 - 1. Cleaver-Brooks, Inc.; CBHL.
 - 2. Heat-Fab, Inc.; Model Saf-T Vent CI.
 - 3. Metal-Fab Inc.; Model Corr/Guard.
 - 4. Schebler Chimney Systems; eVent.
 - 5. Security Chimneys International; Secure Seal SSD.
 - 6. Selkirk Inc.; Selkirk Metalbestos; Model DCV.
 - 7. Van-Packer Co.; Model CS.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 550 deg F continuously, with positive, negative, or neutral flue pressure, complying with NFPA 211 and suitable for condensing gas-fired appliances.
- C. Construction: Inner shell and outer jacket separated by at least 3/32-inch airspace.
- D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.
- E. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - 1. Termination: Round chimney top design to exclude 98 percent of rainwater. A "Pointed Hat" stack cap is not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Listed Special Gas Vent: Condensing gas appliances, and direct vented finned water-tube boilers and water heaters.
- B. CPVC Plastic Pipe and Fittings: Condensing gas water heaters reaching sanitizing temperatures.

3.3 INSTALLATION OF LISTED VENTS, CHIMNEYS AND STACKS

- A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing, local regulations, or NFPA 211, whichever is most stringent.
- B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION

SPLIT-SYSTEM AIR-CONDITIONING UNITS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 SUMMARY

- A. This Section includes ductless split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components.
- B. Products supplied but not installed under this Section:
 - 1. Roof curbs and equipment rails.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For split-system air-conditioning units to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- E. Seasonal Energy-Efficiency Ratio (SEER): Minimum 13.

1.5 COORDINATION

- A. Coordinate size and location of concrete or plastic pads for units.
- B. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories." Pipe Roof Penetration Enclosures are specified in Division 20 Section "Basic Mechanical Materials and Methods."

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set 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. Single-Zone Split-System Air-Conditioning Units:
 - a. Airedale North America, Inc.
 - b. Daikin Applied; a member of Daikin Industries, Ltd.; Daikin AC.
 - c. Samsung Electronics.
 - d. LG Electronics, HVAC Division.
 - e. Mitsubishi Electric & Electronics America, Inc.; HVAC Advanced Products Division.
 - f. Panasonic Corporation of North America.

2.2 SINGLE-ZONE DUCTLESS SPLIT SYSTEM AIR CONDITIONER

- A. Complete packaged air conditioning unit factory fabricated and tested.

- B. Indoor Evaporator Section: Complete with fan section, motor, washable filter, condensate drain pan, and direct expansion evaporator section.
- C. Air Cooled Condensing Section: Completely factory piped for single point connection of refrigerant lines. Condensing unit with propeller fan shall be matched to evaporator section to provide cooling capacity as scheduled on drawings.
- D. Controls: Unit furnished with factory installed microprocessor controls. Provide wireless remote or unit mounted control or wall thermostat, which shall provide selection of all functions and control of room temperature set points. Furnish and install one mounting bracket for each wireless remote control.
- E. Provide complete refrigerant piping circuit (including all piping specialties) sized in accordance with manufacturer's requirements to interconnect evaporator and condenser sections.
- F. Ceiling-Mounting, Evaporator-Fan Components:
 - 1. Cabinet: Enameled steel chassis with removable panels on front and ends, and discharge drain pans with drain connection.
 - 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
 - 3. Fan: Direct drive, centrifugal fan, with outside air intake, and integral factory or field installed condensate pump.
 - 4. Fan Motors: Comply with requirements in Division 20 Section "Motors."
 - a. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - 5. Filters: Permanent, cleanable.
- G. Air-Cooled, Compressor-Condenser Components:
 - 1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 - 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Reciprocating or Scroll.
 - b. Include refrigerant charge.
 - c. Refrigerant: R-410A.
 - 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
 - 4. Fan: Aluminum-propeller type, directly connected to motor.
 - 5. Motor: Permanently lubricated, with integral thermal-overload protection.
- H. Control equipment is specified in Division 23 Section "Temperature Controls," and sequence of operation is indicated on the Drawings.

- I. Thermostat: Wall-mounted low voltage type to control compressor and evaporator fan.
- J. Automatic-reset timer to prevent rapid/short cycling of compressor.

2.3 ACCESSORIES

- A. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install grade-mounting, compressor-condenser components on 2-inch thick reinforced precast concrete, or plastic pad; extending 2 inches beyond unit perimeter.
- D. Install and connect refrigerant tubing to components. Install tubing to allow access to unit. Evacuate and charge with refrigerant in accordance with manufacturers instructions.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

****END OF SECTION****

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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 work of this section.

1.2 SUMMARY

- A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.3 REFERENCES

- A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. ANSI - American National Standards Institute; www.ansi.org.

2. ASTM - ASTM International; www.astm.org.
3. CSI - Construction Specifications Institute (The); www.csiresources.org.
4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
6. NEC - National Electrical Code
7. NECA - National Electrical Contractors Association; www.necanet.org.
 - a. NECA 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."
8. NEMA - National Electrical Manufacturers Association; www.nema.org.
9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
10. UL - Underwriters Laboratories Inc.; www.ul.com.

1.4 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
 1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
 2. The Contractor understands that the work herein described shall be complete in every detail.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
 1. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.
- C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.
- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

1.5 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items and all utilities costs in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

1.6 DRAWINGS

- A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.
- C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.7 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

- C. Where existing equipment is modified to include new switches, circuit breakers, metering or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.8 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.9 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

- A. Submit project-specific submittals for review in compliance with Division 1.
- B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.
- C. Submit for approval shop drawings for all electrical systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures). Refer to other sections of the electrical Specifications for additional requirements.

1. Wiring Devices
2. Lighting Control Devices

3. Enclosed Switches and Circuit Breakers
4. Enclosed Controllers
5. Panelboards
6. Interior Lighting
7. Exterior Lighting
8. Fire Alarm

1.11 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
- B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Four (4) copies of all literature shall be furnished for Owner and shall be bound in ring binder form. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.
- C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
 1. Routine maintenance procedures.
 2. Trouble-shooting procedures.
 3. Contractor's telephone numbers for warranty repair service.
 4. Submittals.
 5. Recommended spare parts lists.
 6. Names and telephone numbers of major material suppliers and subcontractors.
 7. System schematic drawings on 8-1/2" x 11" sheets.

1.12 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 01.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be clearly marked with a contrasting color so the marks are readily apparent.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request during the course of construction.

1.13 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.
- D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.14 WARRANTY

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.
- C. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.15 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, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.16 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of

obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 INSTALLATION OF EQUIPMENT

- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
- B. Device Location:
 - 1. Allow for relocation prior to installation of wiring devices and other control devices, for example, receptacles, switches, fire alarm devices, and access control devices, within a 10-foot radius of indicated location without additional cost.

3.3 TEMPORARY SERVICES

- A. Provide and remove upon completion of the project, in accordance with the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

3.4 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

- A. Refer to General Conditions for requirements.
- B. All cutting, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.5 EXCAVATION AND BACKFILLING

- A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.
- B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.
- C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
- D. Backfill all excavations inside building, under drives and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
- E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling.

3.6 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, motors, lighting fixtures, and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.7 CLEANING

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.8 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be protected from theft, injury or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.9 DRAWINGS AND MEASUREMENTS

- A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION

CONDUCTORS AND CABLES

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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. Building wires and cables rated 600V and less.
- 2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

- 1. Division 26 Section "Control/Signal Transmission Media" for transmission media used for control and signal circuits.
- 2. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
- 3. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 SUBMITTALS

- A. 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/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for types THHN/THWN-2, XHHW-2.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.
- C. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).
- D. Use conductor not smaller than 12 AWG for power and lighting circuits. Unless indicated otherwise, all circuits shall be 2#12, 1#12G, ¾"C.
- E. Use conductor not smaller than 14 AWG for control circuits, provided by Electrical Contractor.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, including in Crawlspace: Type THHN/THWN-2, single conductors in

raceway.

- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN/THWN-2, single conductors in raceway.
- H. Underground Feeders and Branch Circuits: XHHW-2 single conductors in conduit.
- I. Feeders and Branch Circuits on Rooftops: XHHW-2 single conductors in conduit.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.
- K. Fire Alarm Circuits: Type THHN/THWN-2, in raceway.
- L. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.
- M. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- G. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- I. Branch circuits may be combined up to 3 circuits in a homerun conduit.
- J. Provide a separate neutral conductor for each circuit.
- K. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable.
- L. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.

- M. Do not route conductors across roof without prior approval from engineer. Where approved, conductors shall be installed in rigid steel conduit and shall be de-rated for ambient temperature per the NEC.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
 - 2. Use compression type terminations for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- D. Clean conductor surfaces before installing lugs and connectors.
- E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- F. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.
- G. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260533 "Raceways and Boxes."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping".

3.8 FIELD QUALITY CONTROL

- A. Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Description: Test all feeders rated 200 A and above.

2. Visual and Mechanical Inspection
 - a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
 - b. Test cable mechanical connections with an infrared survey.
 - c. Check cable color-coding against project Specifications and N.E.C. requirements.
 3. Electrical Tests
 - a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
 - b. Perform continuity test to insure proper cable connection.
 4. Test Values
 - a. Minimum insulation resistance values shall be not less than fifty mega-ohms.
- B. 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.

****END OF SECTION****

GROUNDING AND BONDING

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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 grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements".
 - 2. Division 26 Section "Conductors and Cables".

1.3 REFERENCES

- A. ASTM B 3: Specification for Soft or Annealed Copper Wire.
- B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
- C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
- E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface

Potentials of a Ground System.

- F. IEEE 142: Grounding of Industrial and Commercial Power Systems.
- G. IEEE C2: National Electrical Safety Code.
- H. NETA MTS – 2001: Maintenance Testing Specifications.
- I. NFPA 70: National Electrical Code.
- J. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
- K. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.
- L. UL 467: Grounding and Bonding Equipment.
- M. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Ground rods.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- C. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - 4. Indicate overall system resistance to ground.
 - 5. Indicate overall Telecommunications system resistance to ground.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 26 "Electrical General Requirements".
- B. Accurately record actual locations of grounding electrodes and connections to building steel.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer to specification section "Electrical Testing."
- 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.
 - 1. Comply with UL 467.

- C. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. By one of the following:
 - 1. Grounding Conductors and Cables:
 - a. Refer to Division 26 Section "Conductors and Cables".
 - 2. Grounding Rods:
 - a. American Electric-Blackburn.
 - b. Apache Grounding/Erico Inc.
 - c. Chance/Hubbell.
 - 3. Mechanical Connectors:
 - a. American Electric-Blackburn.
 - b. Burndy.
 - c. Chance/Hubbell.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
- B. Material: copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, stranded, copper unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
- G. Copper Bonding Conductors: As follows:
 - 1. Bonding Conductor: Stranded copper conductor; size per the NEC.
 - 2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
 - 3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.
- H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.
- D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
 - 1. Size: 3/4 in diameter.
 - 2. Length: 96 inches.

PART 3 - EXECUTION

3.1 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches.
- D. In raceways, use insulated equipment grounding conductors.
- E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- F. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors. Bond pole and foundation reinforcing steel to equipment ground conductor.
- I. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.2 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select

connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Equipment Grounding Conductor Terminations

1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B .

E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

F. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.3 INSTALLATION

A. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system. Grounding electrodes to be interconnected include:

1. Ground rods.
2. Metal water service pipe.

B. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

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1. Verify that final backfill and compaction has been complete before driving ground rods.
 2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- C. Counterpoise Ground:
1. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart.
 2. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use conductors not less than No. 2/0 AWG for counterpoise and for tap to building steel. Bury counterpoise not less than 18 inches below grade and 24 inches from building foundation.
- D. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.
- E. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- F. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- G. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- H. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers to grounding electrodes per NFPA 70.
- I. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.
- J. Bond together metal building elements not attached to grounded structure; bond to ground.
- K. **Pool Structures:** Provide a common bonding grid with a solid copper conductor not smaller than No. 6 AWG. Bond together the following:
1. All metallic parts of the pool or fountain structure, including reinforcing steel of the pool or fountain shell, coping stones, and deck.

2. All forming shells and mounting brackets of no-niche luminaries.
3. All metal fittings within or attached to the pool or fountain structure that are greater than 4 inches in any dimension and penetrate the pool or fountain structure more than one inch.
4. Metal parts of electrical equipment associated with the pool or fountain water circulating system, including pump motors and metal parts of equipment associated with pool covers, including electric motors.
5. Metal sheathed cables and raceways, metal piping, and all fixed metal parts including fences, awnings, door and window frames, except those separated from the pool or fountain by a permanent barrier shall be bonded that are within the following distances of the pool:
 - a. Within 5 feet horizontally of the inside walls of the pool.
 - b. Within 12 feet measured vertically above the maximum water level of the pool, or any observation stands, towers, or platforms, or any diving structure.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
 2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal
 - b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - c. Perform tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.
 - d. Perform ground-impedance measurements utilizing either the intersecting curves method of the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81).
 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - c. Equipment Rated More Than 1000 kVA: 3 ohms.
 - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - e. Manhole Grounds: 10 ohms.
 - f. The telecommunications grounding system shall have a maximum resistance of 1

ohm as measured from the TMGB ground to earth ground.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.5 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

****END OF SECTION****

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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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. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 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; a part of Atkore International..
 - b. B-Line, by Eaton..
 - c. GS Metals Corp.
 - d. Pentair Electrical & Fastening Solutions.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; a part of Atkore International.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International..
 - b. B-Line by Eaton.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 - 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

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- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, 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) B-Line by Eaton.
 - 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.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70 or as scheduled in NECA 1. 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:
 - a. Two-bolt conduit clamps
 - b. Single-bolt conduit clamps
 - c. Single-bolt conduit clamps using spring friction action for retention in support channel.

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 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 New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel:
 - a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
 - 6. To Light Steel: Sheet metal screws.
 - 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 support systems attached to substrate.
- E. Slotted support systems applications:
 - 1. Indoor dry and damp Locations: Painted Steel
 - 2. Outdoors and interior wet locations: Galvanized Steel
 - 3. Corrosive Environments, including pool equipment rooms: Nonmetallic
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- G. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- H. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- I. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

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- L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
- M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Provide concrete bases for all floor mounted electrical equipment.
- B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.
- C. Base/Pad Construction:
 - 1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.
 - 2. Interior concrete bases shall have a minimum depth of 4" unless other indicated or recommended by the manufacturer.
 - 3. Exterior concrete bases shall have a minimum depth of 8" unless other indicated or recommended by the manufacturer.
 - 4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.
- D. Anchor equipment to base per both supports and equipment manufacturer's instructions.
- E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

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- B. Touchup: Comply with requirements in Division 09 painting Sections 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

RACEWAYS AND BOXES

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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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 07 Section, "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
 - 2. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
 - 3. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.

- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.
- H. PVC: Polyvinyl Chloride.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

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. Comply with NFPA 70.
- C. All work in natatoriums, pool areas and fountain structures shall be in accordance with N.E.C. article 680, "Swimming Pools, Fountains, and Similar Installations."

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube Triangle Century.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. International Metal Hose.
 - 6. Electri-Flex Co
 - 7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 - 8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.

9. Maverick.
 10. O-Z Gedney; unit of General Signal.
 11. Wheatland.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- E. EMT: ANSI C80.3.
- F. FMC: Zinc-coated steel or Aluminum.
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. 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 or compression type.
 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- 2.2 FIRE ALARM EMT
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube Triangle Century.
- B. EMT conduit with bright red topcoat; Fire Alarm EMT.
- C. EMT and Fittings: ANSI C80.3.
- 2.3 NONMETALLIC CONDUIT AND TUBING
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American International.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arnco Corp.
 4. Cantex Inc.

5. Certainteed Corp.; Pipe and Plastics Group.
 6. Condux International.
 7. ElecSys, Inc.
 8. Electri-Flex Co.
 9. Integral.
 10. Kor-Kap.
 11. Lamson and Sessions: Carlon Electrical Products.
 12. Manhattan/CDT/Cole-Flex.
 13. RACO; Division of Hubbell, Inc.
 14. Scepter.
 15. Spiralduct, Inc./AFC Cable Systems, Inc.
 16. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- E. LFNC: UL 1660.
- 2.4 METAL WIREWAYS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hoffman.
 2. Square D.
- B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- E. Wireway Covers: Hinged type.
- F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.
- E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- F. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Provide raceways in interior and exterior locations in accordance with the "Raceway Application Matrix" included on the drawings.
- B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.
- C. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

- D. Minimum Raceway Size: 1/2-inch trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
 - 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- F. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Install temporary closures to prevent foreign matter from entering raceways.
- F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs:
 - 1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded

conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.

2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
 3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 4. Space raceways laterally to prevent voids in concrete.
 5. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 7. Conduits shall run flat. Do not allow conduits to cross.
 8. Change from non-metallic raceway to EMT before turning up out of the concrete and rising above the floor.
- L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
1. Run parallel or banked raceways together on common supports.
 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

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RACEWAYS AND BOXES

- T. 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.

- U. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
 - 1. Electrical conduit (LB's) are not permitted.
 - 2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
 - 3. Conduits shall contain no continuous sections longer than 100 ft. without a pull point/box.
 - 4. The bend radius of conduit must be at least 6 times the internal diameter for a conduit 2 inches or less and a radius of 10 times the diameter for a conduit greater than two inches.
 - 5. All conduit ends shall have an insulated bushing.

- V. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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 conduits route through, to, or from a hazardous classified space (Class I or II), provide proper seal offs when exiting or entering the hazardous classified space.
 - 3. Where conduits pass between spaces that are maintained at two different vapor pressures.
 - 4. Where otherwise required by NFPA 70.

- W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

- X. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

- Y. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.

- Z. 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.

- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same

vertical channel.

- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.
- FF. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- GG. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.
- HH. Conduit run in natatorium/pool area shall be EMT with compression fittings, and painted by the painting contractor (corrosion treatment paint per Architect's requirements).
- II. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.
- JJ. Outlet boxes within hazardous locations shall be of the proper class and division as noted in the N.E.C.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

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 Division 07 Section "Through-Penetration Firestop Systems."
- B. Patch both sides of wall penetrations cut for electrical equipment and raceways to seal against the passage of air, sound and fire.
 - 1. Seal conduit penetrations in fire rated walls using fire-sealing caulk approved by a Nationally Recognized Testing Laboratory.
 - 2. Seal conduit penetrations in non-rated walls using masonry materials that match the wall construction.
 - 3. Fire seal between recessed outlet boxes located on opposite sides of a fire rated wall if the box openings are over 16 square inches and the boxes are less than 24 inches apart.

3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.6 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

****END OF SECTION****

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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. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Equipment identification labels.
 - 4. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. 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.

2.2 CONDUCTOR, COMMUNICATION AND CONTROL CABLE 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. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.
- B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb, minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.5 WIRING DEVICE IDENTIFICATION

- A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders More Than 200 A: Identify with orange self-adhesive vinyl label.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
 - 1. Fire Alarm System: Red.
 - 2. Security System: Blue and yellow.
 - 3. Telecommunication System: Green and yellow.
 - 4. Control Wiring: Green and red.
- C. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.
- E. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.
- F. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data 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 Operation and Maintenance Manual.
- H. Provide a 3" by 5" Arc Flash and Shock Hazard" label on the outside of panels in 'occupant areas' - Brady Type 99454 or equivalent from another manufacturer. Center the label horizontally and vertically on outside of door.
 - 1. Provide yellow background" "Warning" labels for labels which indicate PPE levels 1-4.

2. Provide red background "Danger" labels for labels which indicate that there is no appropriate PPE.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.
 - b. Outdoor Equipment: Stenciled.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled: If included on project. All items may not be on project.
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Transformers.
 - c. Disconnect switches.
 - d. Enclosed circuit breakers.
 - e. Motor starters.
 - f. Push-button stations.
 - g. Contactors.
 - h. Fire-alarm control panel and annunciators.
 - i. Breakers or switches at distribution panels.
- J. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location:
 1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
 2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.
- C. Apply identification devices to surfaces after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-

foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- H. Label information arrangement for 3 lines of text.
 - 1. Line one shall describe the panel or equipment. Line one example: "DP-XX," RP-XX," "T-XX," "EF-XX," etc.
 - 2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: "Fed from DP-XX," "Fed from RP-XX," etc.
 - 3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: "First Floor Elect. Rm #XXX."
 - 4. Line four shall include "Via T-XX" when panel or equipment is fed from a transformer.
- I. Examples:

RP-1A FED FROM DP-1A ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM MCC-1A MECHANICAL ROOM F101	LP-1A LOCATED IN ELECTRICAL ROOM A100
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- J. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.
- K. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.
- L. Degrease and clean surface to receive nameplates.
- M. Install nameplate and labels parallel to equipment lines.
- N. Secure nameplate to equipment front using screws.

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- O. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- P. Identify conduit using field painting where required.
- Q. Paint red colored band on each fire alarm conduit and junction box.
- R. Paint bands 10 feet on center, and 4 inches minimum in width.
- S. Labels shall be neatly centered. Place labels in like positions on similar equipment.

****END OF SECTION****

PANELBOARDS

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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. Distribution panelboards.
 2. Lighting and appliance branch-circuit panelboards.
- B. Related Sections:
1. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.
- 1.3 DEFINITIONS
- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. AFCI: Arc-fault circuit interrupter.

- E. RFI: Radio-frequency interference.
- F. RMS: Root mean square.
- G. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Related Submittals:
 - 1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.
- C. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA PB 1.

- E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

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. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Protection Div.
 - c. Siemens Industries, Inc.

- d. Square D.

2.2 MANUFACTURED UNITS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.
 - 1. Cabinet Front: Flush or surface cabinet as noted on the Drawings.
 - a. Eaton – LT Trim with Door in Door Design, piano hinge on outer door.
 - b. Siemens – Figure 4 hinge to box w/piano hinge.
 - c. GE – FGB (front hinge to box).
 - d. Square D – Continuous piano hinge trim.
 - 2. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
 - 3. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
- C. Phase and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material.
 - 1. Main and Neutral Lugs: Mechanical type.
 - 2. Ground Lugs and Bus Configured Terminators: Compression type.
 - 3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 4. Double Lugs: Mechanical type mounted at location of main incoming lugs.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

- A. Main bus bars, neutral and ground, shall be copper and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.
- C. Main Overcurrent Protective Devices: Circuit breaker.
- D. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 3. Fused switches.
- E. Short Circuit Rating: for panelboard. 35,000 AIC min @ 240 Vac or 25,000 AIC @ 480 Vac for circuit breakers.
- F. Enclosure Size: Enclosure shall be sized to provide adequate conduit knockout space and gutter wire-bending space for all future conduits and cables. Enclosures that are too small to accommodate future conduits and cables shall be replaced at the Contractor's expense.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Main bus bars, neutral and ground, shall be sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
 - a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.
 2. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings with restricted access cover:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

4. Do not use tandem circuit breakers.
5. Provide lock on devices for circuit breakers when called out on panel schedules with "LOD" designation.
6. Provide type GFEP circuit breakers for all self-regulating heating (snow melting and heat trace) cables branch circuits and where noted on panel schedules with "GFEP" designation
7. Provide GFCI circuit breaker when called out on panel schedules with "GFCI" designation.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Install overcurrent protective devices and controllers.
 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with Owner.
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

WIRING DEVICES

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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. Single and duplex receptacles
 - 2. Ground-fault circuit interrupter receptacles
 - 3. Single- and double-pole snap switches and dimmer switches.
 - 4. Device wall plates.
- 1.3 DEFINITIONS
- A. EMI: Electromagnetic interference.
 - B. GFCI: Ground-fault circuit interrupter.
 - C. PVC: Polyvinyl chloride.
 - D. RFI: Radio-frequency interference.
 - E. UTP: Unshielded twisted pair.

1.4 REFERENCES

- A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.
- B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
- C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes
- D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
- E. NEMA WD 1: General Requirements for Wiring Devices.
- F. NEMA WD 6: Wiring Device – Dimensional Requirements.
- G. UL 20: General-Use Snap Switches.
- H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- I. UL 498: Electrical Attachment Plugs and Receptacles.
- J. UL 943: Ground Fault Circuit Interrupters.
- K. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.
- 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 NFPA 70.

1.7 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498. Configuration 5-20R duplex receptacle.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell: 5352.
 - b. Eaton/Arrow Hart: 5352.
 - c. Bryant: 5362.
 - d. Pass & Seymour/Legrand; wiring Devices Division: 5362, PT5362 (use with PTR6STRNA prewired pigtail connector).
- B. GFCI Receptacles: Straight blade, non-feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems GF20-LA.
 - b. Eaton/Arrow Hart Wiring Devices VGFH20.
 - c. Leviton 7899.
 - d. Pass & Seymour/Legrand; Wiring Devices Division 2095, PT2095 (use with PTR6STRNA prewired pigtail connector).
- C. Self-Test GFCI's: Duplex GFCI Convenience Receptacles, 125 V, 20 A. Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL 498, Federal Specification W-C-596 and UL 943, Class A, and include indicator light that is lighted when device is tripped. Must have self-test feature and SafeLock protection™: conducts an automatic test every second, ensuring its always ready to protect. If the device fails the self-test, the indicator light flashes to signal that the GFCI should be replaced. With SafeLock Protection™, if critical components are damaged and ground fault protection is lost, power to receptacle must be discontinued.
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. Pass & Seymour/Legrand; Wiring Devices Division: 2096.
 - b. Eaton/Arrow Hart Wiring Devices SGF20.

2.2 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.3 WALL SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems 1220 Series.
 - 2. Eaton/Arrow Hart Wiring Devices AH1220 Series.
 - 3. Leviton 1220 Series.
 - 4. Bryant 4900 Series.
 - 5. Pass & Seymour/Legrand; Wiring Devices Division PS20AC Series.
- B. Device body: Plastic handle.
- C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.
- E. Provide single-pole, two-pole, three-way and four-way switches as indicated.
- F. Provide pilot light where indicated.
- G. Provide key type where indicated. Furnish four keys to Owner.

2.4 DIMMER SWITCHES

- A. General:
 - 1. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
 - 2. Dimmer switches shall provide full-range, variable control of light intensity utilizing a continuous Square Law dimming curve.
 - 3. Provide protected memory during temporary power failures that restores lights to same level of intensity set prior to power interruption.
 - 4. Provide dimmer switches UL listed for the type of load being served (incandescent, fluorescent, magnetic low voltage transformer, electronic low voltage transformer). Universal load-type dimmer switches shall not be acceptable.
 - 5. Provide dimmers that provide no adverse effects on other components of the electrical system being served (low voltage transformers, ballasts, lamps, etc.).

2.5 WALL PLATES

- A. Manufacturers:
 - 1. Provide wall plates and corresponding wiring devices from same manufacturer.
- B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces:
 - a. 0.035-inch- (1-mm-) thick, satin-finished stainless steel
3. Material for Unfinished Spaces:
 - a. Galvanized steel
4. Material for Wet Locations: Gasketed Cast aluminum with spring-loaded cover, and listed and labeled for use in "wet locations."
 - a. Manufacturers:
 - 1) Red Dot Model CKSUV, Thomas & Betts.
 - 2) Eaton/Arrow Hart WIUM-Series.
 - 3) Pass & Seymour: WIUCAST1 (single gang), WIUCAST2 (2 gang)

2.6 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70.
2. Wall Switches: White, unless otherwise indicated.
3. Dimmer Switches: White, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.
- C. Install devices and assemblies level, plumb, and square with building lines.
- D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging according to manufacturer's written instructions.
- E. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.
- F. Arrangement of Devices:
 1. Coordinate locations of outlet boxes provided under Division 26 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.
 2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding

terminal of receptacles on top.

3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
4. Install horizontally mounted receptacles with grounding pole on the left.
5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
6. Install switches with OFF position down.

G. Install cover plates on switch, receptacle, and blank outlets in finished areas.

H. Use oversized plates for outlets installed in masonry walls.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

J. Remove wall plates and protect devices and assemblies during painting.

K. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with Black-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.

B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Inspect each wiring device for defects.
2. Operate each wall switch with circuit energized and verify proper operation.

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WIRING DEVICES

3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
 4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

****END OF SECTION****

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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. Cartridge fuses rated 600 V and less for use in switches, panelboards, switchboards, and controllers.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:

- 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- 2. Let-through current curves for fuses with current-limiting characteristics.
- 3. Time-current curves, coordination charts and tables, and related data.
- 4. Fuse size for elevator feeders and elevator disconnect switches.

- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

- 1. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- 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:
 - 1. NEMA FU 1 – Low Voltage Cartridge Fuses.
 - 2. NFPA 70 – National Electrical Code.
 - 3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
 - 4. UL 198E – Class R Fuses.
 - 5. UL 512 – Fuseholders.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

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. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
 - 1. Feeders: Class RK1, fast acting.
 - 2. Motor Branch Circuits: Class RK5, time delay.
 - 3. Other Branch Circuits: Class RK5, time delay.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.
- B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

- A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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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.
- B. Related Sections include the following:
 - 1. Division 26 Section "Fuses".

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.

- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 REFERENCES

- A. NECA 1: Practices for Good Workmanship in Electrical Contracting.
- B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.
- E. NEMA FU 1: Low Voltage Cartridge Fuses.
- F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- I. NFPA 70: National Electrical Code.

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.6 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. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

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 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Industries, Inc.
 - 4. Square D/Group Schneider.
- B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch

Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.
2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 TOGGLE DISCONNECT SWITCH

A. Manufacturers:

1. Double Pole:
 - a. Hubbell 1372.
 - b. Leviton 6808G-DAC.
 - c. Pass & Seymour 7812.
 - d. Bryant 30102.
2. Three Pole:
 - a. Hubbell 1379.
 - b. Leviton 7810GD.
 - c. Pass & Seymour 7813.
 - d. Bryant 30103.

- B. Description: Heavy duty, 30A, 600 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Indoor Dry Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Install switches with off position down.
- D. Install NEMA KS 1 enclosed switch where indicated for motor loads ½ HP and larger and equipment loads greater than 30A.
- E. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than ½ HP and equipment loads 30A. and less.
- F. Install fuses in fusible disconnect switches.
- G. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6'-0" (1830 mm) whip.
- H. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.
- I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.
- J. Install equipment on exterior foundation walls at least one inch (25 mm) from wall to permit vertical flow of air behind breaker and switch enclosures.
- K. Support enclosures independent of connecting conduit or raceway system.
- L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."
- C. Provide adhesive label as specified in Division 26 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.

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ENCLOSED SWITCHES AND CIRCUIT BREAKERS

3. Verify rating of installed fuses.
 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- B. Perform the following field tests and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. Certify compliance with test parameters.

3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

ENCLOSED CONTROLLERS

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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 ac, enclosed controllers rated 600 V and less, of the following types:
 - 1. Across-the-line, manual and magnetic controllers.
- B. Related Sections include the following:
 - 1. Division 20 Section "Variable Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on constant torque loads in ranges up to 200 hp.
 - 2. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

- B. Shop Drawings: For each enclosed controller.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and all installed components.
- D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.
- C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
- E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
- F. NECA 402-2000 – Recommended Practice for Installing and Maintaining Motor Control Centers.
- G. NEMA AB 1 - Molded Case Circuit Breakers.
- H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- I. NEMA KS 1 - Enclosed Switches.
- J. ANSI/NFPA 70 - National Electrical Code.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for

intended use.

- D. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.
- B. Deliver products to site under provisions of Section 26 0010. Store and protect products under provisions of Section 26 0010.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0010.

1.8 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- C. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 2. Danfoss Inc.; Danfoss Electronic Drives Div.
 3. Eaton Corporation; Cutler-Hammer Products.
 4. General Electrical Company; GE Industrial Systems.

5. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
6. Siemens/Furnas Controls.
7. Square D.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

- A. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.
 1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
 2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.

2.3 VARIABLE FREQUENCY CONTROLLERS

- A. Refer to Division 20 "Variable Frequency Controllers."
- B. Equipment furnished by mechanical trades and installed by electrical trades.

2.4 ENCLOSURES

- A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.5 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights: NEMA ICS 2, heavy-duty type.
- C. Indicating Lights: Run (Red), off or ready (Green).
- D. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.
- E. Selector Switch: NEMA ISC 2, mounted in front cover to read "hand/off/auto," provide auxiliary contact for auto position monitoring.

2.6 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."
- D. Install motor control equipment and contactors in accordance with manufacturer's instructions.
- E. Select and install heater elements in motor starters to match installed motor characteristics.
- F. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.4 IDENTIFICATION

- A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with enclosed controller circuit in both hand and automatic

positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.

END OF SECTION

LED INTERIOR LIGHTING

PART 1 - GENERAL 1

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PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. Section Includes:
 - 1. Interior solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.
 - B. Related Requirements:
 - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Section 260926 "Lighting Control Panelboards" for panelboards used for lighting control.

3. Section 260933 "Central Dimming Controls" or Section 260936 "Modular Dimming Controls" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.
4. Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lamp: LED and substrate as a replaceable assembly.
- F. LED: Light-emitting diode.
- G. Lumen: Measured output of lamp and luminaire, or both.
- H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 1. Arrange in order of luminaire designation.
 2. Include data on features, accessories, and finishes.
 3. Include physical description and dimensions of luminaires.
 4. Include emergency lighting units, including batteries and chargers.
 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.
- B. Shop Drawings: For nonstandard or custom luminaires.
 1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) 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. Lighting luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 4. Structural members to which luminaires will be attached.
 5. Initial access modules for acoustical tile, including size and locations.
 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with:
1. NFPA 70 - National Electrical Code.

2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
 3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
 4. Code of Federal Regulations (47 CFR 37342).
- G. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- 1.8 COORDINATION
- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- 1.9 WARRANTY
- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

- 2.1 LUMINAIRES (LIGHTING FIXTURES)
- A. Provide Luminaires as included in specification 26 5700 “Luminaire Product Data.” This section contains product data sheets from the basis of design manufacturer with annotations.
 - B. Acceptable alternate manufacturers are indicated on the product data sheets. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.
 - C. The Luminaire schedule shown on the drawings is supplemental provided for convenience and reference only. The requirements of this section and 26 5700 shall govern.
- 2.2 LUMINAIRE REQUIREMENTS
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
 - C. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.
 - D. Unless otherwise specified in Luminaire product data, provide products with a CCT of 2700 K
 - E. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 70,000 hours.

- F. Driver
 - 1. Provided as a integrated component of the luminaire or as a external component of an assembly of luminaries.
 - 2. Nominal Input Voltage: 277 V ac.

2.3 EXIT SIGNS

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - 1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- D. Provide edge lit signs with a mirror plaque background.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- D. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:

- a. "USE ONLY" and include specific lamp type.
- b. Lamp diameter, shape, size, wattage, and coating.
- c. CCT and CRI for all luminaires.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. Do not use permanent luminaires for temporary lighting.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.
- B. Locate ceiling luminaires as indicated on reflected ceiling plan.
- C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.

2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- D. Support luminaires independent of ceiling framing. Support recessed grid luminaires from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Install recessed luminaires to permit removal from below.
- F. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces.
- H. Supports:
1. Sized and rated for luminaire weight.
 2. Able to maintain luminaire position after cleaning and relamping.
 3. Provide support for luminaire without causing deflection of ceiling or wall.
 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- I. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 3. Trim ring flush with finished surface.
- J. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.
 2. Do not attach luminaires directly to gypsum board.
- K. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod wire support for suspension for each unit length of luminaire chassis, including

one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- L. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- M. Connect night light fixtures and emergency lighting fixtures to the hot (unswitched) side of lighting circuits.
- N. Provide an individual feed with ground conductor from a junction box to each lighting fixture. Lighting fixtures shall not be daisy-chained.
- O. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.
- P. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned. Non-functioning LED Boards and drivers shall be replaced.
- Q. For emergency fixtures, locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.
- R. Mount LED emergency lighting units where shown and aim to light the egress path as uniformly as possible.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- C. Bond products and metal accessories to branch circuit equipment grounding conductor.
- D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.
- D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.7 ADJUSTING

- A. Adjust exit sign directional arrows as indicated on Drawings.
- B. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner's representative and Architect/Engineer.

3.8 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures and lenses.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

END OF SECTION

EXTERIOR LIGHTING

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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. Exterior luminaires with lamps and ballasts.
 - 2. Luminaire-mounted photoelectric relays.
 - 3. Poles and accessories.
 - 4. Luminaire lowering devices.
 - B. Related Sections include the following:
 - 1. Division 26 Section "LED Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.
- 1.3 DEFINITIONS
 - A. CRI: Color-rendering index.
 - B. Luminaire: Complete lighting fixture, including ballast housing if provided.

- C. Pole: Luminaire support structure, including tower used for large area illumination.
- D. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load for poles 50 feet or less in height is 70 mph.

1.5 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaires and accessories.
 - 3. Details of installation and construction.
 - 4. Luminaire materials.
 - 5. Photoelectric relays.
 - 6. Ballasts, including energy-efficiency data.
 - 7. Lamps, including life, output, and energy-efficiency data.
 - 8. Materials, dimensions, and finishes of poles.
 - 9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 - 10. Anchor bolts for poles.
 - 11. Manufactured pole foundations.
- B. Shop Drawings:
 - 1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

- D. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- 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 IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - 2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
 - 4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion.
 - 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Basis of Design Product: The design of each item of exterior luminaire and its support 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 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. 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.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Finish designations prefixed by AA comply with the system established by the Aluminum

Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

2.3 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete."

2.4 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
 1. Shape: Round, straight.
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
 2. Finish: Same as pole.
- F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install exterior lighting system per N.E.C.A./I.E.S.N.A. 501-2006.
- B. Install lamps in each luminaire.
- C. Fasten luminaire to indicated structural supports.
- D. Adjust luminaires that require field adjustment or aiming]

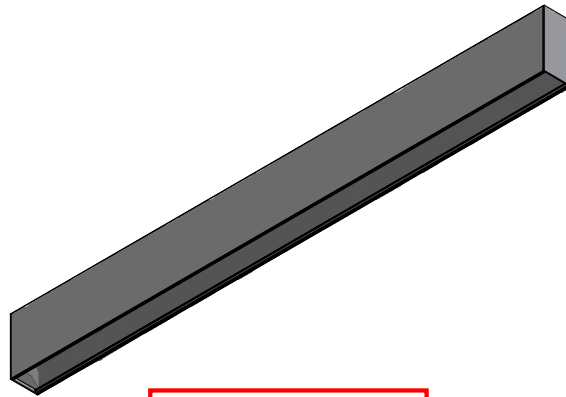
3.2 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
 3. Trees: 15 feet.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 3. Install base covers, unless otherwise indicated.

4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 1. Dig holes large enough to permit use of tampers in the full depth of hole.
 2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
 - F. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
 - G. Raise and set poles using web fabric slings (not chain or cable).
- 3.3 CORROSION PREVENTION
- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
 - B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.
- 3.4 GROUNDING
- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding."
 - B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding."
- 3.5 FIELD QUALITY CONTROL
- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
 - B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 1. Verify operation of photoelectric controls.

END OF SECTION

Type
--
Date
--/--/20--



ES255
DIRECT, INDIRECT,
DIRECT/INDIRECT
HIGH EFFICIENCY LED
SUSPENDED, WALL,
SURFACE, RECESSED

L1

NEO LED



OPTIONS:

Output Options:
DI - Direct / Indirect
D - Direct
I - Indirect

Mounting Options:
AC - Adjustable Aircraft Cable (48" Standard)
P - Pendant / Canopy (18" Standard)
SP - Swivel Pendant / Canopy (45° / 18" Standard)
S - Surface
W - Wall
FL - Flanged for plaster or dry-wall ceilings
T - Standard T-Bar Ceiling

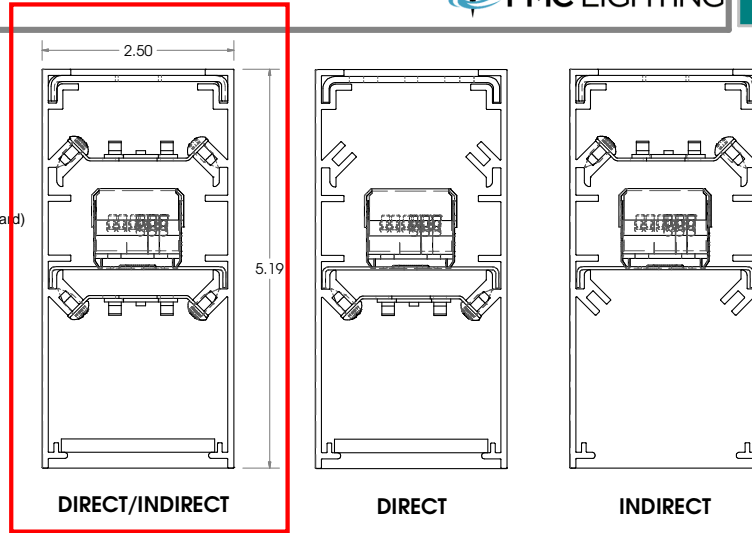
Color Temp:
3000K - 3000K Warm White LED
3500K - 3500K Natural White LED
4000K - 4000K Cool White LED

Output Level:
INDIRECT OUTPUT LEVELS:
135 - 1350 Lumens / Foot*
096 - 965 Lumens / Foot*
075 - 750 Lumens / Foot*
064 - 642 Lumens / Foot*
051 - 510 Lumens / Foot*
DIRECT OUTPUT LEVELS:
135 - 1350 Lumens / Foot*
096 - 965 Lumens / Foot*
075 - 750 Lumens / Foot*
064 - 642 Lumens / Foot*
051 - 510 Lumens / Foot*

Diffuser Options:
FCA - Snap-in 91% Transmissive Microlinear Frosted Lens
WOA - White Acrylic Lens
Color Options:
WHT - White Powder Coat (Standard)
CA - Custom Color (Consult Factory)

Voltage Options:
UNV - Universal voltage - 120/277v (Standard)
120V - 120 volt operation
277V - 277 volt operation

Electrical Options:
GLR - In line fusing
CC - Coiled Cord - Power Feed
DC - Clear Polycarbonate Dust Cover



PRODUCT SPECIFICATION DATA:

Construction: Extruded Aluminum housing with precision formed 20Ga. CRS internal components.
Finish: Standard fixtures are polyester powdercoated white. Reflective internal components are finished in high gloss white enamel (Min. Reflectance Factor = 90%)
Consult Factory for custom finishes.
Factory wired for ease in installation.

Fixtures are cETLus listed for Damp Location, and have standard dimming LED drivers.
Each fixture is tested at the factory before shipment.

ORDERING INFORMATION

Series	Output	Mounting	Color Temp	IND out / DIR out	Length	Diffuser	Color	Voltage	Electrical
ES255	--	--	--	-- / --	--	--	--	--	--
ES255-R	DI	AC	3000K 3500K 4000K	Indirect 135 Direct 135	2' 3' 4' 5' 6' 7' 8'	FCA WOA	WHT (STANDARD) CA (CUSTOM; CONSULT FACTORY)	UNV (STANDARD) 120V 277V	(CONSULT FACTORY FOR ALL OPTIONS) GLR CC DC

	135	096	075	064	051
Indirect Output Code	135	096	075	064	051
Lumens/Foot*	1350	965	750	642	510
LED Wattage/Foot	11.2w/ft	7.2w/ft	5.3w/ft	4.4w/ft	3.4w/ft
Fixture Wattage/Foot	12.3w/ft	7.9w/ft	5.8w/ft	4.8w/ft	3.8w/ft
Direct Output Code	135	096	075	064	051
Lumens/Foot*	1350	965	750	642	510
LED Wattage/Foot	11.2w/ft	7.2w/ft	5.3w/ft	4.4w/ft	3.4w/ft
Fixture Wattage/Foot	12.3w/ft	7.9w/ft	5.8w/ft	4.8w/ft	3.8w/ft

0-10VDC DIMMING DOWN TO 10% STANDARD

EldoLED, DMX, DALI, EcoSystem,
0-10V DOWN TO 1%, 0-10V DOWN TO 0%
DIMMING (CONSULT FACTORY)

*SEE PAGE 2 FOR
ACTUAL FIXTURE
LENGTHS

Dual circuit



*LUMENS/FOOT Based on 4000K Color Temperature. For 3500k 96.7%, For 3000k 93.8%

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Specifications and Dimensions are subject to change without notice.
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ES255-LED_rev2-000

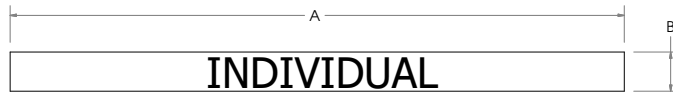
NELIO LED

ES255

DIRECT, INDIRECT,
DIRECT/INDIRECT
HIGH EFFICIENCY LED
SUSPENDED, WALL,
SURFACE, RECESSED

MOUNTING / INSTALLATION

LED STRIPS AVAILABLE IN 11 INCH AND 22 INCH LENGTHS.



FOR INDIVIDUAL FIXTURE SIZES, SEE CORRESPONDING SEGMENTS OF CHART BELOW. TO CALCULATE TOTAL ROW LENGTH OF COMBINED FIXTURES, ADD LENGTHS OF EACH REQUIRED BEGINNING (BOR), INTERMEDIATE (INT), AND END OF ROW (EOR) FIXTURES.

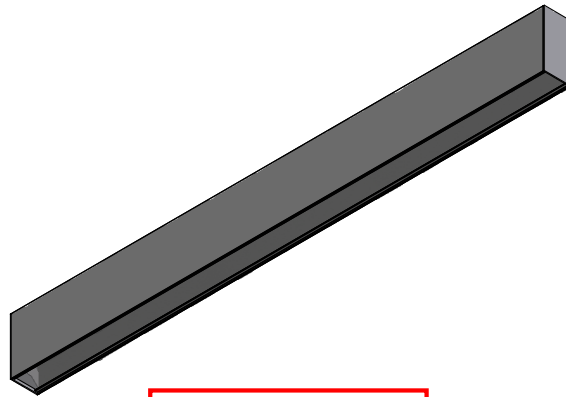
ES255-LED EXTRUDED FIXTURE DIMENSIONS (ALL UNITS IN INCHES)																
NOMINAL LENGTH	PENDANT / SWIVEL PENDANT / AIRCRAFT CABLE			SURFACE				WALL (WIDTH INCLUDES WALL BOXES)			T-BAR (WIDTH INCLUDES RAILS)		FLANGED (WIDTH INCLUDES FLANGES)			
	A		B	A		B	A		B	A		B	A		B	
	D	I / DI		D	I / DI		D	I / DI		D	I / DI		D	I / DI		
8 FEET	IND	89	92	2.5	89	N/A	2.5	89	89	3.5	95.75	N/A	3.25	91	N/A	4.5
	BOR	89	92	2.5	89	N/A	2.5	89	89	3.5	89.38	N/A	3.25	90	N/A	4.5
	INT	89	90.5	2.5	89	N/A	2.5	89	89	3.5	89	N/A	3.25	89	N/A	4.5
	EOR	89	90.5	2.5	89	N/A	2.5	89	89	3.5	89.38	N/A	3.25	90	N/A	4.5
7 FEET	IND	78	81	2.5	78	N/A	2.5	78	78	3.5	83.75	N/A	3.25	80	N/A	4.5
	BOR	78	81	2.5	78	N/A	2.5	78	78	3.5	N/A	N/A	3.25	79	N/A	4.5
	INT	78	79.5	2.5	78	N/A	2.5	78	78	3.5	78	N/A	3.25	78	N/A	4.5
	EOR	78	79.5	2.5	78	N/A	2.5	78	78	3.5	83.75	N/A	3.25	79	N/A	4.5
6 FEET	IND	66.75	69.75	2.5	66.75	N/A	2.5	66.75	66.75	3.5	71.75	N/A	3.25	68.75	N/A	4.5
	BOR	66.75	69.75	2.5	66.75	N/A	2.5	66.75	66.75	3.5	72.38	N/A	3.25	67.75	N/A	4.5
	INT	66.75	68.25	2.5	66.75	N/A	2.5	66.75	66.75	3.5	66.75	N/A	3.25	66.75	N/A	4.5
	EOR	66.75	68.25	2.5	66.75	N/A	2.5	66.75	66.75	3.5	71.75	N/A	3.25	67.75	N/A	4.5
5 FEET	IND	55.75	58.75	2.5	55.75	N/A	2.5	55.75	55.75	3.5	59.75	N/A	3.25	57.75	N/A	4.5
	BOR	55.75	58.75	2.5	55.75	N/A	2.5	55.75	55.75	3.5	N/A	N/A	3.25	56.75	N/A	4.5
	INT	55.75	57.25	2.5	55.75	N/A	2.5	55.75	55.75	3.5	55.75	N/A	3.25	55.75	N/A	4.5
	EOR	55.75	57.25	2.5	55.75	N/A	2.5	55.75	55.75	3.5	59.75	N/A	3.25	56.75	N/A	4.5
4 FEET	IND	44.5	47.5	2.5	44.5	N/A	2.5	44.5	44.5	3.5	47.75	N/A	3.25	46.5	N/A	4.5
	BOR	44.5	47.5	2.5	44.5	N/A	2.5	44.5	44.5	3.5	N/A	N/A	3.25	45.5	N/A	4.5
	INT	44.5	46	2.5	44.5	N/A	2.5	44.5	44.5	3.5	44.5	N/A	3.25	44.5	N/A	4.5
	EOR	44.5	46	2.5	44.5	N/A	2.5	44.5	44.5	3.5	47.75	N/A	3.25	45.5	N/A	4.5
3 FEET	IND	33.5	36.5	2.5	33.5	N/A	2.5	33.5	33.5	3.5	35.75	N/A	3.25	35.5	N/A	4.5
	BOR	33.5	36.5	2.5	33.5	N/A	2.5	33.5	33.5	3.5	N/A	N/A	3.25	34.5	N/A	4.5
	INT	33.5	35	2.5	33.5	N/A	2.5	33.5	33.5	3.5	33.5	N/A	3.25	33.5	N/A	4.5
	EOR	33.5	35	2.5	33.5	N/A	2.5	33.5	33.5	3.5	35.75	N/A	3.25	34.5	N/A	4.5
2 FEET	IND	22.5	25.5	2.5	22.5	N/A	2.5	22.5	22.5	3.5	23.75	N/A	3.25	24.5	N/A	4.5
	BOR	22.5	25.5	2.5	22.5	N/A	2.5	22.5	22.5	3.5	N/A	N/A	3.25	23.5	N/A	4.5
	INT	22.5	24	2.5	22.5	N/A	2.5	22.5	22.5	3.5	22.5	N/A	3.25	22.5	N/A	4.5
	EOR	22.5	24	2.5	22.5	N/A	2.5	22.5	22.5	3.5	23.75	N/A	3.25	23.5	N/A	4.5

NON-STANDARD ROW CONFIGURATIONS MAY RESULT IN A MAXIMUM OF 11 INCHES OF UNLIT FIXTURE LENGTH AT THE END OF THE ROW. CONSULT FACTORY FOR NON-STANDARD SIZES.

CONSULT FACTORY FOR PHOTOMETRIC DATA ON FIXTURE CONFIGURATIONS NOT SHOWN.



Type
--
Date
--/--/20--



ES255
DIRECT, INDIRECT,
DIRECT/INDIRECT
HIGH EFFICIENCY LED
SUSPENDED, WALL,
SURFACE, RECESSED

L2

NELO LED



OPTIONS:

Output Options:
DI - Direct / Indirect
D - Direct
I - Indirect

Mounting Options:
AC - Adjustable Aircraft Cable (48" Standard)
P - Pendant / Canopy (18" Standard)
SP - Swivel Pendant / Canopy (45° / 18" Standard)
S - Surface
W - Wall
FL - Flanged for plaster or dry-wall ceilings
T - Standard T-Bar Ceiling

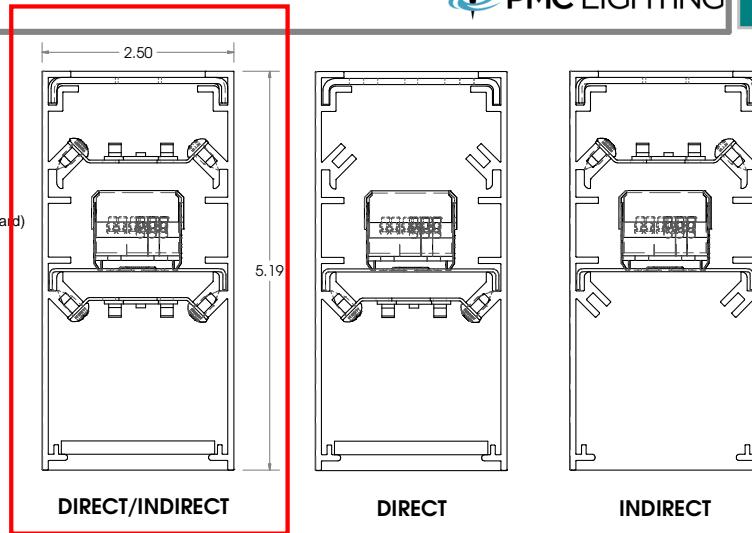
Color Temp:
3000K - 3000K Warm White LED
3500K - 3500K Natural White LED
4000K - 4000K Cool White LED

Output Level:
INDIRECT OUTPUT LEVELS:
135 - 1350 Lumens / Foot*
096 - 965 Lumens / Foot*
075 - 750 Lumens / Foot*
064 - 642 Lumens / Foot*
051 - 510 Lumens / Foot*
DIRECT OUTPUT LEVELS:
135 - 1350 Lumens / Foot*
096 - 965 Lumens / Foot*
075 - 750 Lumens / Foot*
064 - 642 Lumens / Foot*
051 - 510 Lumens / Foot*

Diffuser Options:
FCA - Snap-in 91% Transmissive Microlinear Frosted Lens
WOA - White Acrylic Lens
Color Options:
WHT - White Powder Coat (Standard)
CA - Custom Color (Consult Factory)

Voltage Options:
UNV - Universal voltage - 120/277v (Standard)
120V - 120 volt operation
277V - 277 volt operation

Electrical Options:
GLR - In line fusing
CC - Coiled Cord - Power Feed
DC - Clear Polycarbonate Dust Cover



PRODUCT SPECIFICATION DATA:

Construction: Extruded Aluminum housing with precision formed 20Ga. CRS internal components.
Finish: Standard fixtures are polyester powdercoated white. Reflective internal components are finished in high gloss white enamel (Min. Reflectance Factor = 90%)
Consult Factory for custom finishes.
Factory wired for ease in installation.

Fixtures are cETLus listed for Damp Location, and have standard dimming LED drivers.
Each fixture is tested at the factory before shipment.

ORDERING INFORMATION

Series	Output	Mounting	Color Temp	IND out / DIR out	Length	Diffuser	Color	Voltage	Electrical
ES255	--	--	--	-- / --	--	--	--	--	--
ES255	DI	AC	3000K	Indirect	2'	FCA	WHT	UNV	(CONSULT FACTORY FOR ALL OPTIONS)
ES255-R	D	P	3500K	Direct	3'	WOA	(STANDARD)	(STANDARD)	
	I	SP	4000K	096	4'		CA	120V	GLR
		S		075	5'		(CUSTOM; CONSULT FACTORY)	277V	CC
		W		064	6'				DC
		FL		051	7'				
		T		051	8'				

LED FIXTURES ARE CONFIGURED WITH HIGH EFFICIENCY LED BOARDS.

0-10VDC DIMMING DOWN TO 10% STANDARD

EldoLED, DMX, DALI, EcoSystem, 0-10V DOWN TO 1%, 0-10V DOWN TO 0% DIMMING (CONSULT FACTORY)

*SEE PAGE 2 FOR ACTUAL FIXTURE LENGTHS

VOLTAGE MUST BE SPECIFIED FOR "T" OR "FL" FIXTURES.

Electrical Specifications					
Indirect Output Code	135	096	075	064	051
Lumens/Foot*	1350	965	750	642	510
LED Wattage/Foot	11.2w/ft	7.2w/ft	5.3w/ft	4.4w/ft	3.4w/ft
Fixture Wattage/Foot	12.3w/ft	7.9w/ft	5.8w/ft	4.8w/ft	3.8w/ft
Direct Output Code	135	096	075	064	051
Lumens/Foot*	1350	965	750	642	510
LED Wattage/Foot	11.2w/ft	7.2w/ft	5.3w/ft	4.4w/ft	3.4w/ft
Fixture Wattage/Foot	12.3w/ft	7.9w/ft	5.8w/ft	4.8w/ft	3.8w/ft

*LUMENS/FOOT Based on 4000k Color Temperature. For 3500k 96.7%, For 3000k 93.8%



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Specifications and Dimensions are subject to change without notice.
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ES255-LED_rev2-000

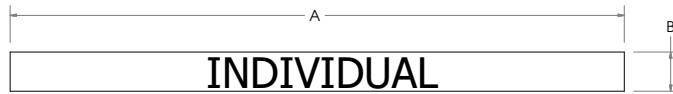
NELIO LED

ES255

DIRECT, INDIRECT,
DIRECT/INDIRECT
HIGH EFFICIENCY LED
SUSPENDED, WALL,
SURFACE, RECESSED

MOUNTING / INSTALLATION

LED STRIPS AVAILABLE IN 11 INCH AND 22 INCH LENGTHS.



FOR INDIVIDUAL FIXTURE SIZES, SEE CORRESPONDING SEGMENTS OF CHART BELOW. TO CALCULATE TOTAL ROW LENGTH OF COMBINED FIXTURES, ADD LENGTHS OF EACH REQUIRED BEGINNING (BOR), INTERMEDIATE (INT), AND END OF ROW (EOR) FIXTURES.

ES255-LED EXTRUDED FIXTURE DIMENSIONS (ALL UNITS IN INCHES)																
NOMINAL LENGTH	PENDANT / SWIVEL PENDANT / AIRCRAFT CABLE			SURFACE				WALL (WIDTH INCLUDES WALL BOXES)			T-BAR (WIDTH INCLUDES RAILS)		FLANGED (WIDTH INCLUDES FLANGES)			
	A		B	A		B	A		B	A		B	A		B	
	D	I / DI		D	I / DI		D	I / DI		D	I / DI		D	I / DI		
8 FEET	IND	89	92	2.5	89	N/A	2.5	89	89	3.5	95.75	N/A	3.25	91	N/A	4.5
	BOR	89	92	2.5	89	N/A	2.5	89	89	3.5	89.38	N/A	3.25	90	N/A	4.5
	INT	89	90.5	2.5	89	N/A	2.5	89	89	3.5	89	N/A	3.25	89	N/A	4.5
	EOR	89	90.5	2.5	89	N/A	2.5	89	89	3.5	89.38	N/A	3.25	90	N/A	4.5
7 FEET	IND	78	81	2.5	78	N/A	2.5	78	78	3.5	83.75	N/A	3.25	80	N/A	4.5
	BOR	78	81	2.5	78	N/A	2.5	78	78	3.5	N/A	N/A	3.25	79	N/A	4.5
	INT	78	79.5	2.5	78	N/A	2.5	78	78	3.5	78	N/A	3.25	78	N/A	4.5
	EOR	78	79.5	2.5	78	N/A	2.5	78	78	3.5	83.75	N/A	3.25	79	N/A	4.5
6 FEET	IND	66.75	69.75	2.5	66.75	N/A	2.5	66.75	66.75	3.5	71.75	N/A	3.25	68.75	N/A	4.5
	BOR	66.75	69.75	2.5	66.75	N/A	2.5	66.75	66.75	3.5	72.38	N/A	3.25	67.75	N/A	4.5
	INT	66.75	68.25	2.5	66.75	N/A	2.5	66.75	66.75	3.5	66.75	N/A	3.25	66.75	N/A	4.5
	EOR	66.75	68.25	2.5	66.75	N/A	2.5	66.75	66.75	3.5	71.75	N/A	3.25	67.75	N/A	4.5
5 FEET	IND	55.75	58.75	2.5	55.75	N/A	2.5	55.75	55.75	3.5	59.75	N/A	3.25	57.75	N/A	4.5
	BOR	55.75	58.75	2.5	55.75	N/A	2.5	55.75	55.75	3.5	N/A	N/A	3.25	56.75	N/A	4.5
	INT	55.75	57.25	2.5	55.75	N/A	2.5	55.75	55.75	3.5	55.75	N/A	3.25	55.75	N/A	4.5
	EOR	55.75	57.25	2.5	55.75	N/A	2.5	55.75	55.75	3.5	59.75	N/A	3.25	56.75	N/A	4.5
4 FEET	IND	44.5	47.5	2.5	44.5	N/A	2.5	44.5	44.5	3.5	47.75	N/A	3.25	46.5	N/A	4.5
	BOR	44.5	47.5	2.5	44.5	N/A	2.5	44.5	44.5	3.5	N/A	N/A	3.25	45.5	N/A	4.5
	INT	44.5	46	2.5	44.5	N/A	2.5	44.5	44.5	3.5	44.5	N/A	3.25	44.5	N/A	4.5
	EOR	44.5	46	2.5	44.5	N/A	2.5	44.5	44.5	3.5	47.75	N/A	3.25	45.5	N/A	4.5
3 FEET	IND	33.5	36.5	2.5	33.5	N/A	2.5	33.5	33.5	3.5	35.75	N/A	3.25	35.5	N/A	4.5
	BOR	33.5	36.5	2.5	33.5	N/A	2.5	33.5	33.5	3.5	N/A	N/A	3.25	34.5	N/A	4.5
	INT	33.5	35	2.5	33.5	N/A	2.5	33.5	33.5	3.5	33.5	N/A	3.25	33.5	N/A	4.5
	EOR	33.5	35	2.5	33.5	N/A	2.5	33.5	33.5	3.5	35.75	N/A	3.25	34.5	N/A	4.5
2 FEET	IND	22.5	25.5	2.5	22.5	N/A	2.5	22.5	22.5	3.5	23.75	N/A	3.25	24.5	N/A	4.5
	BOR	22.5	25.5	2.5	22.5	N/A	2.5	22.5	22.5	3.5	N/A	N/A	3.25	23.5	N/A	4.5
	INT	22.5	24	2.5	22.5	N/A	2.5	22.5	22.5	3.5	22.5	N/A	3.25	22.5	N/A	4.5
	EOR	22.5	24	2.5	22.5	N/A	2.5	22.5	22.5	3.5	23.75	N/A	3.25	23.5	N/A	4.5

NON-STANDARD ROW CONFIGURATIONS MAY RESULT IN A MAXIMUM OF 11 INCHES OF UNLIT FIXTURE LENGTH AT THE END OF THE ROW. CONSULT FACTORY FOR NON-STANDARD SIZES.

CONSULT FACTORY FOR PHOTOMETRIC DATA ON FIXTURE CONFIGURATIONS NOT SHOWN.



L3



Sileä
LED

LUCENTE
LED TROFFER AVAILABLE IN
1X4, 2X2 AND 2X4 SIZES



PERFORMANCE CHARACTERISTICS

SIZE	NOMINAL LUMENS	WATTAGE
2x2	3700LM	37W
	5000LM	48W
1x4	4000LM	37W
2x4	4000LM	36W
	7400LM	65W
	9200LM	77W

Premium-grade, recessed, lay-in T-Bar luminaire featuring a single piece luminous lens. For use with indoor applications where high-efficiency, high-performance and ease of installation are required. This IC-rated luminaire's low-profile design is ideal for shallow or obstructed plenum applications.

Features

Shallow design

No door frame for maximum luminous opening

One piece frosted polycarbonate lens with decorative options

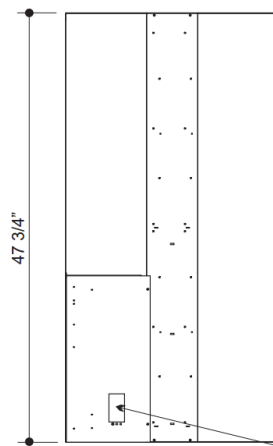
Enhanced, uniform lighting delivers a balanced amount of light to walls, cubicles, work surfaces and people

Multiple CCT options, 80+ CRI standard

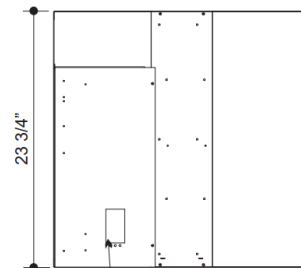
Standard low voltage dimming (0-10v) - Other dimming options available

Available in 1x4, 2x2 and 2x4 configurations

For use in insulated ceilings

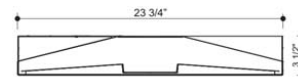


2x4



2x2

ACCESS PLATE
W/ 2x 7/8" K.O.



End View

INTEGRAL
EARTHQUAKE
CLIPS



2x2/2x4

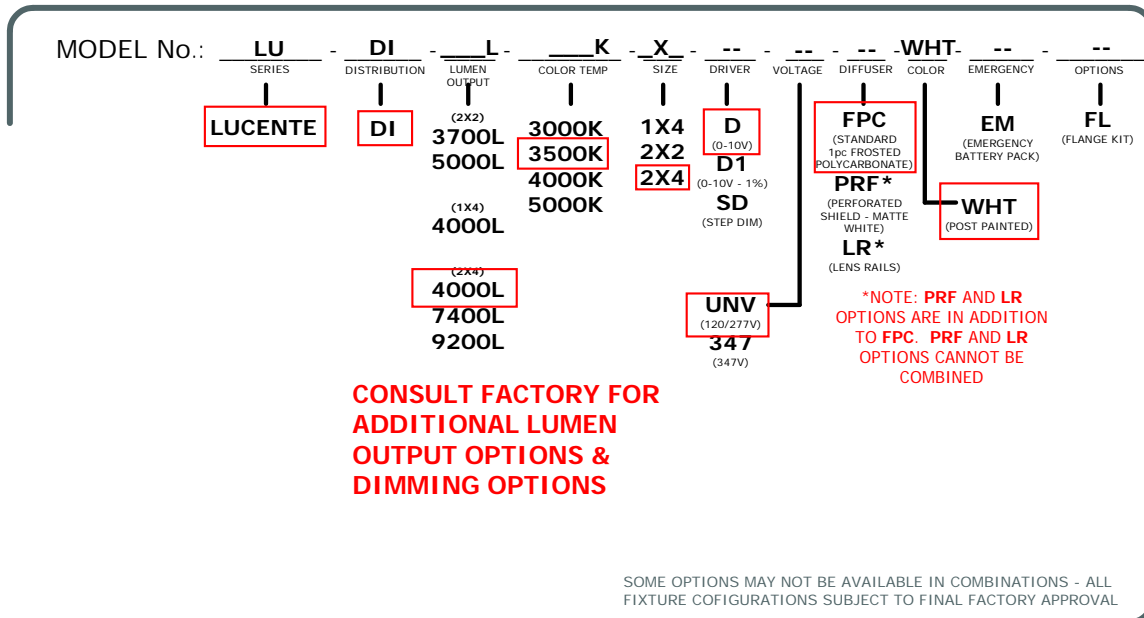
Side View



100 GILBANE STREET - WARWICK, RI - 02888
TEL: (401)738-7266 FAX: (401)738-0618
www.PMCLIGHTING.com

FIXTURE TYPE:
MODEL NO.:
PROJECT:
NOTES:

LUCENTE - 000



Specifications

Optical System

White translucent one-piece Polycarbonate diffuser is standard.

Mounting

This luminaire has been specifically designed for T-Bar applications. Holes provided for chain-mounting support to building structure. Integral earthquake clips for additional support. Optional Flange Kit Available.

Construction

Die-formed, code gauge pre-painted, high-reflectance white steel housing. Precisionformed steel reflector. Wiring access plate and knockout is provided on end plate.

Finish

White, polyester powder painted finish is standard.

Electrical

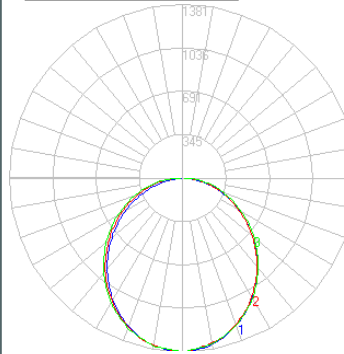
Long life LEDs coupled with high efficiency drivers, provide quality illumination. Rated to deliver L80 performance > 50,000 hours.

Approvals

Approved to CSA/UL standards. UL listed for insulated ceilings. Tested in accordance to IESNA LM-79. Suitable for damp locations. DesignLights Consortium® Qualified. All configurations may not be DLC qualified.

SAMPLE PHOTOMETRICS - CONSULT FACTORY OR VISIT WEBSITE FOR ADDITIONAL PHOTOMETRIC OPTIONS

LUCENTE - 2X2 - 3700LM



Characteristics

Lumens Per Lamp	N.A. (absolute)
Total Lamp Lumens	N.A. (absolute)
Luminaire Lumens	3716
Total Luminaire Efficiency	N.A.
Luminaire Efficacy Rating (LER)	116
Total Luminaire Watts	31.9
Balast Factor	1.00
CIE Type	Direct
Spacing Criterion (0-180)	1.20
Spacing Criterion (90-270)	1.20
Spacing Criterion (Diagonal)	1.32
Basic Luminous Shape	Rectangular
Luminous Length (0-180)	1.97 ft
Luminous Width (90-270)	1.57 ft
Luminous Height	0.00 ft

Zonal Lumen Summary

Zone	Lumens
0-10	129.75
10-20	367.82
20-30	547.11
30-40	644.08
40-50	651.81
50-60	578.25
60-70	441.38
70-80	266.60
80-90	88.96
90-100	0.00
100-110	0.00
110-120	0.00
120-130	0.00
130-140	0.00
140-150	0.00
150-160	0.00
160-170	0.00
170-180	0.00



CONSULT FACTORY OR VISIT OUR WEBSITE FOR SPECIFIC INSTALLATION INSTRUCTIONS

100 GILBANE STREET - WARWICK, RI - 02888
TEL: (401)738-7266 FAX: (401)738-0618
www.PMCLIGHTING.com

Specifications and Dimensions are subject to change without notice.

LUCENTE - 000



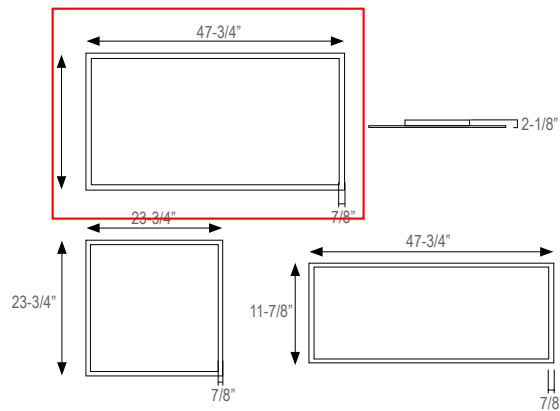
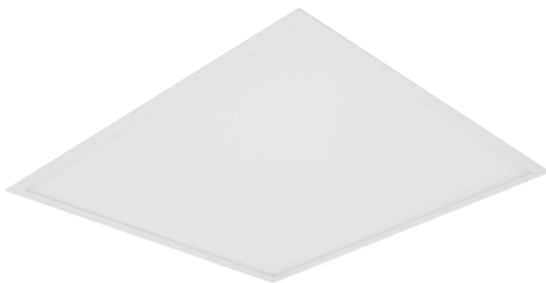
SFP-LED

Smart Panel LED Fixture



Job Information

Type:	L4
Catalog #:	
Project:	
Comments:	
Prepared by:	



Description

SFP-LED is an LED troffer luminaire designed for installation in 1x4, 2x2 and 2x4 conventional suspended grid ceilings for new construction or retrofit projects. Featuring superior, evenly dispersed lighting that sets the standard in performance for solid state ceiling luminaires, the SFP can also significantly reduce the number of fixtures needed to light a given area. Custom fixture and power supply kit design allows for quick and easy installation, reducing costly labor time. The superior thermal design will extend both the life of the fixture and power supply. While still emitting 70% of the original light output after more than 100,000 hours, SFP-LED will last many years without the need for costly replacement or maintenance.

Ordering Information

Example: (SFP-LED-24-40-40-UNV-EM)

Series	Size	Wattage/Lumen	Color Temp.	Voltage	Options
Smart Flat Panel LED Fixture	14 1x 4'	20 20W/2019 ^{1,3}	30 3000K	UNV 120-277V	SMK Surface Mount Kit EM Emergency Backup
		30 30W/2827 ^{1,3}	35 3500K		
		40 40W/4268 ^{1,3}	40 4000K		
			50 5000K		
	22 2x 2'	20 20W/2061 ^{1,3}			C60 60" Adjustable Pendant Mount Cable ⁴
		30 30W/3056 ^{1,3}			
		40 40W/4661 ^{1,3}			
24 2x 4'	20 20W/2045 ¹				
	30 30W/2909 ^{1,3}				
	40 40W/4334 ^{1,3}				
	50 50W/4959 ^{1,2}				

¹ Delivered Lumens (4000K) - Please see Page 2 for full lumen chart.
² 50W Package currently only available in 3500K.

³ DLC Listed Wattage, View Page 2 for DLC Matrix breakdown by color temp and wattage
⁴ Consult Factory for any length greater than 60"



Deco Lighting practices a program of continuous product development, and as a result product specifications change frequently. We reserve the right to change product specifications without notice. Contact Deco for the latest product information.

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Rev Date: 5/18/17 #7

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SFP-LED Smart Panel LED Fixture

Features

- Recommended for offices, schools, hospitals, medical facilities and other commercial and institutional applications
- Finished Color: White and Silver
- Housing: Extruded aluminum frame
- Lens Type: Frosted polycarbonate diffuser
- Choose the perfect lumen output using Select-a-Watt Technology
- IP44 damp location rated
- 0-10V dimming standard
- Beam Angle 120°
- CRI 85
- Power Factor: 0.994; Total Harmonic Distortion: 7.75%
- Operating Temperature: -20°C - +40°C (-4°F - +104°F)
- UL and cUL Listed for Insulation Contact (IC)
- CCEA (Chicago Plenum) compliant
- CE Listed, RoHS compliant
- DLC Listed for utility rebates (See matrix below)

DLC Listing

	1x4			2X2			2X4			
	20W	30W	40W	20W	30W	40W	20W	30W	40W	50W
3000K	X	X	X	X	X	X		X	X	
3500K	X	X	X	X	X	X		X	X	
4000K	X	X	X	X	X	X		X	X	
5000K	X	X	X	X	X	X		X	X	

Lumen Output

Lumen Chart										
Fixture Size	Nominal Wattage	System Wattage	5000K	LPW	4000K	LPW	3500K	LPW	3000K	LPW
1x4	20	18.3	2110	115	2019	110	1973	108	1927	105
	30	25.7	2956	115	2827	110	2776	108	2699	105
	40	38.8	4462	115	4268	110	4190	108	4074	105
2x2	20	17.4	2154	123	2061	118	2014	115	1967	112
	30	25.9	3186	123	3056	118	2979	115	2901	112
	40	39.5	4859	123	4661	118	4543	115	4424	112
2x4	20	18.4	2137	115	2045	110	1998	108	1952	105
	30	26.6	3041	115	2909	110	2843	108	2777	105
	40	39.4	4531	115	4334	110	4225	108	4137	105
	50 ¹	52.2	--	--	--	--	4959	95	--	--

¹50W only available in 3500K currently

Projected LED Maintenance

Operating Hours	0	25,000	50,000	75,000	100,000
Lumen Maintenance Factor	25°C Ambient Interior Temp (77°F)				
	1	0.92	0.84	0.78	0.71
	45°C Ambient Interior Temp (113°F)				
	1	0.92	0.83	0.77	0.70



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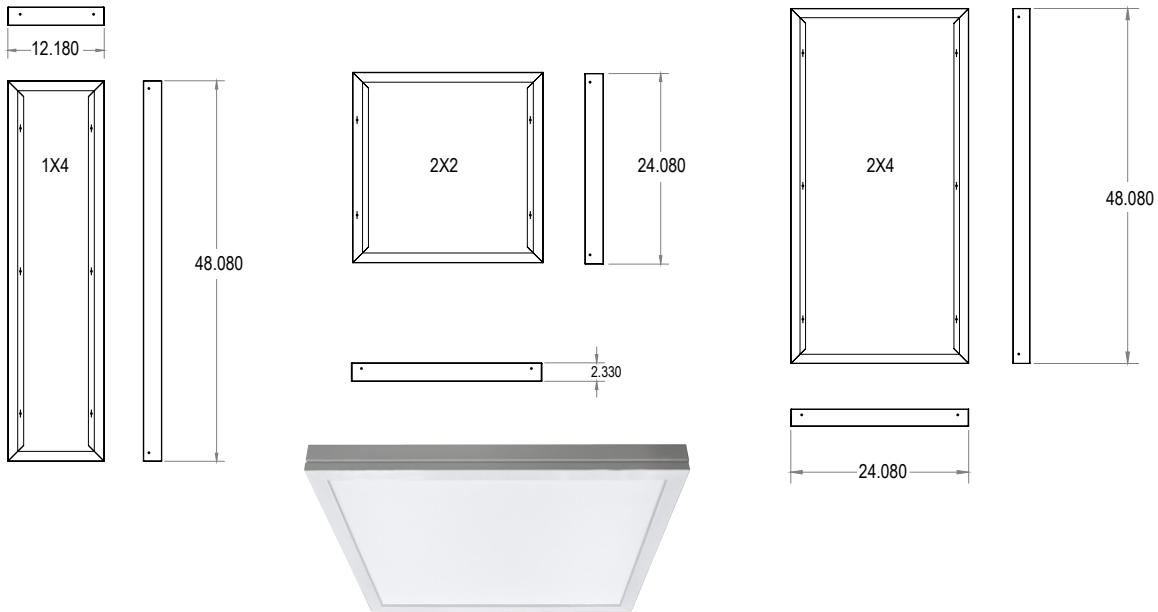
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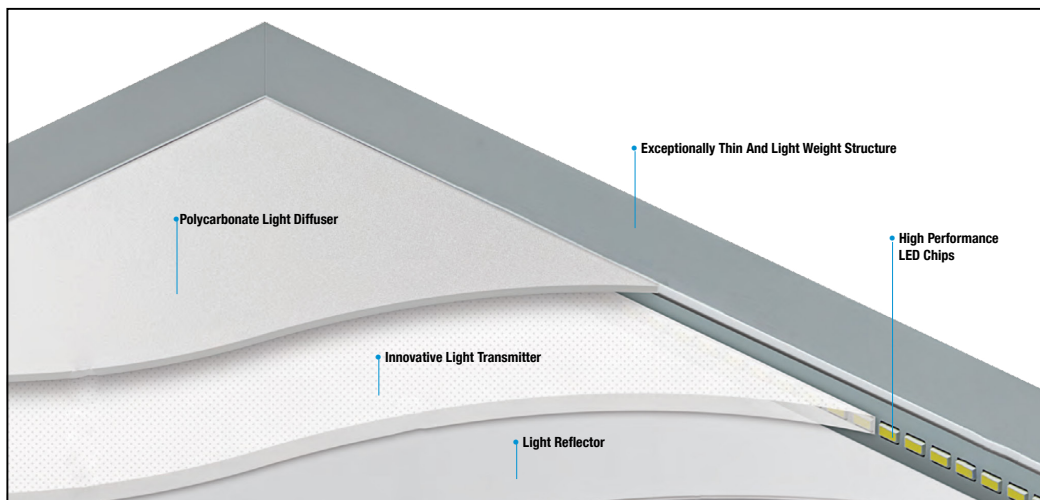


SFP-LED Smart Panel LED Fixture

Surface Mount Kit (SMK) Dimensions



Panel Detail



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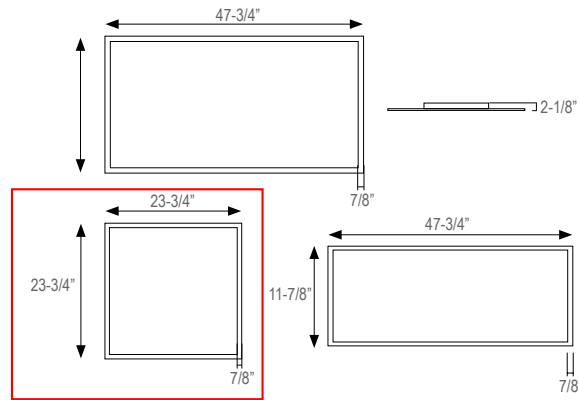
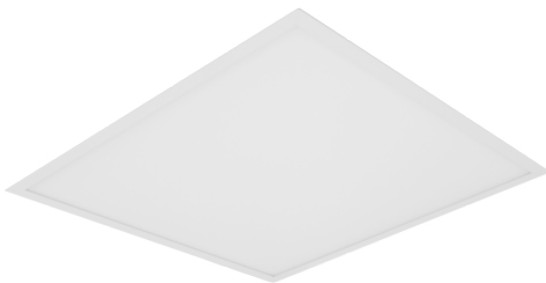


SFP-LED

Smart Panel LED Fixture

Job Information

Type:	L5
Catalog #:	
Project:	
Comments:	
Prepared by:	



Description

SFP-LED is an LED troffer luminaire designed for installation in 1x4, 2x2 and 2x4 conventional suspended grid ceilings for new construction or retrofit projects. Featuring superior, evenly dispersed lighting that sets the standard in performance for solid state ceiling luminaires, the SFP can also significantly reduce the number of fixtures needed to light a given area. Custom fixture and power supply kit design allows for quick and easy installation, reducing costly labor time. The superior thermal design will extend both the life of the fixture and power supply. While still emitting 70% of the original light output after more than 100,000 hours, SFP-LED will last many years without the need for costly replacement or maintenance.

Ordering Information

Example: (SFP-LED-24-40-40-UNV-EM)

Series	Size	Wattage/Lumen	Color Temp.	Voltage	Options	
Smart Flat Panel LED Fixture	14 1x 4'	20 20W/2019 ^{1,3}	30 3000K	UNV 120-277V	SMK Surface Mount Kit EM Emergency Backup	
		30 30W/2827 ^{1,3}	35 3500K			
		40 40W/4268 ^{1,3}	40 4000K			
	22 2x 2'	20 20W/2061 ^{1,3}	30 3000K			C60 60" Adjustable Pendant Mount Cable ⁴
		30 30W/3056 ^{1,3}	35 3500K			
		40 40W/4661 ^{1,3}	40 4000K			
	24 2x 4'	20 20W/2045 ¹	30 3000K			
		30 30W/2909 ^{1,3}	35 3500K			
		40 40W/4334 ^{1,3}	40 4000K			
		50 50W/4959 ²	50 5000K			

¹ Delivered Lumens (4000K) - Please see Page 2 for full lumen chart.
² 50W Package currently only available in 3500K.

³ DLC Listed Wattage, View Page 2 for DLC Matrix breakdown by color temp and wattage
⁴ Consult Factory for any length greater than 60"



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SFP-LED

Smart Panel LED Fixture

Features

- Recommended for offices, schools, hospitals, medical facilities and other commercial and institutional applications
- Finished Color: White and Silver
- Housing: Extruded aluminum frame
- Lens Type: Frosted polycarbonate diffuser
- Choose the perfect lumen output using Select-a-Watt Technology
- IP44 damp location rated
- 0-10V dimming standard
- Beam Angle 120°
- CRI 85
- Power Factor: 0.994; Total Harmonic Distortion: 7.75%
- Operating Temperature: -20°C - +40°C (-4°F - +104°F)
- UL and cUL Listed for Insulation Contact (IC)
- CCEA (Chicago Plenum) compliant
- CE Listed, RoHS compliant
- DLC Listed for utility rebates (See matrix below)

DLC Listing

	1x4			2X2			2X4			
	20W	30W	40W	20W	30W	40W	20W	30W	40W	50W
3000K	X	X	X	X	X	X		X	X	
3500K	X	X	X	X	X	X		X	X	
4000K	X	X	X	X	X	X		X	X	
5000K	X	X	X	X	X	X		X	X	

Lumen Output

Lumen Chart										
Fixture Size	Nominal Wattage	System Wattage	5000K	LPW	4000K	LPW	3500K	LPW	3000K	LPW
1x4	20	18.3	2110	115	2019	110	1973	108	1927	105
	30	25.7	2956	115	2827	110	2776	108	2699	105
	40	38.8	4462	115	4268	110	4190	108	4074	105
2x2	20	17.4	2154	123	2061	118	2014	115	1967	112
	30	25.9	3186	123	3056	118	2979	115	2901	112
	40	39.5	4859	123	4661	118	4543	115	4424	112
2x4	20	18.4	2137	115	2045	110	1998	108	1952	105
	30	26.6	3041	115	2909	110	2843	108	2777	105
	40	39.4	4531	115	4334	110	4225	108	4137	105
	50 ¹	52.2	--	--	--	--	4959	95	--	--

¹50W only available in 3500K currently

Projected LED Maintenance

Operating Hours	0	25,000	50,000	75,000	100,000
Lumen Maintenance Factor	25°C Ambient Interior Temp (77°F)				
	1	0.92	0.84	0.78	0.71
	45°C Ambient Interior Temp (113°F)				
	1	0.92	0.83	0.77	0.70



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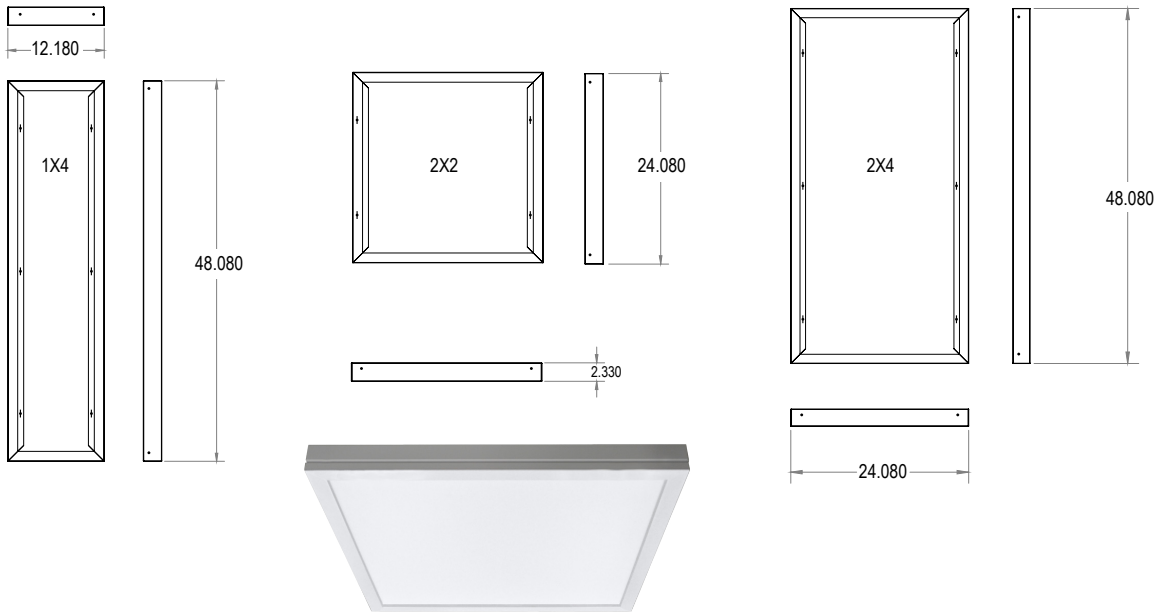
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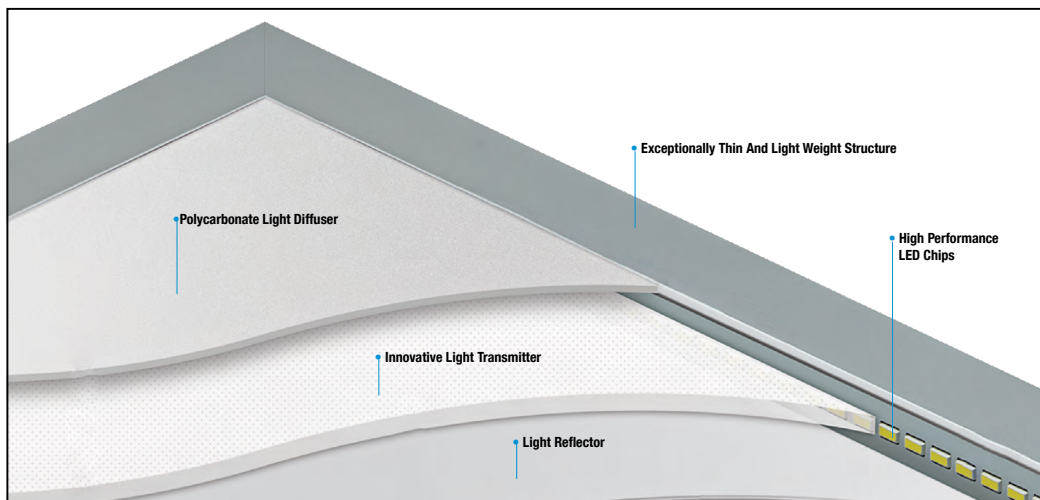


SFP-LED Smart Panel LED Fixture

Surface Mount Kit (SMK) Dimensions



Panel Detail



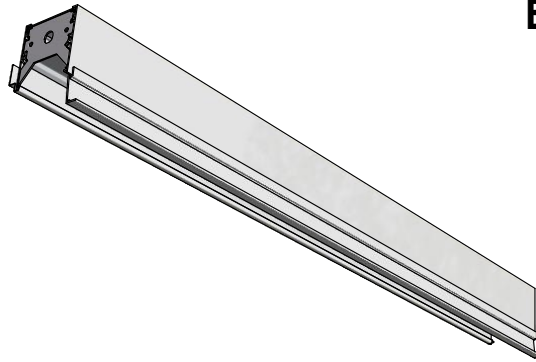
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Type
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Date
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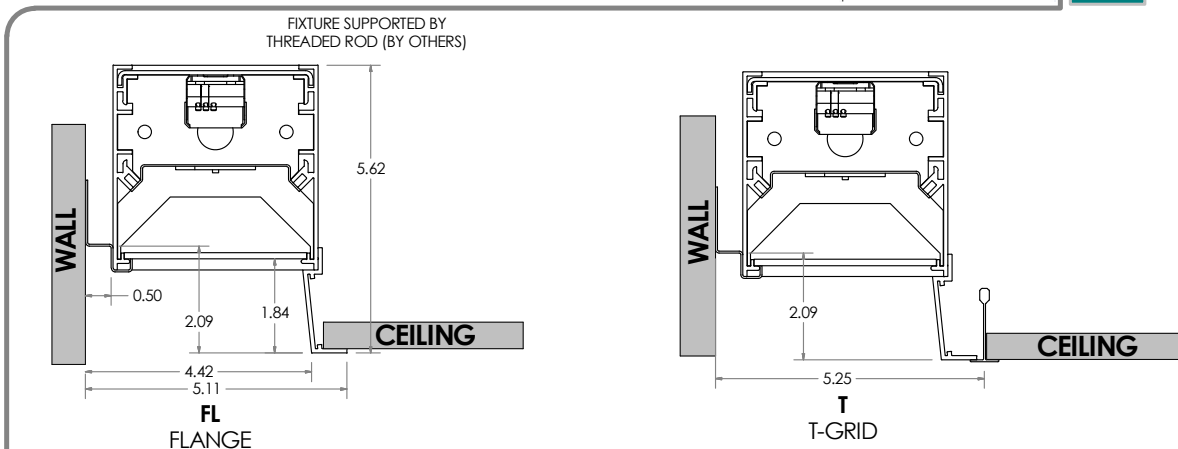
E3095-LED SERIES

DIRECT
HIGH EFFICIENCY LED
FLANGE or T-GRID

L6



PERI-MITTARI LED



OPTIONS:

Output Options:
D - Direct

Mounting Options:
T - Standard T-Bar Ceiling
(Clips to hold T-Bar supplied)
FL - Flanged for plaster or dry-wall ceilings - threaded rod
(by others) to support and adjust fixture level.

Color Temp Options:
3000K - 3000K Warm White LED
3500K - 3500K Natural White LED
4000K - 4000K Cool White LED

Output Level Options:
H - High Output
M - Medium Output
L - Low Output

Diffuser Options:
WOA - White Acrylic Lens - Lay-in

Color Options:
WHT - White Powder Coat (Standard)
CA - Custom Color (Consult Factory)

Voltage Options:
120V - 120 volt operation
277V - 277 volt operation

Electrical Options:
GLR - In line fusing
EM - Emergency Driver

PRODUCT SPECIFICATION DATA:

Construction: Extruded Aluminum Housing. Internal components die formed from heavy gauge cold rolled steel.
Finish: Standard fixtures are polyester powdercoated white. Reflective internal components are finished in high gloss white enamel (Min. Reflectance Factor = 90%)
Consult Factory for custom finishes.
Factory wired for ease in installation.
Driver accessible from below ceiling.
Fixtures are cETLus listed for Damp Location, and have **standard dimming LED drivers**.
Each fixture is tested at the factory before shipment.

ORDERING INFORMATION

Series	Output	Mounting	Color Temp	Output Level	Length	Diffuser	Color	Voltage	Electrical
E3095-LED	D	FL	3000K	M	2'	WOA	WHT	120V	(CONSULT FACTORY FOR ALL OPTIONS)
		T	3500K	H	3'	CA	STANDARD	277V	EM
			4000K		4'	(CUSTOM-CONSULT FACTORY)			GLR
					6'				
					8'				

AS REQUIRED PER PLANS

E3095-LED FIXTURES ARE CONFIGURED WITH HIGH EFFICIENCY LED BOARDS.

0-10VDC DIMMING STANDARD

Wattage specified for LED modules only. Add 10% to calculate total fixture wattage draw.

	Electrical Specifications		
	Low Output	Medium Output	High Output
Lumens	4' - 2,933 8' - 5,866	4' - 3,560 8' - 7,120	4' - 4,400 8' - 8,800
Wattage	4' - 26.9W 8' - 53.8W	4' - 32.6W 8' - 65.3W	4' - 40.3W 8' - 80.6W
Efficiency	4' - 109.4L/W 8' - 109.3L/W	4' - 109.1L/W 8' - 109.1L/W	4' - 109.2L/W 8' - 109.1L/W

PERI-MITTARI LED

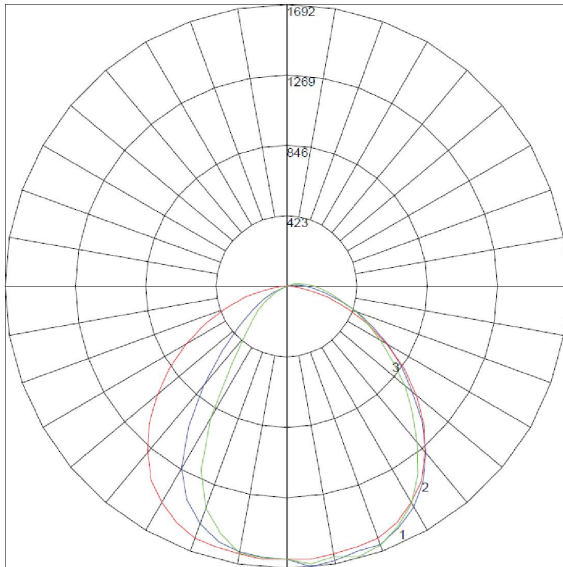
E3095-LED SERIES

DIRECT
HIGH EFFICIENCY LED
FLANGE or T-GRID

MOUNTING / INSTALLATION

FIXTURE MODEL TESTED - E3095-D-FL/T-3000K-H-4'-FCA-WHT-120V

PHOTOMETRICS



ZONAL LUMEN SUMMARY

Zone	Lumens	%Lamp	%Fixt
0-20	613.84	12.30	15.30
0-30	1298.34	26.00	32.40
0-40	2055.49	41.10	51.30
0-60	3295.55	65.90	82.30
0-80	3863.1	77.30	96.40
0-90	3955.88	79.10	98.70
10-90	3798.55	76.00	94.80
20-40	1441.65	28.80	36.00
20-50	2132.9	42.70	53.20
40-70	1605.4	32.10	40.10
60-80	567.54	11.40	14.20
70-80	202.21	4.00	5.00
80-90	92.78	1.90	2.30
90-110	49.61	1.00	1.20
90-120	50.26	1.00	1.30
90-130	50.34	1.00	1.30
90-150	50.38	1.00	1.30
90-180	50.39	1.00	1.30
110-180	0.78	0.00	0.00
0-180	4006.26	80.10	100.00

Total Luminaire Efficiency = 80.10%

RC	80				70				50				30				10				0			
RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	
0	95	95	95	95	93	93	93	93	88	88	88	84	84	84	81	81	81	79						
1	87	84	81	78	85	82	79	76	78	76	74	75	73	71	72	70	69	67						
2	80	74	69	64	78	72	68	64	69	65	62	67	63	60	64	61	59	57						
3	73	66	59	54	71	64	59	54	62	57	53	59	55	52	57	54	51	49						
4	68	59	52	47	66	57	51	46	55	50	46	53	49	45	52	48	44	43						
5	63	53	46	41	61	52	45	41	50	44	40	48	43	40	47	42	39	37						
6	58	48	41	36	56	47	41	36	45	40	35	44	39	35	43	38	35	33						
7	54	44	37	32	52	43	36	32	42	36	32	40	35	31	39	35	31	30						
8	50	40	33	29	49	39	33	29	38	33	29	37	32	28	36	32	28	27						
9	47	37	30	26	46	36	30	26	35	30	26	34	29	26	33	29	26	24						
10	44	34	28	24	43	34	28	24	33	27	24	32	27	23	31	27	23	22						



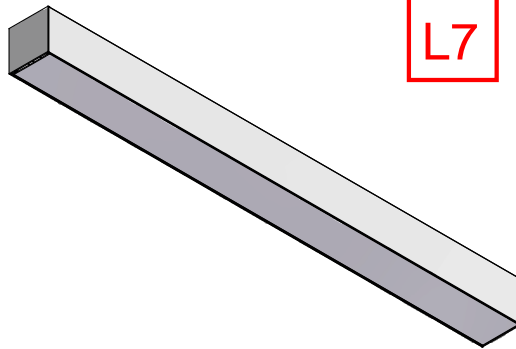
CONSULT FACTORY FOR PHOTOMETRIC DATA ON FIXTURE CONFIGURATIONS NOT SHOWN.

E3095-LED-000

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Type
--
Date
--/--/2014



L7

ES44-LED

DIRECT or INDIRECT
HIGH EFFICIENCY LED
RECESSED, SURFACE, WALL
or SUSPENDED

NELIO LED



OPTIONS:

Output Options:

- D - Direct
- I - Indirect

Mounting Options:

- P - Pendant / Canopy (24" Standard)
- SP - Swivel Pendant / Canopy (45° / 24" Standard)
- AC - Adjustable Aircraft Cable (48" Standard)
- S - Surface
- W - Wall
- T - Standard T-Bar Ceiling
(Clips to hold T-Bar supplied)
- FL - Flanged for plaster or dry-wall ceilings
(Mounting Yokes Provided)

Color Temp:

- 3000K - 3000K Warm White LED
- 3500K - 3500K Natural White LED
- 4000K - 4000K Cool White LED

Output Level:

- L - Low Output
- M - Medium Output
- H - High Output

Diffuser Options:

- FCA - Snap-in 91% Transmissive Microliner Frosted Lens
- WOA - White Acrylic Lens - Lay-in

Color Options:

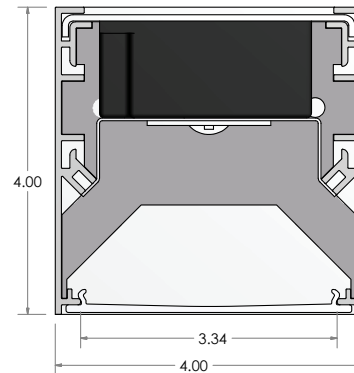
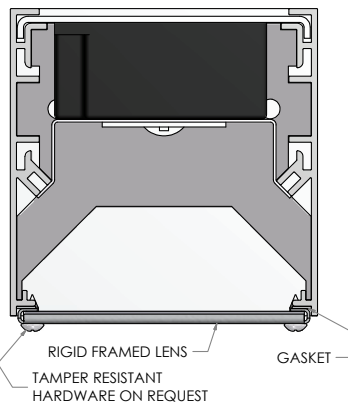
- WHT - White Powder Coat (Standard)
- CA - Custom Color (Consult Factory)

Voltage Options:

- UNV - Universal voltage - 120/277v (Standard)
- 120V - 120V Operation
- 277V - 277V Operation

Electrical Options:

- GLR - In line fusing
- CC - Coiled Cord - Power Feed
- EM - Emergency Driver
- WL - Wet Location



WET LOCATION

PRODUCT SPECIFICATION DATA:

Construction: Extruded Aluminum and welded housing. Internal components die formed from heavy gauge cold rolled steel.
Finish: Standard fixtures are polyester powdercoated white. Reflective internal components are finished in high gloss white enamel (Min. Reflectance Factor = 90%)
Consult Factory for custom finishes.
Factory wired for ease in installation.
LED Driver accessible from below ceiling on recessed versions.
Chicago Plenum-CCEA - consult factory.

Fixtures are cETLus listed for Damp Location, and have **standard dimming LED drivers**.
Each fixture is tested at the factory before shipment.

ORDERING INFORMATION

Series	Output	Mounting	Color Temp.	Output Level	Length	Diffuser	Color	Voltage	Electrical
ES44-LED	--	--	--00K	--	--'	--	--	--V	--

D
I
AC
P
SP
S
W
FL
T
3000K
3500K
4000K
L
M
H
2'
3'
4'
6'
8'
FCA
WOA
WHT
(STANDARD)
CA
(CUSTOM-CONSULT FACTORY)
UNV
(STANDARD)
120V
277V
(CONSULT FACTORY FOR ALL OPTIONS)
GLR
CC
EM
WL

VOLTAGE MUST BE SPECIFIED FOR FL OR T MOUNTING

ES44-LED FIXTURES ARE CONFIGURED WITH HIGH EFFICIENCY LED BOARDS.

0-10VDC DIMMING STANDARD

	Electrical Specifications		
	Low Output	Medium Output	High Output
Lumens	4' - 2,933 8' - 5,866	4' - 3,560 8' - 7,120	4' - 4,400 8' - 8,800
Wattage	4' - 26.9W 8' - 53.8W	4' - 32.6W 8' - 65.3W	4' - 40.3W 8' - 80.6W
Efficiency	4' - 109.4L/W 8' - 109.3L/W	4' - 109.1L/W 8' - 109.1L/W	4' - 109.2L/W 8' - 109.1L/W

Wattage specified for LED modules only. Add 10% to calculate total fixture wattage draw.

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ES44-LED-000

NELIO LED

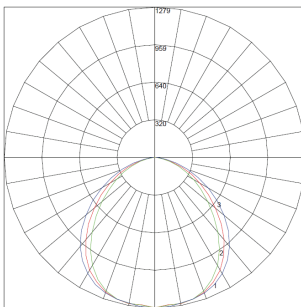
ES44-LED

DIRECT or INDIRECT
HIGH EFFICIENCY LED
RECESSED, SURFACE, WALL or SUSPENDED

MOUNTING / INSTALLATION

FIXTURE MODEL TESTED - ES44-D-S-2700K-HO-4'-FCA-WHT-UNV-DIM

PHOTOMETRICS



ZONAL LUMEN SUMMARY

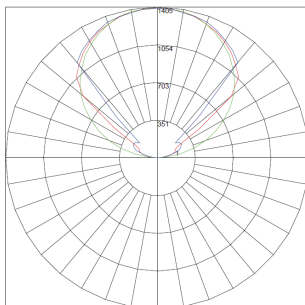
Zone	Lumens	%Lamp	%Fixt
0-20	473.30	11.80	14.30
0-30	1012.01	26.30	30.50
0-40	1646.88	41.20	48.70
0-60	2761.66	69.00	83.30
0-80	3276.88	81.90	98.90
0-90	3314.13	82.90	100.00
10-60	3193.1	79.80	96.30
20-40	1173.59	29.30	35.40
20-50	1787.08	44.70	53.90
40-70	1459.01	36.50	44.00
60-80	515.22	12.90	15.50
70-80	170.99	4.30	5.20
80-90	37.25	0.90	1.10
90-110	0.00	0.00	0.00
90-120	0.00	0.00	0.00
90-130	0.00	0.00	0.00
90-150	0.00	0.00	0.00
90-180	0.00	0.00	0.00
110-180	0.00	0.00	0.00
0-180	3314.13	82.90	100.00

Total Luminaire Efficiency = 82.90%

COEFFICIENT OF UTILIZATION

RC	80			70			50			30			10			0		
	RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10			
0	99	99	99	99	99	96	96	96	96	92	92	88	88	88	85	85	85	83
1	91	87	84	81	81	89	85	82	80	82	79	77	77	75	76	74	72	71
2	83	77	71	67	67	81	75	70	66	72	68	64	69	66	63	67	64	60
3	76	68	61	56	56	74	66	60	56	64	59	55	62	57	54	60	56	51
4	70	60	53	48	48	68	59	53	48	57	51	47	55	50	46	53	49	44
5	64	54	47	42	42	63	53	46	41	51	45	41	50	45	40	48	44	38
6	60	49	42	37	37	58	48	41	36	47	41	36	45	40	36	44	39	34
7	55	44	37	32	32	54	44	37	32	42	36	32	41	36	32	40	35	30
8	52	41	34	29	29	50	40	33	29	39	33	29	38	33	29	37	32	27
9	48	37	31	26	26	47	37	30	26	36	30	26	35	30	26	34	29	24
10	45	34	28	24	24	44	34	28	24	33	28	24	32	27	23	32	27	22

FIXTURE MODEL TESTED - ES44-I-AC-2700K-HO-4'-FCA-WHT-UNV-DIM



ZONAL LUMEN SUMMARY

Zone	Lumens	%Lamp	%Fixt
0-20	0.00	0.00	0.00
0-30	0.00	0.00	0.00
0-40	0.00	0.00	0.00
0-60	0.00	0.00	0.00
0-80	0.00	0.00	0.00
0-90	0.00	0.00	0.00
10-90	0.00	0.00	0.00
20-40	0.00	0.00	0.00
20-50	0.00	0.00	0.00
40-70	0.00	0.00	0.00
60-80	0.00	0.00	0.00
70-80	0.00	0.00	0.00
80-90	0.00	0.00	0.00
90-110	245.01	6.10	6.80
90-120	575.88	14.40	15.90
90-130	1053.23	26.30	29.10
90-150	2507.36	62.70	69.20
90-180	3621.21	90.50	100.00
110-180	3376.2	84.40	93.20
0-180	3621.21	90.50	100.00

Total Luminaire Efficiency = 90.50%

COEFFICIENT OF UTILIZATION

RC	80			70			50			30			10			0			
	RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10				
0	86	86	86	86	86	74	74	74	74	50	50	50	29	29	29	9	9	9	0
1	78	75	72	69	69	67	64	61	59	44	42	41	25	24	24	8	8	8	0
2	71	65	60	56	56	61	56	52	48	38	36	34	22	21	20	7	7	6	0
3	65	57	51	46	46	55	49	44	40	34	31	28	19	18	17	6	6	5	0
4	59	50	44	39	39	50	43	38	34	30	26	24	17	15	14	6	5	5	0
5	54	45	38	33	33	46	38	33	29	26	23	20	15	13	12	5	4	4	0
6	50	40	33	28	28	42	34	29	25	24	20	17	14	12	10	4	4	3	0
7	46	36	29	24	24	39	31	25	21	21	18	15	12	10	9	4	3	3	0
8	42	32	26	21	21	36	28	22	18	19	16	13	11	9	8	4	3	3	0
9	39	29	23	19	19	33	25	20	16	17	14	11	10	8	7	3	3	2	0
10	36	26	20	16	16	31	23	18	14	16	12	10	9	7	6	3	2	2	0

CONSULT FACTORY FOR PHOTOMETRIC DATA ON FIXTURE CONFIGURATIONS NOT SHOWN.

ES44-LED-000

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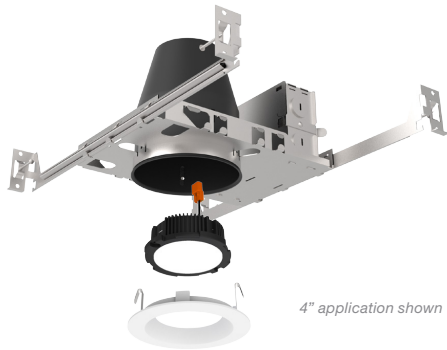
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DRD2

Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

PRODUCT SPECIFICATIONS



- Maximum installation compatibility
- Easy, tool-free installation, including Twist & Lock trim feature
- 750 & 1000 lumen outputs
- 2700K, 3000K, 3500K, 4000K CCT
- Flicker-free TRIAC/ELV, 0-10V or Lutron Hi-lume 1% dimming
- 50,000 hr lifetime at 70% lumen maintenance
- 5 year limited warranty



Dimmable



50000 hrs lifetime



Warranty



UL listed for wet location



Twist & lock

Frame-in Kit

HOUSING: 18 ga. die-formed aluminum box fastened to 22 ga. steel mounting frame (4" frame-in kit, 4" shallow frame-in kit), 20 ga. die-formed aluminum (5" frame-in kit), 22 ga. die-formed aluminum (6" frame-in kit), 20 ga. die-formed aluminum (6" shallow frame-in kit).

JUNCTION BOX: Galvanized steel. Equipped with (6) 1/2" and (1) 3/4" knockouts with pryout slots to allow straight conduit runs. (4) knockouts for non-metallic sheathed cable installation. Junction box tension spring allows snap-in installation of plate cover for easy access to wiring. Approved for 8 (four-in, four-out) #12 AWG 90 through wire conductors.

MOUNTING: Pre-installed adjustable bar hangers engineered to accommodate lumber, laminated beams and T-bar.

CEILING: 1/2" up to 1".

CUTOUT: 4 3/8" (4" frame-in kit, 4" shallow frame-in kit), 5 3/4" (5" frame-in kit), 6 3/8" (6" frame-in kit, 6" shallow frame-in kit).

Light Engine

LED: Tightly binned, high performing white Cree® LED.

LUMEN OUTPUT (POWER): 750 lm (10.8W), 1000 lm (12.8W).

COLOR QUALITY: 93+ CRI, 2-step SDCM.

CCT OPTIONS: 2700K, 3000K, 3500K, 4000K.

CONNECTOR: PowerPlug® Luminaire Disconnect Model 182 (TRIAC/ELV), Model 102 (0-10V, Lutron Hi-lume® 1% and/or emergency lighting).

INPUT VOLTAGE: 120/277V.

DIMMING: Down to less than 5% for TRIAC/ELV at 120V or 0-10V at 120/277V. Down to less than 1% for Lutron Hi-lume® 1% at 120/277V.

EMERGENCY LIGHTING: Optional Emergency LED Driver for lighting up to 90 minutes in event of power failure.

LIFETIME: 50,000 hours at 70% lumen maintenance.

PHOTOMETRIC TESTING: Tested in accordance to IESNA LM-79-2008.

LISTINGS: IC rated. cULus Listed. ENERGY STAR® qualified. California Title 24 JA8 compliant. ASTM E283 certified Air Tight. UL Listed for Wet Location. CEC listed.

WARRANTY: 5 year limited warranty.

Trim

CONSTRUCTION: Die-cast aluminum. Twist & Lock mounting allows easy tool-free field installation and tight ceiling fit.

Product Code:	Type:	
Project:	Contact:	Date:

dmf Lighting® 1118 E. 223rd St. Carson, CA 90745 T: 1.800.441.4422

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DRD2

Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

PRODUCT SELECTION GUIDE

FRAME-IN KIT (Product Code Example: DRDHNIC4)

PRODUCT CODE	APPLICATION	IC/NON-IC	APERTURE	DRIVER	OPTION
DRDH Housing	N New Construction	IC Insulation Contact	4 4" Aperture	[Blank] Integrated TRIAC/ELV	[Blank] None
			4S 4" Shallow ¹	7O 0-10V, 750 lm	EM Emergency Driver <i>Only available for 0-10V and Lutron Hi-Lume 1% driver</i>
			5 5" Aperture	10O 0-10V, 1000 lm	
			6 6" Aperture	7C Lutron LDE1 ² , 750 lm	
			6S 6" Shallow	10C Lutron LDE1 ² , 1000 lm	
				7W Lutron L3DA3W ³ , 750 lm	
				10W Lutron L3DA3W ³ , 1000 lm	

LIGHT ENGINE (Product Code Example: DRD2M7927)

PRODUCT CODE	LUMENS (WATTS)	CRI	CCT	DRIVER
DRD2M Module	7 750 lm (10.8W)	9 93+ CRI	27 2700K	[Blank] Integrated TRIAC/ELV
	10 1000 lm (12.8W)		30 3000K	A Alternate Dimming <i>Must be selected if 0-10V, Lutron Hi-Lume 1% or EM driver is selected for frame-in kit driver</i>
			35 3500K	
			40 4000K	

TRIM (Product Code Example: DRD2TR4SWH)

PRODUCT CODE	SHAPE	APERTURE	STYLE	FINISH	OPTION
DRD2T Trim	R Round	4 4" Aperture	S Smooth	WH White	[Blank] None
	S Square <i>Only available in 4" aperture, smooth style</i>	5 5" Aperture	B Baffle	BK Black	DF Dead Front <i>Only available in round shape, 4" aperture, smooth style; Compatible with 750 lm light engine only</i>
	D Deep <i>Only available in 6" aperture; smooth or baffle style; white, low iridescent or custom finish</i>	6 6" Aperture	W Wall Wash <i>Only available in white finish</i>	SW Silver Reflector, White Flange	
				AZ Low Iridescent Reflector, White Flange <i>Only available in deep shape</i>	
				CC Custom Color	

¹ DRDHNIC4S Alternate Dimming utilizes 12" x 10" frame-in kit, see line drawings for details
² Lutron LDE1 Dimming refers to Lutron Hi-Lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black™
³ Lutron L3DAE Dimming refers to Lutron Hi-Lume 1% 3-wire LED driver



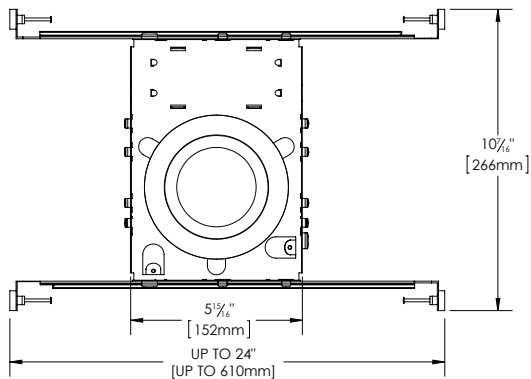
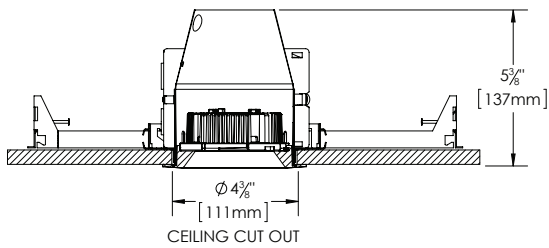
DRD2

Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

FRAME-IN KIT DIMENSIONS

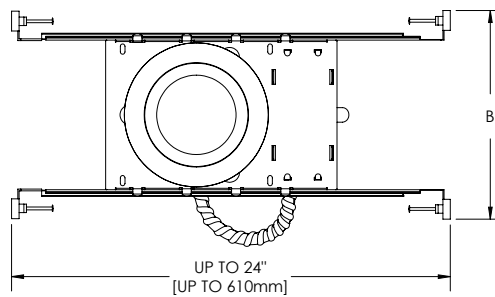
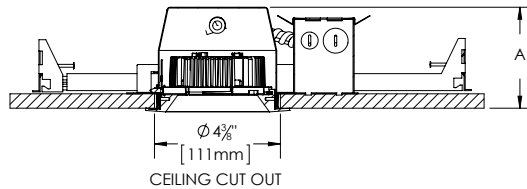
DRDHNIC4

4" New Construction IC Frame-in Kit



DRDHNIC4S

4" Shallow New Construction IC Frame-in Kit



DRDHNIC4S Measurements

	A	B
Standard	3 1/2" [89 mm]	7 1/4" [184 mm]
Alternate Dimming	4" [102 mm]	10" [254 mm]



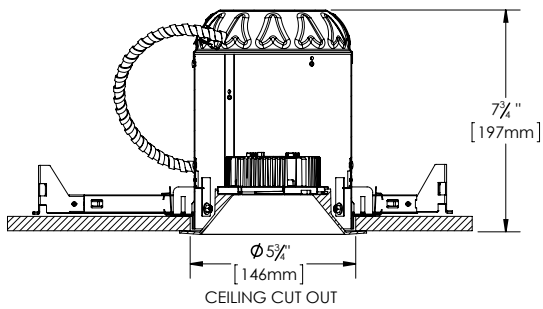
DRD2

Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

FRAME-IN KIT DIMENSIONS

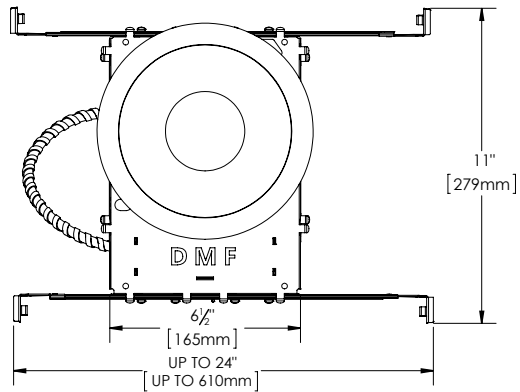
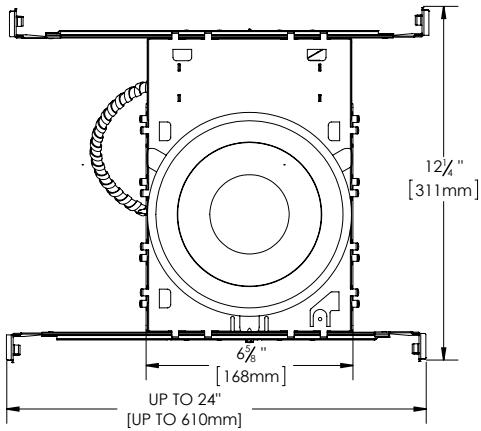
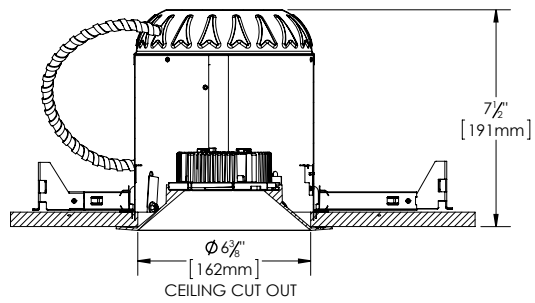
DRDHNIC5

5" New Construction IC Frame-in Kit



DRDHNIC6

6" New Construction IC Frame-in Kit





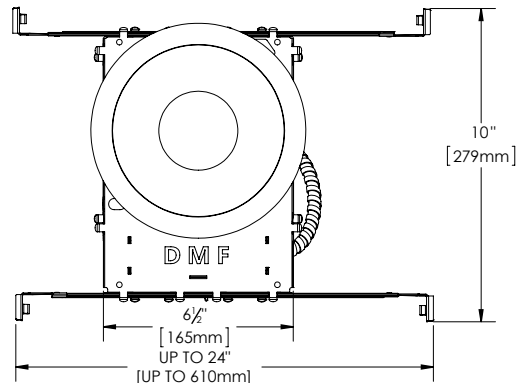
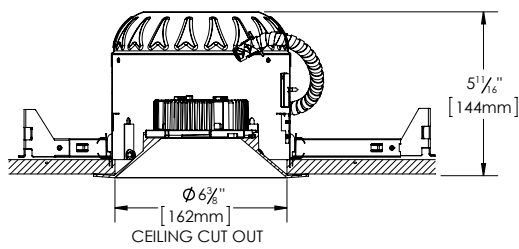
DRD2

Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

FRAME-IN KIT DIMENSIONS

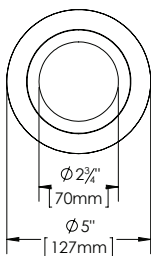
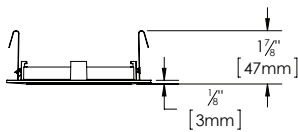
DRDHNIC6S

6" Shallow New Construction IC Frame-in Kit

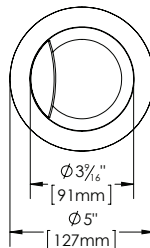
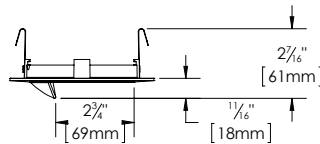


TRIM DIMENSIONS

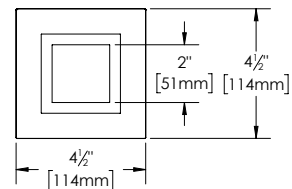
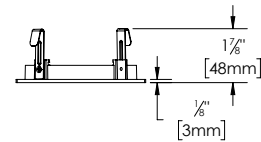
DRD2TR4 4" Round Trim



DRD2TR4W 4" Wall Wash Trim



DRD2TS4 4" Square Trim



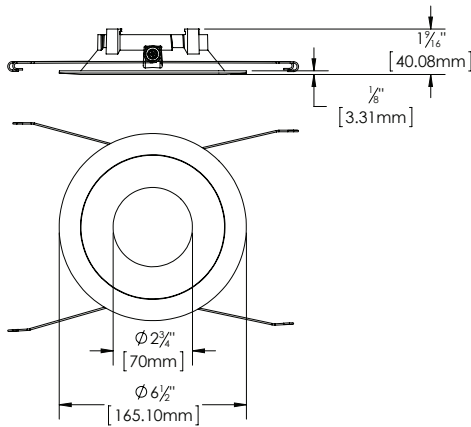


DRD2

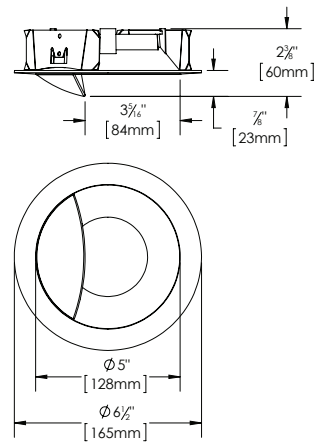
Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

TRIM DIMENSIONS

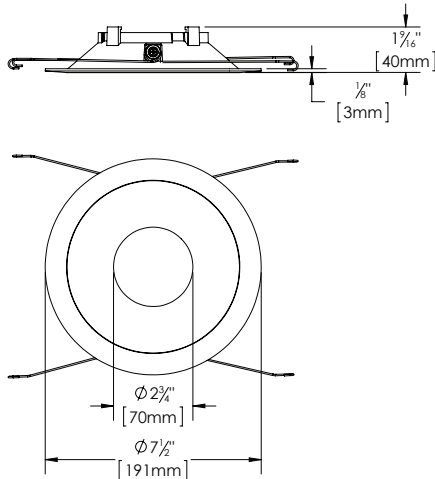
DRD2TR5
5" Round Trim



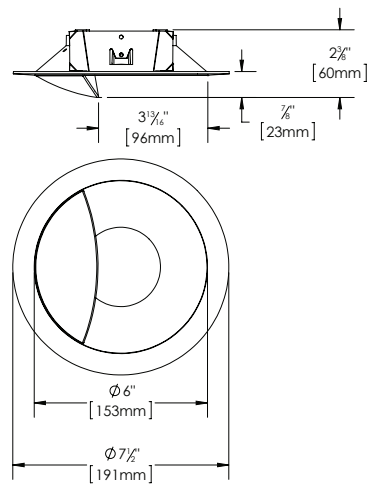
DRD2TR5W
5" Wall Wash Trim



DRD2TR6
6" Round Trim



DRD2TR6W
6" Wall Wash Trim



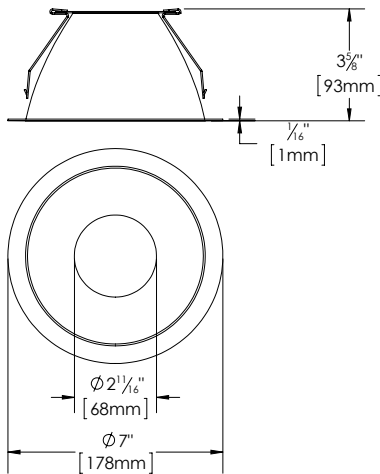


DRD2

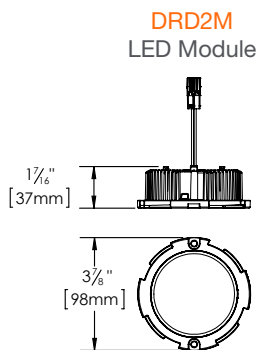
Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

TRIM DIMENSIONS

DRD2TD6
6" Deep Trim



LIGHT ENGINE OVERVIEW



	DRD2M7	DRD2M10
Total Module Lumen Output (lm)	750	1000
Total Rated Power (W)	10.8	12.8
Efficacy (lm/W)	80	85
Color Rendering Index	93+	
CCT Options	2700K, 3000K, 3500K, 4000K	
Optics	Flood	
Binning	2-step SDCM	
Lifetime (L70)	50,000 hours	
Max Ambient Operating Temperature	40°C	
Input Voltage (V)	120/277V, 50/60Hz	
Input Current at 120V (Max)	0.090	0.107
Input Current at 277V (Max)	0.042	0.050
Power Factor	>0.9	
Total Harmonic Distortion	<20%	
Dimming	100% - 5%	

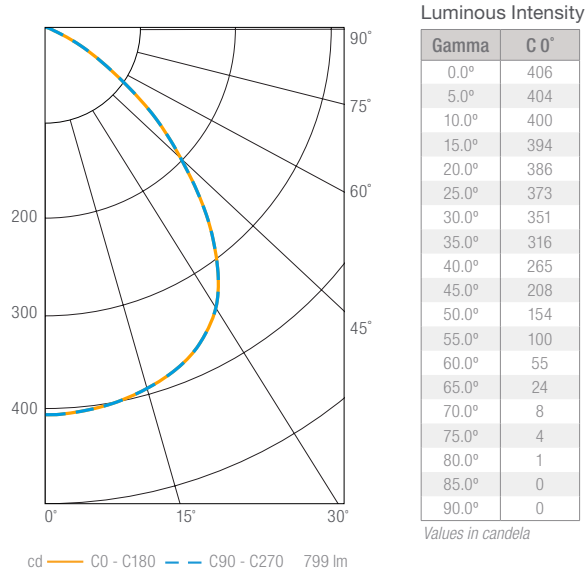


DRD2

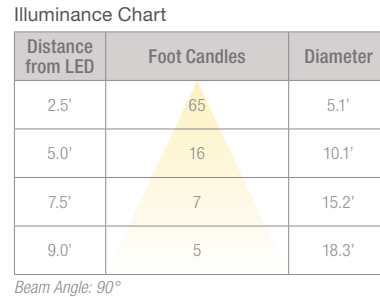
Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

PHOTOMETRICS

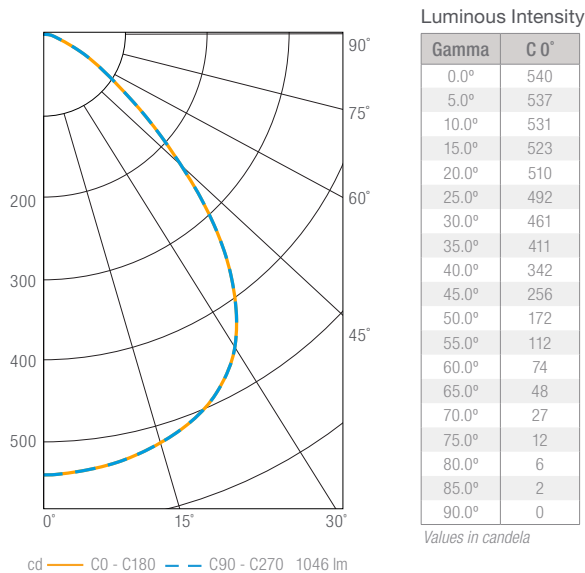
Light Engine: **DRD2M7930** (DRD2 Module, 750 lm, 93 CRI, 3000K)
Trim: **DRD2TR6SWH** (DRD2 Trim, 6" Aperture, Smooth, White)



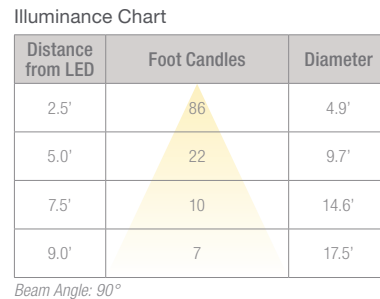
Zone	Lumens	Luminaire %
0-30	321	40
0-40	517	65
0-60	768	96
0-90	799	100
0-180	799	100



Light Engine: **DRD2M10930** (DRD2 Module, 1000 lm, 93 CRI, 3000K)
Trim: **DRD2TR6SWH** (DRD2 Trim, 6" Aperture, Smooth, White)



Zone	Lumens	Luminaire %
0-30	425	41
0-40	679	65
0-60	980	94
0-90	1046	100
0-180	1046	100





DRD2

Recessed LED Downlight
General New Construction
4", 5", 6" Aperture

DIMMER COMPATIBILITY

Recommended Phase-control Dimmers (Dims down to 5% nominal measured light output)

Brand	Series	Model Number	Max Load DRD2M7	Max Load DRD2M10
Control 4	Control 4	C4-APD120	10	9
Cooper	Decorator	DLC03P, DAL06P	25	20
Legrand	Adorne	ADTP703TU	35	30
Lutron	Caseta	PD-6WCL	12	10
	CL Series	AYCL-153, CTCL-153, DVCL-153, LGCL-513, SCL-153, TGCL-513	12	10
	CL Series	AYCL-253, DVCL-253	20	15
	Grafik Eye 3000	QSGR-3P	30	25
	Grafik Sys / Homeworks	RPM-4A	25	20
	Grafik Sys / Homeworks	RPM-4U	30	25
	Maestro CL	MACL-153M, MSCL-OP153M, MSCL-VP153M	12	10
	Maestro Wireless	MRF2-6ELV, MRF2-6CL	12	10
	Radio RA	RRD-6NA, RRD-6CL, RRD-6D	12	10

Compatible Phase-control Dimmers¹ (Dims down to 20% nominal measured light output)

Brand	Series	Model Number	Max Load DRD2M7	Max Load DRD2M10
Cooper	Slide	SLC03P, SAL06P	25	20
Legrand	Harmony	H703PTU, HCL453P	30	25
Leviton	IllumaTech Slide	IPE04	25	20
	SureSlide	6621, 6674	10	10
Lutron	Diva	DV-600	12	10
	Maestro	MA-600	12	9
	Maestro ELV	MAELV-600, MSCELV-600	35	30
	Maestro Wireless	MRF2-6ND	12	10
	Power Booster	PHPM-PA, PHPM-WBX	25	20
	Sunrise	SR400RPC120, ZP260QEW	20	15
Watt Stopper	Digital Light Management	LMRC-221	160	150
	Dimming Sensor	PW-100D	14	12

¹ Dimmer compatibility reflects performance compatibility only. Please reference your local codes for application.



PROJECT INFORMATION

Project Name	L9	Type
Catalog #		Date

VAPOR TIGHT ENCLOSURE LED

VTE LED



APPLICATIONS

- Wash Down
- Food Processing
- Manufacturing Facilities
- Industrial Facilities
- Refrigeration

APPROVALS

- IP 65, IP 66, IP 67, NSF
- Select models DLC Qualified. For a complete list of DLC Qualified products, please visit: <http://www.xtralight.com/dlc> or www.designlights.org/qlp

PRODUCT PERFORMANCE

REPLACES	MODEL	WATTS	LUMENS	EFFICACY
250W HID	42	41.3	4034	97.7

FEATURES

- Energy-efficient replacement up to 250W HID.
- Utilizes high efficiency patented LED technology.
- Suitable for ambient operation down to -40°C (-40°F).

CONSTRUCTION

- Weather resistant and corrosion free construction with no exposed parts to corrode.
- High impact polyester, fire retardant fiberglass housing.
- Impact resistant diffuser secured to housing with plastic cam latches.
- Stainless steel latches available.
- Poured-in-place gasket and cam latches seal the enclosures from most hostile environments.
- Economical mounting system can provide dramatic savings on the installation labor.
- Knockouts and end plugs provided for easy wiring access.

ELECTRICAL

- Voltage - 120-277VAC input. Optional 480V.
- Driver and LED modules easily accessible. LED modules individually replaceable via plug-in connector insuring easy serviceability.
- Driver - 24VDC Class 2, constant current, electronic power supply factory calibrated to LED modules. Multi-volt 120-277V or 0-10V dimming option is available.
- Wiring - Internal factory wiring and pre-installed LED modules are factory tested to ensure luminaire performance and quality.
- Optional 10kV/10kA surge protection available.

WARRANTY

- 10 year limited warranty.

ORDER LOGIC

SAMPLE CATALOG NUMBER: VTELED402042X4XDIMXXFLXX055

VTE LED			X		X					X			
MODULE	OPTICS	MOUNTING	CORD LENGTH	SHIELDING	EMERGENCY BACKUP	SPECIAL OPTIONS	LENGTH	MODEL	CCT	DRIVER	NEMA PLUG	OCCUPANCY SENSOR	COLOR
01 02 04	X None	G Adjustable Cable X None	2 2 Ft 6 6 Ft 8 8 Ft 1 12 Ft X None	FR Lens, Frosted RL Lens, Ribbed FL Lens, Frosted & Ribbed XX Lens, Clear	X None 1 Emergency battery back-up	055 Stainless Steel Latch 480 480V SRG 10kV/10kA Surge Protection	2 2 Ft 4 4 Ft 8 8 Ft	025 ¹ 042 ² 052 ² 100	T 3500K 4 4000K 5 5000K (std)	UIN Multi-Volt 120-277V DIM Dimmable Multi-Volt 120-277V	A 120V, 15A straight blade B 277V, 20A twistlock C 480V, 20A twistlock D 277V, 15A twistlock F 120V, 15A twistlock X None	1 Aisle, multi-volt 120-277V 2 Open area, multi-volt 120-277V 5 Open area, photocell M Microwave occupancy sensor X None	X None

1. 2 ft. available in 25W only.
2. 4 ft. available in 42W and 52W.



VTE2.4-25.100
172006

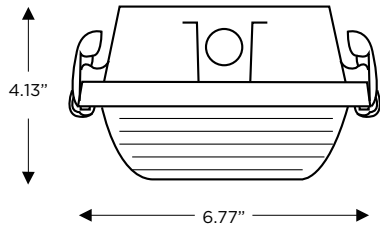
www.xtralight.com • (800) 678-6960 • customerservice@xtralight.com

All information is believed to be accurate at the time of publication. Please contact customer service or visit www.xtralight.com for the most updated product specifications. XtraLight® reserves the right to change specifications without notice.

VAPOR TIGHT ENCLOSURE LED

VTE LED

DIMENSIONAL DATA



PHOTOMETRIC DATA

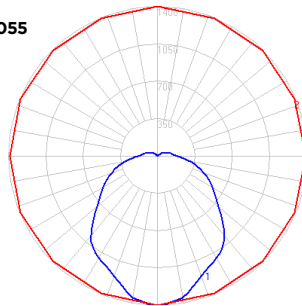
VTE LED 42

Catalog Number:
VTELED402042X4XDIMXXFLXX055

Report Number: ATAL007408.ies
Issue Date: 01/22/15
Lamp: 2 modules
Optic/Lens: Frosted Ribbed
IESNA: LM-63-2002

Total Input Watts: 41.3
Efficacy (Lm/W): 97.7
Total Lumens: 4034

Prepared by: American Testing & Assessment Laboratory
NOTE: Data shown is absolute for product shown.



CANDELA DISTRIBUTION

	0	22.5	45	67.5	90
0	1397	1397	1397	1397	1397
5	1383	1381	1377	1373	1380
15	1323	1303	1297	1269	1265
25	1201	1180	1136	1132	1141
35	1030	996	1003	1040	1056
45	829	812	864	857	855
55	599	626	629	645	660
65	371	405	438	502	525
75	185	222	293	362	387
85	56	103	174	228	244
90	22	66	129	174	185

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixt
0-30	1026.93	25.50
0-40	1665.05	41.30
0-60	2881.99	71.40
0-90	3817.48	94.60
90-180	216.68	5.40
0-180	4034.16	100.00

AVERAGE LUMINANCE

	0°	45°	90°
45	5533	4425	4089
55	4811	3551	3417
65	3889	2851	3064
75	2918	2335	2681
85	1900	1861	2160



WORKING HARDER. LIGHTING SMARTER.®

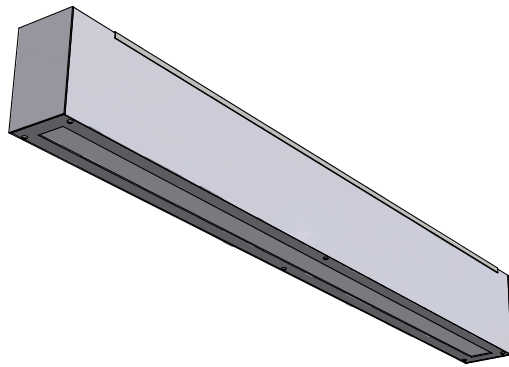
VTE2.4-25.100
172006

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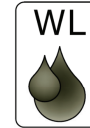
Type
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Date
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PMC-9060
DIRECT/INDIRECT
HIGH EFFICIENCY LED
SUSPENDED WET LOCATION

L10



NELIO LED



OPTIONS:

Output Options:
DI - Direct/Indirect

Mounting Options:
P - Pendant / Canopy (24" Standard)
SP - Swivel Pendant / Canopy (45" / 24" Standard)
AC - Adjustable Aircraft Cable
W - Wall Mount - 1" Wall Box

Color Temp:
3000K - 3000K Warm White LED
3500K - 3500K Natural White LED
4000K - 4000K Cool White LED
5000K - 5000K Cool White LED

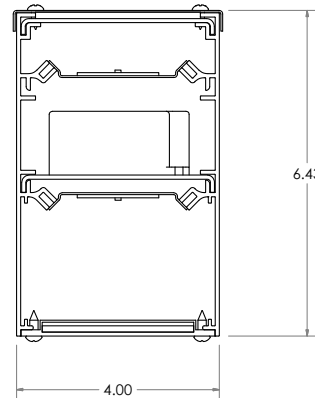
Output Level:
INDIRECT OUTPUT LEVELS:
135 - 1350 Lumens / Foot*
096 - 965 Lumens / Foot*
075 - 750 Lumens / Foot*
064 - 642 Lumens / Foot*
051 - 510 Lumens / Foot*
DIRECT OUTPUT LEVELS:
135 - 1350 Lumens / Foot*
096 - 965 Lumens / Foot*
075 - 750 Lumens / Foot*
064 - 642 Lumens / Foot*
051 - 510 Lumens / Foot*

Diffuser Options:
WOA - White Acrylic Lens - Framed and Gasketed for Wet Location

Color Options:
WHT - White Powder Coat (Standard)
CA - Custom Color (Consult Factory)

Voltage Options:
UNV - Universal voltage - 120/277v (Standard)

Electrical Options:
GLR - In line fusing



PRODUCT SPECIFICATION DATA:

Construction: Extruded Aluminum and welded housing. Internal components die formed from heavy gauge cold rolled steel.
Finish: Standard fixtures are polyester powdercoated white. Reflective internal components are finished in high gloss white enamel (Min. Reflectance Factor = 90%)
Consult Factory for custom finishes.
Factory wired for ease in installation.

Fixtures are cETLus listed for WET Location, and have **standard dimming LED drivers**. Each fixture is tested at the factory before shipment.

ORDERING INFORMATION

Series	Output	Mounting	Color Temp	IND out / DIR out	Length	Diffuser	Color	Voltage	Electrical
P9060	DI	--	--	--	--	--	--	UNV	--
	DI	P	3000K	Indirect	2'	WOA	WHT	UNV	(CONSULT FACTORY FOR ALL OPTIONS)
		SP	3500K	Direct	3'		(STANDARD)	(STANDARD)	GLR
		AC	4000K		4'		CA		
		W	5000K		5'		(CUSTOM-CONSULT FACTORY)		
					6'				
					7'				
					8'				

LED FIXTURES ARE CONFIGURED WITH HIGH EFFICIENCY LED BOARDS.

0-10VDC DIMMING DOWN TO 10% STANDARD

EidoLED, DMX, DALI, EcoSystem,
0-10V DOWN TO 1%, 0-10V DOWN TO 0%
DIMMING (CONSULT FACTORY)

Electrical Specifications					
Indirect Output Code	135	096	075	064	051
Lumens/Foot*	1350	965	750	642	510
LED Wattage/Foot	11.2w/ft	7.2w/ft	5.3w/ft	4.4w/ft	3.4w/ft
Fixture Wattage/Foot	12.3w/ft	7.9w/ft	5.8w/ft	4.8w/ft	3.8w/ft
Direct Output Code	135	096	075	064	051
Lumens/Foot*	1350	965	750	642	510
LED Wattage/Foot	11.2w/ft	7.2w/ft	5.3w/ft	4.4w/ft	3.4w/ft
Fixture Wattage/Foot	12.3w/ft	7.9w/ft	5.8w/ft	4.8w/ft	3.8w/ft

*LUMENS/FOOT Based on 4000k Color Temperature. For 3500k 96.7%, For 3000k 93.8%.



www.pmcighting.com

Specifications and Dimensions are subject to change without notice.
100 Gibbone Street / Warwick, RI 02886 • TEL 401.738.7266 • FAX 401.738.0618

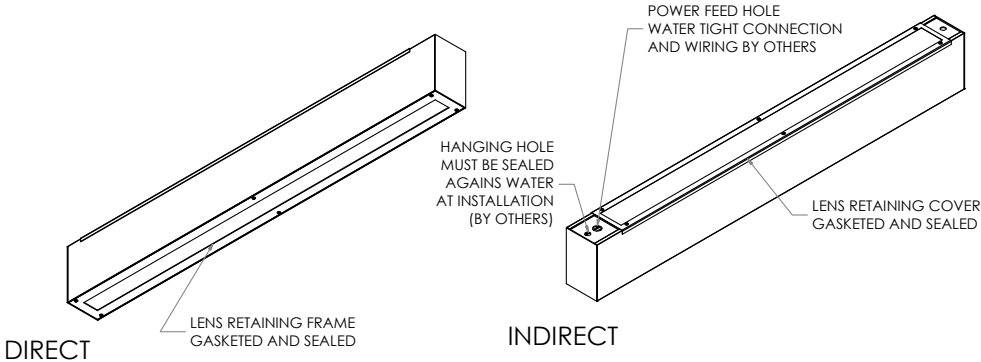
PMC-9060-000

NELIO LED

PMC-9060

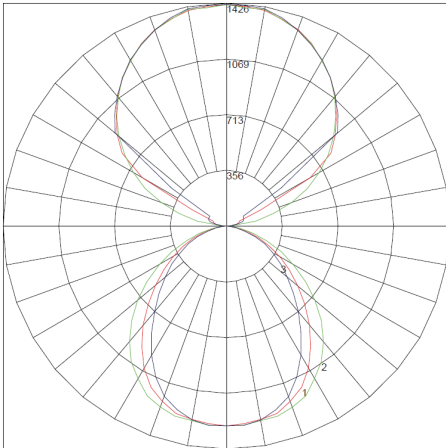
DIRECT/INDIRECT
HIGH EFFICIENCY LED
SUSPENDED WET LOCATION

MOUNTING / INSTALLATION



FIXTURE MODEL TESTED - SIMILAR ES46-DI

PHOTOMETRICS



ZONAL LUMEN SUMMARY

Zone	Lumens	%Lamp	%Fixt
0-20	469.85	5.90	6.90
0-30	989.42	12.40	14.40
0-40	1578.83	19.70	23.00
0-60	2588.56	32.40	37.80
0-80	3059.53	38.20	44.60
0-90	3093.93	38.70	45.10
10-90	2972.86	37.20	43.40
20-40	1108.98	13.90	16.20
20-50	1664.97	20.80	24.30
40-70	1323.34	16.50	19.30
60-80	470.97	5.90	6.90
70-80	157.36	2.00	2.30
80-90	34.41	0.40	0.50
90-110	192.42	2.40	2.80
90-120	520.90	6.50	7.60
90-130	1151.68	14.40	16.80
90-150	2644.99	33.10	38.60
90-180	3760.53	47.00	54.90
110-180	3568.1	44.60	52.10
0-180	6854.46	85.70	100.00

Total Luminaire Efficiency = 85.70%

RC	80				70				50			30			10			0	
	RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
0		91	91	91	91	83	83	83	83	69	69	69	56	56	56	44	44	44	39
1		83	80	76	73	76	73	70	68	61	59	57	50	48	47	40	39	38	33
2		76	70	65	60	69	64	60	56	54	50	48	44	42	40	35	34	32	28
3		69	61	55	50	63	57	51	47	47	44	40	39	36	34	31	29	28	24
4		63	54	48	43	58	50	45	40	42	38	35	35	32	29	28	26	24	21
5		58	49	42	37	53	45	39	34	38	33	30	31	28	25	25	23	21	18
6		54	44	37	32	49	40	34	30	34	30	26	28	25	22	23	21	19	16
7		50	39	33	28	46	37	31	26	31	26	23	26	22	20	21	19	17	14
8		46	36	29	25	42	33	27	23	28	24	21	24	20	18	19	17	15	13
9		43	33	26	22	39	30	25	21	26	22	18	22	18	16	18	15	13	12
10		40	30	24	20	37	28	22	19	24	20	17	20	17	14	17	14	12	11

CONSULT FACTORY FOR PHOTOMETRIC DATA ON FIXTURE CONFIGURATIONS NOT SHOWN.



PMC-9060-000

Specifications and Dimensions are subject to change without notice.
100 Gilbane Street / Warwick, RI 02886 • TEL 401.738.7266 • FAX 401.738.0618

www.pmcighting.com



DCD1

Recessed LED Downlight
General New Construction
5", 6" Aperture

PRODUCT SPECIFICATIONS



- Versatile LED luminaire for 120/277V general applications
- Easy, tool-free installation, including Twist & Lock trim feature
- 1500, 2000 lumen outputs, powered by Cree 90+ CRI LEDs
- Available 2700K, 3000K, 3500K, 4000K CCT
- Flicker-free TRIAC/ELV, 0-10V or Lutron Hi-lume 1% dimming
- 50,000 hour lifetime (L70)
- 5 year limited warranty



Dimmable



50000 hrs lifetime



Warranty



UL listed for Twist & lock wet location



Frame-in Kit

HOUSING: 20 ga. die-formed aluminum (5" frame-in kit), 22 ga. die-formed aluminum (6" frame-in kit), 20 ga. die-formed aluminum (6" shallow frame-in kit).

JUNCTION BOX: Galvanized steel. Equipped with (6) 1/2" and (1) 3/4" knockouts with pryout slots to allow straight conduit runs. (4) knockouts for non-metallic sheathed cable installation. Junction box tension spring allows snap-in installation of plate cover for easy access to wiring. Approved for 8 (four-in, four-out) #12 AWG 90 through wire conductors.

MOUNTING: Pre-installed adjustable bar hangers engineered to accommodate lumber, laminated beams and T-bar.

CEILING: 1/2" up to 1".

CUTOUT: 5 3/4" (5" frame-in kit), 6 3/8" (6" frame-in kit, 6" shallow frame-in kit).

Light Engine

LED: Next generation Cree® chip-on-board LED.

LUMEN OUTPUT (POWER): 1500 lm (19.5W), 2000 lm (29.0W).

COLOR QUALITY: 90+ CRI, 2-step SDCM.

CCT OPTIONS: 2700K, 3000K, 3500K, 4000K.

CONNECTOR: PowerPlug® Luminaire Disconnect Model 182.

INPUT VOLTAGE: 120/277V.

DIMMING: Down to less than 1% for 0-10V or Lutron Hi-lume® 1% at 120/277V.

EMERGENCY LIGHTING: Optional Emergency LED Driver for lighting up to 90 minutes in event of power failure.

LIFETIME: 50,000 hours at 70% lumen maintenance.

PHOTOMETRIC TESTING: Tested in accordance to IESNA LM-79-2008.

LISTINGS: cULus Listed. IC rated. ENERGY STAR® qualified. California Title 24 JA8 compliant. ASTM E283 certified Air Tight. UL Listed for Wet Location. CEC listed.

WARRANTY: 5 year limited warranty.

Trim

CONSTRUCTION: Die-cast aluminum. Twist & Lock mounting allows easy tool-free field installation and tight ceiling fit.

Product Code:	Type:	
Project:	Contact:	Date:

dmf Lighting® 1118 E. 223rd St. Carson, CA 90745 T: 1.800.441.4422
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DCD1

Recessed LED Downlight
General New Construction
5", 6" Aperture

PRODUCT SELECTION GUIDE

FRAME-IN KIT (Product Code Example: DRDHNIC5150)

PRODUCT CODE	APPLICATION	IC/NON-IC	APERTURE	DRIVER	OPTION
DRDH Housing	N New Construction	IC Insulation Contact	5 5" Aperture	150 0-10V, 1500 lm	[Blank] None
			6 6" Aperture	200 0-10V, 2000 lm	EM Emergency Driver
			6S 6" Shallow	15C Lutron LDE1 ¹ , 1500 lm	
				20C Lutron LDE1 ¹ , 2000 lm	
				15W Lutron L3DA3W ² , 1500 lm	
				20W Lutron L3DA3W ² , 2000 lm	

LIGHT ENGINE (Product Code Example: DCD1M15927A)

PRODUCT CODE	LUMENS (WATTS)	CRI	CCT	CONSTRUCTION
DCD1M Module	15 1500 lm (19.5W)	9 90+ CRI	27 2700K	A Alternate Construction
	20 2000 lm (29.0W)		30 3000K	
			35 3500K	
			40 4000K	

TRIM (Product Code Example: DRD2TR5SWH)

PRODUCT CODE	SHAPE	APERTURE	STYLE	FINISH
DRD2T Trim	R Round	5 5" Aperture	S Smooth	WH White
	D Deep <i>Only available in 6" aperture; smooth or baffle style; white, low iridescent or custom finish</i>	6 6" Aperture	B Baffle W Wall Wash <i>Only available in white finish</i>	BK Black SW Silver Reflector, White Flange AZ Low Iridescent Reflector, White Flange <i>Only available in deep shape</i> CC Custom Color

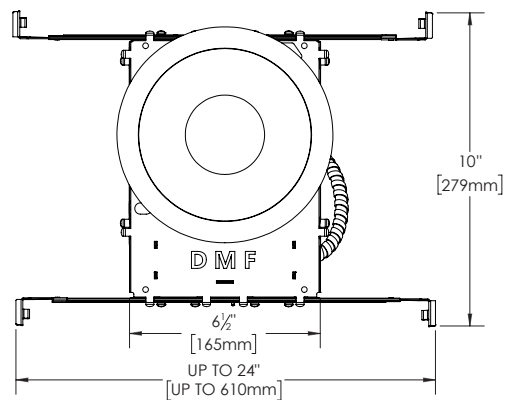
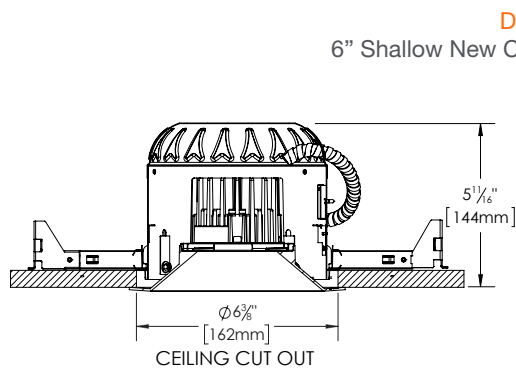
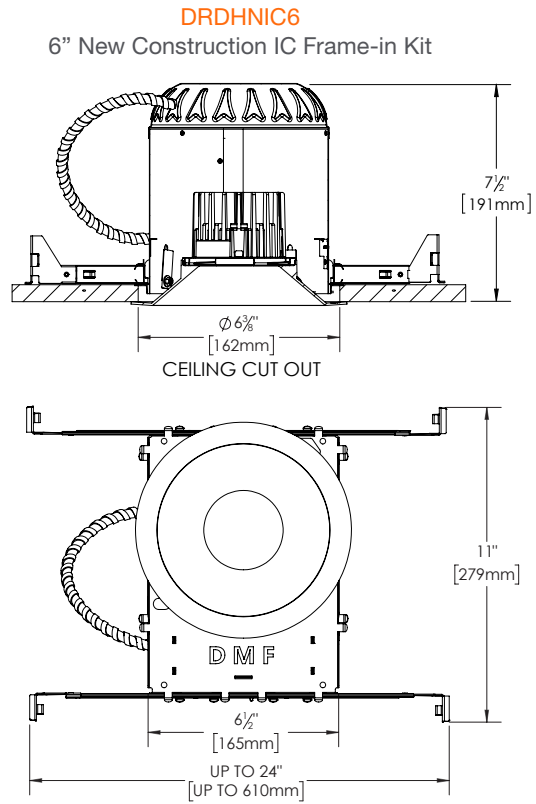
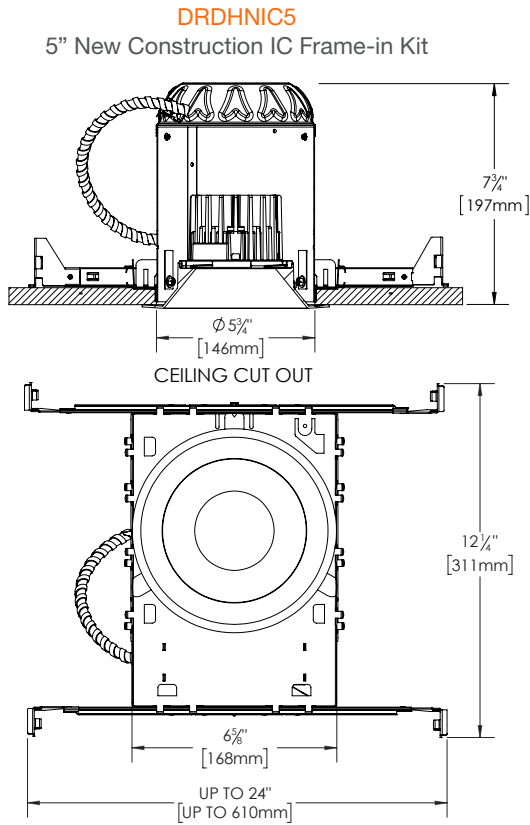
¹ Lutron LDE1 Dimming refers to Lutron Hi-lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black™
² Lutron L3DAE Dimming refers to Lutron Hi-lume 1% 3-wire LED driver



DCD1

Recessed LED Downlight
General New Construction
5", 6" Aperture

FRAME-IN KIT DIMENSIONS



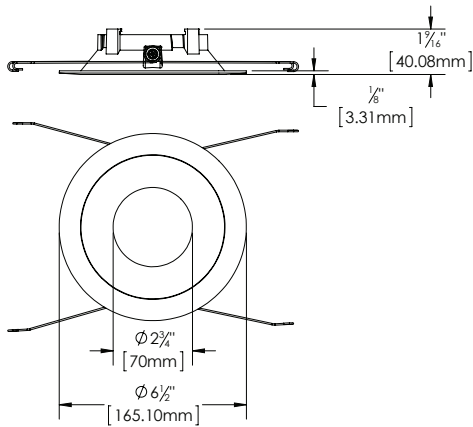


DCD1

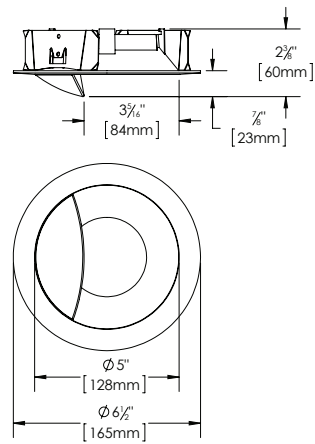
Recessed LED Downlight
General New Construction
5", 6" Aperture

TRIM DIMENSIONS

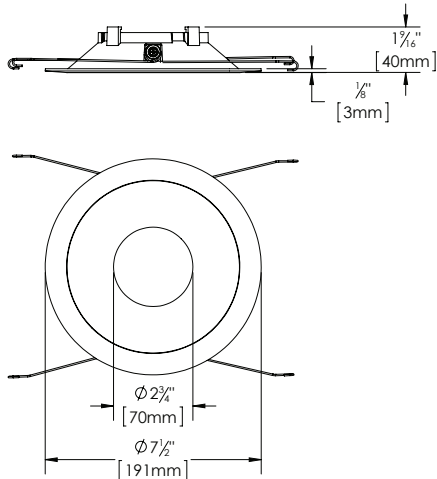
DRD2TR5
5" Round Trim



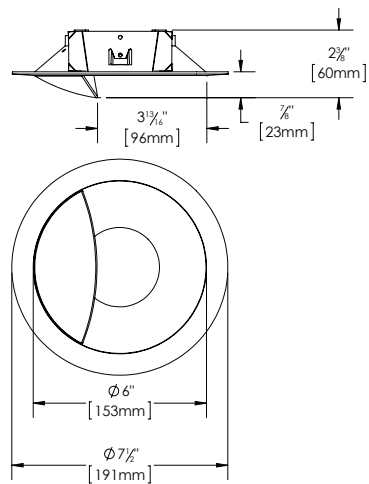
DRD2TR5W
5" Wall Wash Trim



DRD2TR6
6" Round Trim



DRD2TR6W
6" Wall Wash Trim

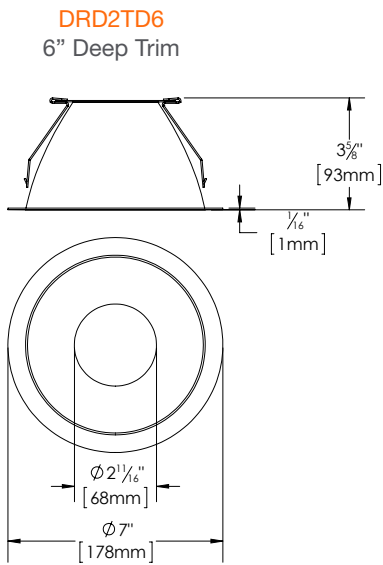




DCD1

Recessed LED Downlight
General New Construction
5", 6" Aperture

TRIM DIMENSIONS

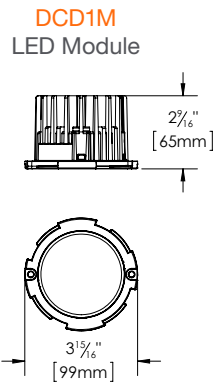




DCD1

Recessed LED Downlight
General New Construction
5", 6" Aperture

LIGHT ENGINE OVERVIEW



	DCD1M15	DCD1M20
Total Module Lumen Output (lm)	1500	2000
Total Rated Power (W)	19.5	29.0
Efficacy (lm/W)	77	69
Color Rendering Index	90+	
CCT Options	2700K, 3000K, 3500K, 4000K	
Optics	Flood	
Binning	2-step SDCM	
Lifetime (L70)	50,000 hours	
Max Ambient Operating Temperature	40°C	
Input Voltage (V)	38VDC (light engine), 120 or 277VAC (luminaire), 50/60Hz	
Input Current at 120V (Max)	0.26A	0.37A
Input Current at 277V (Max)	0.12A	0.16A
Power Factor	>0.9	
Total Harmonic Distortion	<20%	
Dimming	100% - 1% (0-10V, Lutron Hi-lume 1%)	

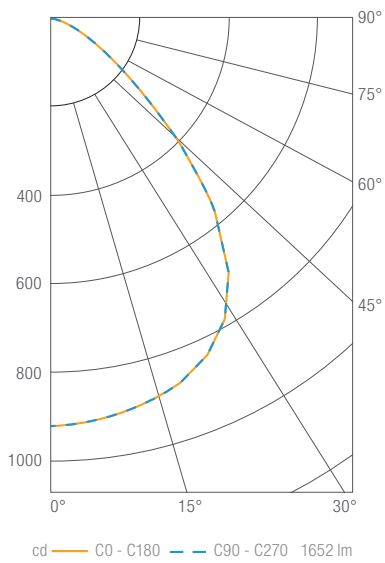


DCD1

Recessed LED Downlight
General New Construction
5", 6" Aperture

PHOTOMETRICS

Light Engine: **DCD1M15930A** (DCD1 Module, 1500 lm, 90 CRI, 3000K)
Trim: **DRD2TR6SWH** (DRD2 Trim, 6" Aperture, Smooth, White)



Luminous Intensity

Gamma	C 0°
0°	851
5°	847
10°	838
15°	824
20°	804
25°	775
30°	727
35°	649
40°	539
45°	403
50°	272
55°	178
60°	117
65°	75
70°	42
75°	20
80°	10
85°	4
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	669	41
0-40	1070	65
0-60	1546	94
0-90	1652	100
0-180	1652	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3.0'	95	5.8'
6.0'	24	11.6'
9.0'	11	17.4'
12.0'	6	23.3'

Beam Angle: 88°

Light Engine: **DCD1M20930A** (DCD1 Module, 2000 lm, 90 CRI, 3000K)

Lumen Scaling

DCD1M15 (1500 lm)	DCD1M20 (2000 lm)
1.00	1.33

Light Engine: **DCD1M15927, DCD1M15935, DCD1M15940**

CCT Scaling

DCD1M15927 (2700K)	DCD1M15930 (3000K)	DCD1M15935 (3500K)	DCD1M15940 (4000K)
0.93	1.00	1.00	1.07



DCD1

Recessed LED Downlight
General New Construction
5", 6" Aperture

DIMMER COMPATIBILITY

Recommended 0-10V Dimmers (Dims down to 1% nominal measured light output)

Brand	Series	Model Number	Max Load DCD1M15	Max Load DCD1M20
Legrand	Titan	CD4FB	97	71
Leviton	IllumaTech	IP710-DLZ	46	34
Lithonia	Synergy	ISD BC	46	34
Lutron	Diva	DVTV	73	54
	Nova	NFTV	110	78
	Nova	NTSTV-DV	105	76
Watt Stopper	Micro Decorator Style	DCLV1	135	95

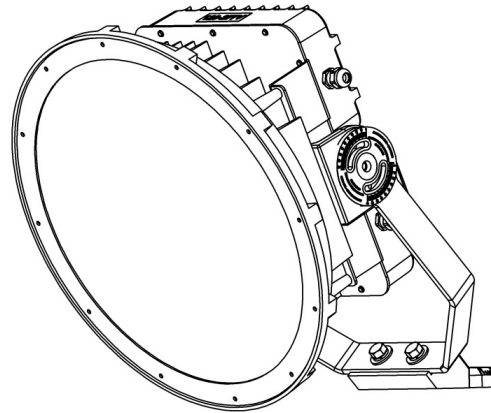


OL1

UltraSpot R

Features

- Compact Dimensions
- Standard 0-10V or PWM Dimming
- Standard Internal Glare Control
- Dim To Off (<6W Standby)
- Integral and Remote Driver Operation
- Replace Traditional 2000W HID
- Designed and manufactured in Texas, USA



Product	FINISH	DRIVE CURRENT	CCT	CRI	BEAM	Voltage	Options
<ul style="list-style-type: none"> • USR = UltraSpot R LED 	<ul style="list-style-type: none"> • G = Gray Powder Coat • DB = Dark Bronze Powder Coat • C = Custom Powder Coat 	<ul style="list-style-type: none"> • 70 = 700mA • 10 = 1050mA 	<ul style="list-style-type: none"> • 30 = 3000K • 35 = 3500K • 40 = 4000K • 50 = 5000K 	<ul style="list-style-type: none"> • 70 = 70 • 80 = 80 	<ul style="list-style-type: none"> • N = Nema 2 • M = Nema 3 • W = Nema 4 • UW = Nema 5 	<ul style="list-style-type: none"> • 1 = 120-277V • 2 = 347-480V • X¹ = Remote 	<ul style="list-style-type: none"> • FT² = Factory Tune • R³ = Remote • TV = Top Visor • 20⁴ = 20kV/20kA Arrestor

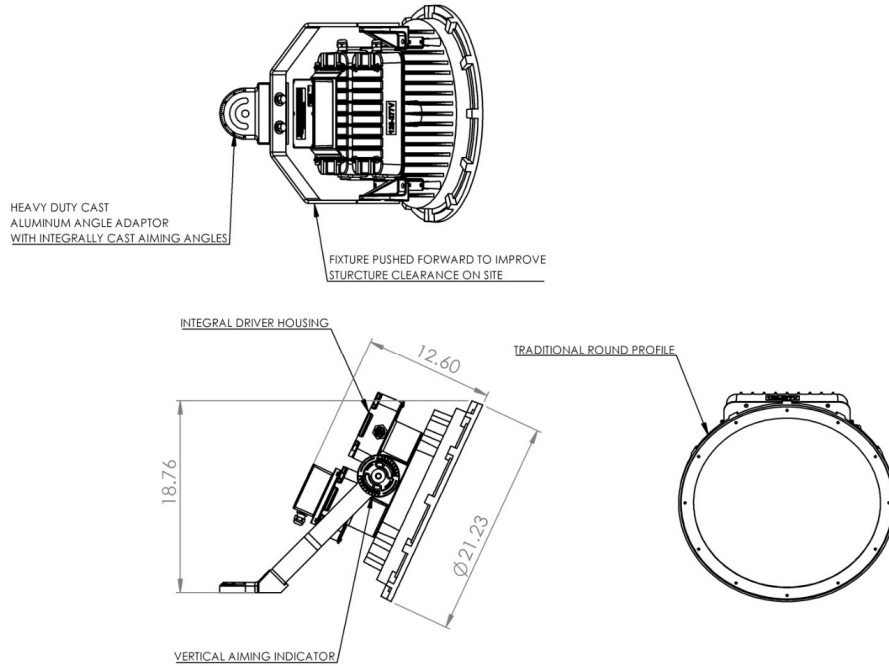
1. Remote Driver option requires separate driver enclosure to be ordered separate from luminaire. Various options are available for remote driver enclosure, contact factory for additional details
2. FT option allows factory reduction in drive current to meet project specific need. Contact factory for more details
3. Must be ordered with CHM remote driver enclosure (RDE). Input voltage and phasing to be specified on RDE.
4. Arrestor is internal only for integral driver. For remote, the arrestor is specified on the RDE.

SPECIFICATIONS AND DETAILS ARE SUBJECT TO CHANGE WITHOUT NOTIFICATION, CONTACT CAROLINA HIGH MAST FOR UP TO DATE DETAILS.
CAROLINA HIGH MAST IS A DIVISION OF CHM INDUSTRIES, INC.
WWW.CAROLINAHIGHMAST.COM

USR_08242017



1



LOADING			
DRIVER LOCATION	WEIGHT (LBS)	EPA HORIZONTAL	EPA 25 DEGREE DOWN
INTEGRAL	75	3.0	2.8
REMOTE	45	3.0	2.8

TECHNICAL SPECIFICATIONS					
DRIVE CURRENT	CRI	DISTRIBUTION	OUTPUT	WATTAGE	LPW
700	70	N	70,274	635	110
700	70	M	66,910	635	105
700	70	W	66,892	635	105
700	80	N	66,760	635	104
700	80	M	63,564	635	99
700	80	W	63,547	635	99
1050	70	N	95,829	960	100
1050	70	M	91,216	960	95
1050	70	W	91,241	960	95
1050	80	N	91,037	960	94
1050	80	M	86,655	960	90
1050	80	W	86,678	960	90

USR_08242017



UltraSpot R Specifications

General Description

The complete luminaire shall have an ambient temperature of no less 40C. The luminaire is designed to thermally isolate the driver from the LED housing by a minimum of 3.5". The driver and optical housings shall be fabricated of duty cast aluminum with a minimum wall thickness of 3/16". The fixture is designed to mount to the same provisions as legacy style HID luminaries with a 3/4" through bolt. The complete luminaire assembly is IP65 rated.

Housing

To ensure long life of the drivers, the driver housing is thermally isolated from the LED housing. To increase cooling efficiency, the housing utilizes integrally cast cooling fins. The housing mounts to the support structure with a heavy gauge steel trunion. The trunion includes a heavy duty cast aluminum angle adaptor and pushes the fixture forward for improved clearance and includes integrally cast angle indicators for horizontal angles. The trunion also includes vertical aiming indication on each side of the luminaire for precision up/down adjustments. The module is available for use in both integral driver and remote driver configuration.

The housings shall be constructed of 363F aluminum and shall be **melted and manufactured in the USA**.

Electrical System

The drivers accept the specified line voltage, to within +/- 10% without the aid of an integral step down transformer. The drivers include integral transient surge protection in accordance with IEEE C62.41 6kV/6kV. The LED drivers have a minimum power factor of 0.95 with a Total Harmonic Distortion no greater than 20%. Drivers come standard with 0-10V dimming leads as well as output tuning. The system includes a secondary surge protection system with supplementary coverage in accordance with IEEE C62.41.2 C High (10kA and 10kV Standard, 20kA and 20kV optional). The secondary surge protection is capable of suppressing a maximum of (1) 20,000 A pulse or (120) 3,000A pulses (8x20 microsecond). The light emitting system is comprised of two (2) thermally isolated LED boards per module each with a dedicated driver to provide overall system redundancy and ease of troubleshooting.

Optic Assembly

Each LED is provided with a dedicated precision cast optical constructed of PMMA. Standard internal glare control optic holders block unwanted glare in all viewing angles to improve comfort for players and spectators. The glare control is provided in a flat black finish to absorb, rather than reflect, spill light thereby eliminating secondary glare. The optional top visor limits up light and further reduces visible glare and property line spill light. The LEDs generate the specified color temperature with a tolerance of no more than +/-6.5% to ensure consistent color across the project. 70 CRI units are provided with a minimum single 5-step MacAdam Ellipse and 80 units offer a minimum single 3-step MacAdam Ellipse. All CRI offerings are stated as minimum, typical CRI will be higher or equal to published minimum.

Warranty

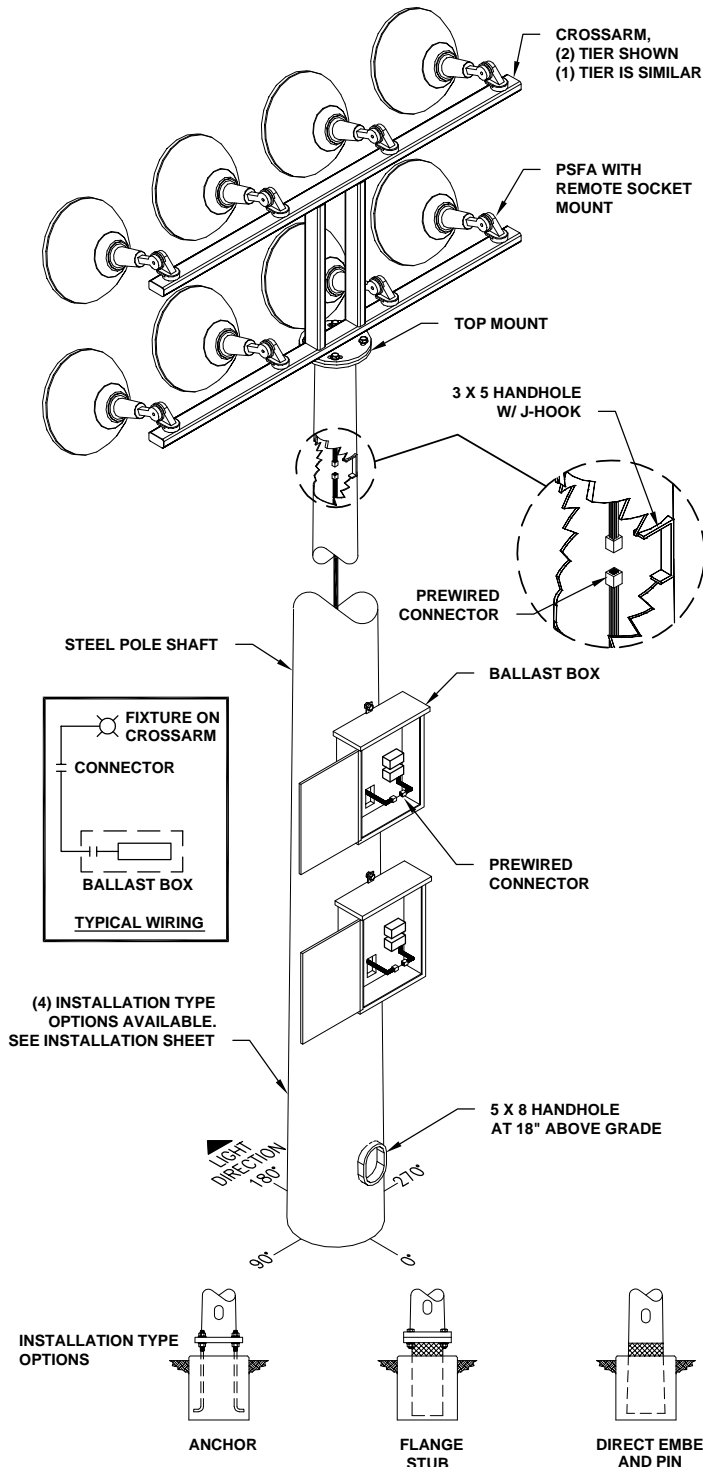
The entire product shall be covered by a minimum five (5) year limited fixture warranty. The warranty shall cover any failure in emission of light from the luminaire. Longer term warranties are available, contact CHM for additional details.

USR_08242017

MODEL
C-210

SPORTS LIGHTING OVERVIEW SHEET

REMOTE SYSTEM, TOP MOUNT TUBE CROSSARM
UP TO 12 FIXTURES



Model description:

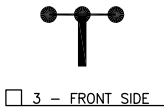
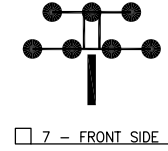
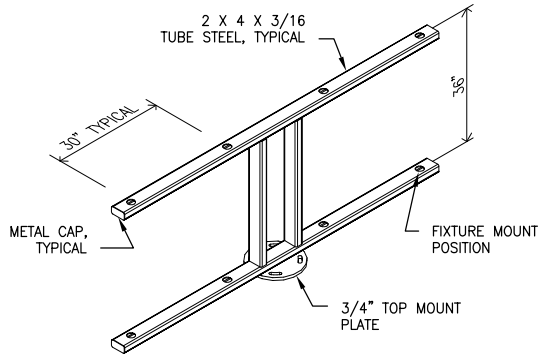
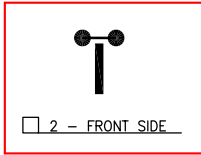
- ▼ Utilizes the GE Power Spot floodlight with remote ballast.
- ▼ Can accommodate from 2 to 12 fixtures.
- ▼ System is UL rated.
- ▼ Ballast are installed near the ground for access with a ladder.
- ▼ Steel poles are designed to accommodate the required EPA and meet local area wind criteria.
- ▼ Steel finish options are available.
- ▼ System is pre-wired.
- ▼ System is pre-aimed.
- ▼ Photometrics designed specifically for each application.

210-1-01

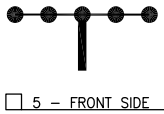
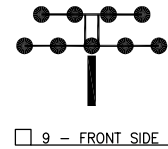
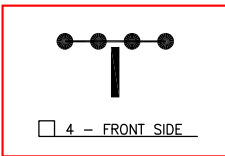
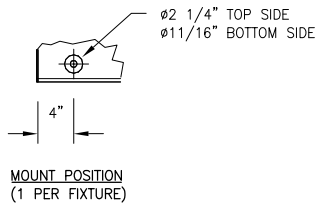
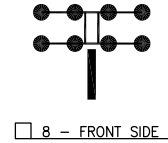


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SPORTS**
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682-286-0046

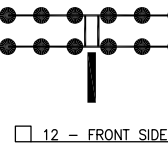
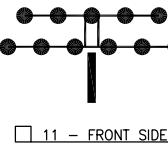
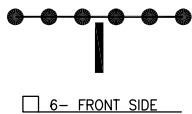
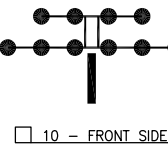
C-210



****REFERENCE VIEW ONLY****
TWO TIER TOP MOUNT CROSSARM
TYPICAL WELDMENT ASSEMBLY



****REFERENCE VIEW ONLY****
TOP MOUNT CROSSARM
TYPICAL WELDMENT ASSEMBLY



SHEET 00
FIXTURE ARRAY DRAWING
REMOTE SYSTEM CROSSARM
UP TO 12 FIXTURES

DWG. NO. 210-2-03
DATE: 09/26/05
REV.



ø210-2-03

3/4-10 X 3" BOLT,
(SHANK NOT TO EXCEED 1 1/2")
W/ F-WASHER

3/4-10 NUT
W/ F-WASHER, L-WASHER


CROSS ARM PLATE

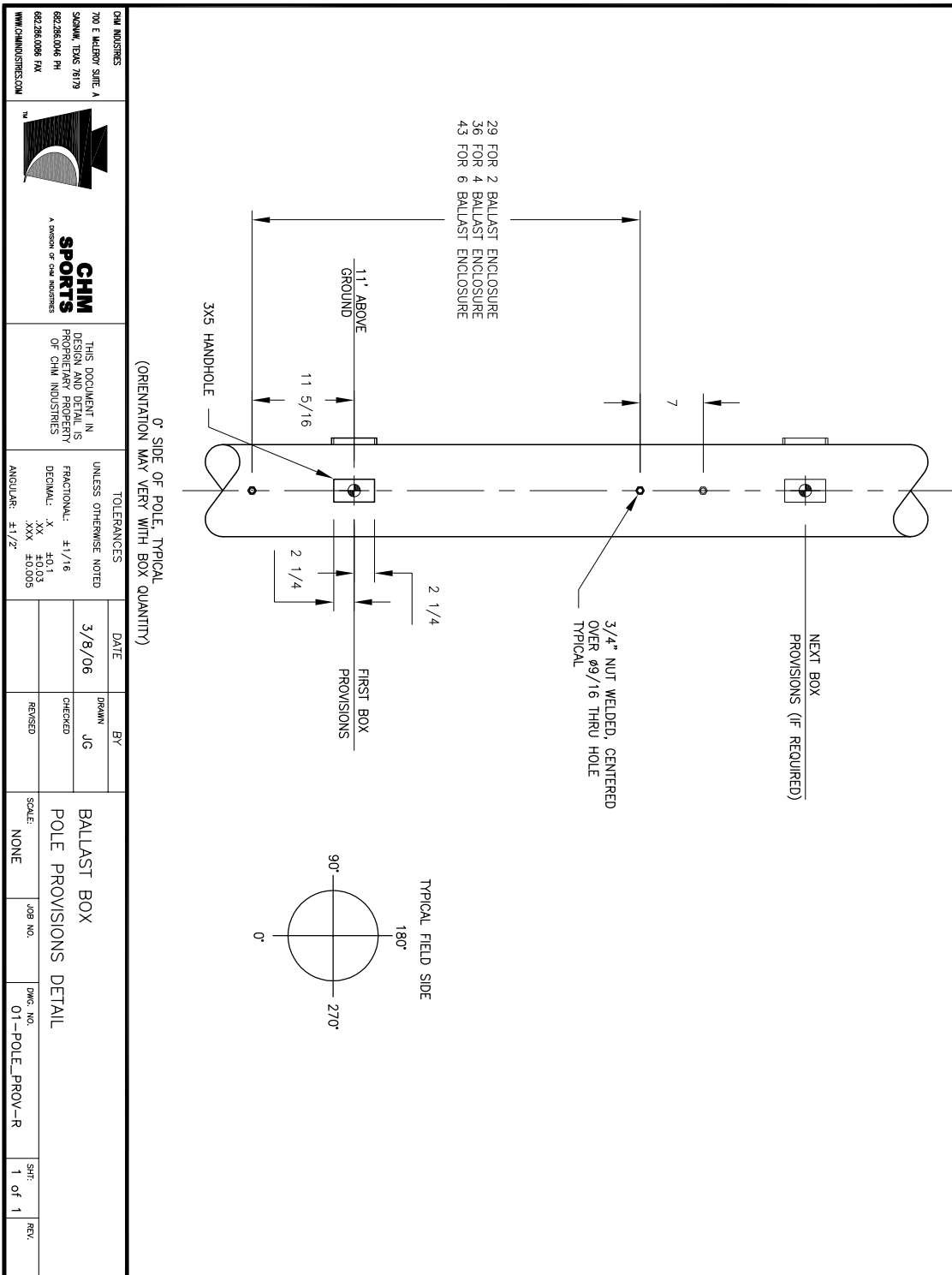
POLE TOP PLATE


MOUNT DETAIL

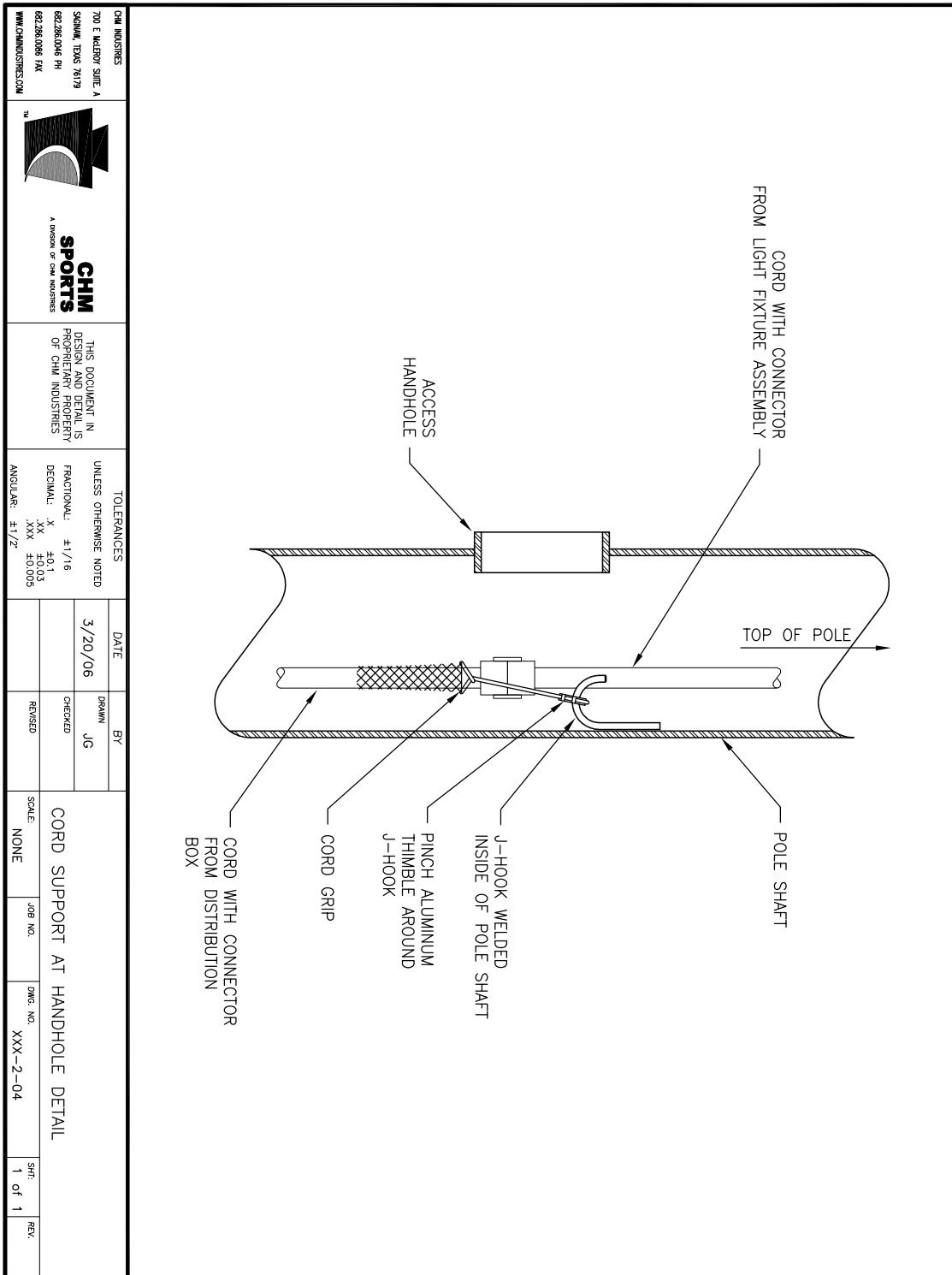
<p>CHM INDUSTRIES 700 E. HALEYVILLE, SUITE A SACHS, TEXAS 76779 862.286.0048 PH 862.286.0048 FAX WWW.CHMINDUSTRIES.COM</p> <p>THIS DOCUMENT IN DESIGN AND DETAIL IS PROPRIETARY PROPERTY OF CHM INDUSTRIES</p>	<p>TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL: ±1/16 DECIMAL: .XX ±0.1 .XXX ±0.03 ANGULAR: ±1/2°</p>	<p>DATE: 3/8/06</p> <p>BY: DRAM JG</p> <p>CHECKED: []</p> <p>REVISED: []</p>	<p>TOP MOUNT PLATE DETAIL</p> <p>SCALE: NONE</p> <p>JOB NO.: NONE</p> <p>DWG. NO.: TMP-TUB</p> <p>SHT: 1 of 1</p> <p>REV.:</p>
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SECTION 265700
LUMINAIRE PRODUCT DATA

<p>CHM INDUSTRIES 700 E. HALEYVILLE, SUITE A SACHIN, TEXAS 76179 862.296.0068 PH 862.296.0068 FAX WWW.CHMINDUSTRIES.COM</p>		 <p>CHM SPORTS A DIVISION OF CHM INDUSTRIES</p>		<p>THIS DOCUMENT IN DESIGN AND DETAIL IS PROPRIETARY PROPERTY OF CHM INDUSTRIES</p>		<p>TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL: ± 1/16 DECIMAL: .X ±0.1 .XX ±0.03 .XXX ±0.005 ANGULAR: ±1/2°</p>		<p>DATE 3/9/06</p>	<p>BY DRAWN JG</p>	<p>BALLAST BOX MOUNT DETAIL (STEEL POLE)</p>			<p>SCALE NONE</p>	<p>JOB NO.</p>	<p>DWG. NO. 01-RBOX_MOUNT</p>	<p>SHT. 1 of 1</p>	<p>REV.</p>
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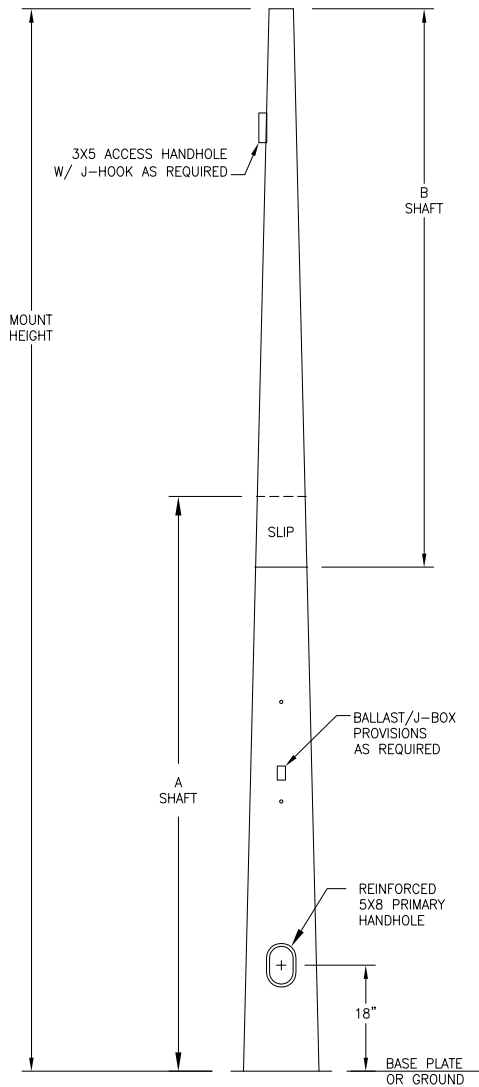
<p>CHM INDUSTRIES 700 E. HALEYVILLE, MO. 64601 660.286.0048 PH 660.286.0048 FAX WWW.CHMINDUSTRIES.COM</p>	 <p>CHM SPORTS A DIVISION OF CHM INDUSTRIES</p>	<p>THIS DOCUMENT IS DESIGN AND DETAIL IS PROPRIETARY PROPERTY OF CHM INDUSTRIES</p>	<p>TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL: ±1/16 DECIMAL: .XX ±0.1 .XXX ±0.005 ANGULAR: ±1/2°</p>	<p>DATE: 3/8/06</p>	<p>BY: JG</p>	<p>SCALE: NONE</p>	<p>JOB NO.</p>	<p>DWG. NO. 01-POLE_PROV-R</p>	<p>SHT: 1 of 1</p>	<p>REV.</p>
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<p>CHM INDUSTRIES 700 E. MEADOWS SUITE A SPRING, TEXAS 74719 862.286.0046 PH 862.286.0046 FAX WWW.CHMINDUSTRIES.COM</p>		<p>CHM SPORTS A DIVISION OF CHM INDUSTRIES</p>		<p>THIS DOCUMENT IN DESIGN AND DETAIL IS PROPRIETARY PROPERTY OF CHM INDUSTRIES</p>		<p>TOLERANCES UNLESS OTHERWISE NOTED</p> <p>FRACTIONAL: ±1/16 DECIMAL: X ±0.1 XX ±0.03 XXX ±0.005 ANGULAR: ±1/2°</p>		<p>DATE: 3/20/06</p>	<p>BY: JG</p>	<p>CORD SUPPORT AT HANDHOLE DETAIL</p>		<p>SCALE: NONE</p>	<p>JOB NO.</p>	<p>DWG. NO. XXX-2-04</p>	<p>SHT: 1 of 1</p>	<p>REV.</p>
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POLE SPECIFICATION

SPORTS LIGHTING



POLE ELEVATION

Shafts	A595 GR. 55
Misc. steel	A36
Anchor bolt	A1554 GR. 55
Base plate	A572 GR 42

MATERIALS SUMMARY

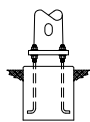
The mast pole shall consist of two or more round or multisided tapered sections. The pole shaft section shall be fabricated from high strength, low-alloy steel plate conforming to ASTM standards, with a minimum yield strength of 55,000 PSI. These shaft sections shall telescope into each other to match the overall desired height of the pole. The overlap telescoping joint shall have a minimum slip distance equal to 1 1/2 times the inside diameter of the female section. The sections shall be pre-fitted and matched marked at the factory. All sections shall maintain a uniform taper from top to bottom. There shall be a maximum of one longitudinal weld in the tapered sections of the shaft. The longitudinal seams shall have at least 60% penetration, except in the areas where the shaft section telescopes over another. In the overlapping areas, the weld penetration shall be 100%. No Transverse butt welds may be used in fabricating the shafts. The finished pole shall be either hot dip galvanized per ASTM A-123 after fabrication, weathering steel per ASTM A-588 or powder coat finish, with the color to be determined at the time of release.

The Base plate (if used) shall be fabricated from structural quality hot rolled carbon steel plate that meets or exceeds ASTM standards with a minimum yield strength of 36,000 PSI. The base plate shall telescope the pole shaft and is circumference-welded top and bottom. The base plate shall have slotted holes for 1/2" variation in the anchor bolt setting.

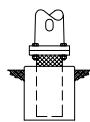
A reinforced hand hole having an appropriate 5" X 8" opening shall be located 18" up from the base. A hand hole cover, attaching hardware, and grounding provisions hardware are included with each hand hole frame.

Anchor bolts (if used) are fabricated from a commercial quality hot-rolled carbon steel bar that meets or exceeds a minimum yield strength of 55,000 PSI. Properly sized anchor bolts will be provided with two hex nuts and two flat washers per bolt.

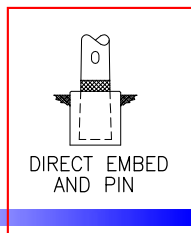
All welding shall be of the highest quality and performed by American Welding Society certified welders and conform to the latest revision of the American Welding Society specification AWS D1.1 Section 8. All welds shall be done by either the shielded metal-arc, gas shielded flux core, gas metal-arc or submerged arc process.



ANCHOR



FLANGE STUB



DIRECT EMBED AND PIN

INSTALLATION TYPES

SPECIFICATIONS

POLE_SPEC2



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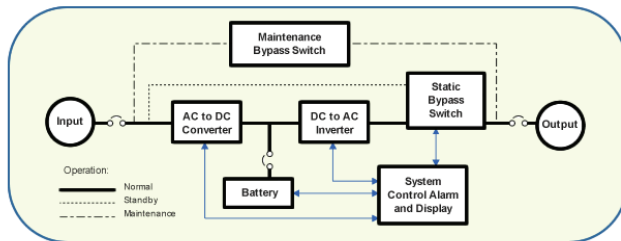
ASTRALITE INVERTER SINGLE PHASE 350W - 2KW

WARRANTY

- 1-year full warranty on system electronics
- 1-year full warranty with 9-year pro-rated warranty on battery
- Extended warranty available
- Maintenance contracts available
- 1-year on-set warranty labor if the inverter system is commissioned by Astralite and is performed by an Astralite authorized service agent

CABINETS

- Space saving, small footprint with modular designs allows for flexible installation
- Standard free standing enclosure with power coat finish
- Optional NEMA – 3r, 4x, or 12 Cabinets with forced air cooling for maximum reliability
- Dimensions - W x H x D - 24" x 26" x 16"



INV-P1



STANDARDS

- Listed to UL924, meets NFPA 101, NFPA 70, NEC and OSHA standards

APPLICATIONS

- Lighting inverter capable of full light output
- Operates fluorescent, compact fluorescent, incandescent, quartz, L.E.D., and other lamp types

MAINTENANCE

- Hassle-free maintenance – the unit automatically performs periodic self-tests

DIAGNOSTICS AND CONTROLS

- Advanced front panel LED display indicating unit status, metering, battery status, alarm event log
- Single point of testing

ORDERING INFORMATION:

INV-P1		POWER RATING		VOLTAGE		OPTIONS	
FAMILY		VA/W	Input	Output			
		350	120	120	ETM120 - 120V Environmental control module / qty		
		525	208	277	ETM277 - 277V Environmental control module / qty		
		700	240	120-240	SPC - Specialized enclosure*		
		875	277	120-277	NF - Normally standby configuration		
		1050			OCB - 20 Amps output circuit breakers / voltage / quantity		
		1400			SRM - Seismic rated bracket		
		2000*			STUM - Onsite start-up		
					IDB - Internal dimmer bypass		
					EMB - External maintenance bypass switch		
					EW - Extended warranty		

* Consult factory for more options

• ASTRALITE • 20 POCONO ROAD • P.O. BOX 91 • BROOKFIELD CT 06804 • 203.775.0172 (P) • 203.775.0797 (F) •
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LED pole top luminaires with asymmetrical light distribution



Housing: Die-cast aluminum housing and slip fitter. Slip fits 3" O.D. pole top, secures to pole with three stainless steel set screws. Die castings are marine grade, copper free ($\leq 0.3\%$ copper content) A360.0 aluminum alloy.

Enclosure: Faceplate is constructed of die-cast aluminum and is secured to housing with mechanically captive stainless steel fasteners. Tempered clear class. Reflector of pure anodized aluminum. Fully shielded to comply with LEED zones 1 and higher. Fully gasketed for weather tight operation using molded silicone rubber "U-channel" gasket.

Electrical: 32.0W LED luminaire, 36.0 total system watts, -30°C start temperature. Integral 120V through 277V electronic LED driver, 0-10V dimming. LED module(s) are available from factory for easy replacement. Standard LED color temperature is 4000K with a >80 CRI. Available in 3000K (>80 CRI); add suffix K3 to order.

Note: LEDs supplied with luminaire. Due to the dynamic nature of LED technology, LED luminaire data on this sheet is subject to change at the discretion of BEGA-US. For the most current technical data, please refer to www.bega-us.com.

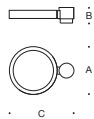
Finish: All BEGA standard finishes are polyester powder coat with minimum 3 mil thickness. Available in four standard BEGA colors: Black (BLK); White (WHT); Bronze (BRZ); Silver (SLV). To specify, add appropriate suffix to catalog number. Custom colors supplied on special order.

CSA certified to U.S. and Canadian standards, suitable for wet locations. Protection class IP65

Weight: 20.0 lbs.

Luminaire Lumens: 2907

Type:
BEGA Product:
Project:
Voltage:
Color:
Options:
Modified:



Pole-top luminaires - asymmetrical wide beam				
Lamp		A	B	C
99407	32.0W LED	Single	18 ⁷ / ₈	24

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SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees, shrubs and other vegetation to remain.
 - 2. Removing existing trees, shrubs and other vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above-grade and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, and abandoning site utilities in place or removing site utilities.
 - 7. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
 - 1. Division 31 2000 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
 - 2. Division 32 9200 Section "Turfs and Grasses" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site unless otherwise noted on the plans.

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings per Division 01 Sections.
 - 1. Identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Sections.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract. Contractor is to confirm that this authority has been obtained before beginning work on adjoining property.
- C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 2000 Section "Earth Moving."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site. Contractor is responsible for doing an independent earthwork computation and including all necessary import and/or export of materials in their bid.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction. If said points will be disturbed, establish new points prior to removal.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction and the sediment and erosion control drawings, whichever is more stringent.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls only after all areas are restored and stabilized.

3.3 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within fenced area.
 - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
 - 3. Maintain fenced area free of weeds and trash.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
 2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 4. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.4 UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
1. Arrange with utility companies to shut off indicated utilities.
 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Architect not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.
- E. Removal of underground utilities is included in Division 33 Sections "Common Work Results for Utilities." for covering site utilities.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
 4. Use only hand methods for grubbing within tree protection zone.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile topsoil material in locations approved by the Owner or Architect.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, other vegetation and waste materials including trash and debris, and legally dispose of them off Owner's property.
 - 1. Burning of materials on project property is prohibited.

END OF SECTION

FINE GRADING

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. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

1.2 SUMMARY

- A. Work included: All labor, materials, necessary equipment and services to complete the Fine Grading work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as not in contract on the plans.
- B. Related work specified elsewhere:
 - 1. Division 312000 Section "Earth Moving."
 - 2. Division 329200 Section "Turfs and Grasses."

1.3 SITE INSPECTION

- A. The Contractor shall visit the site and acquaint himself with all existing conditions. The Contractor shall be responsible for his own subsurface investigations, as necessary, to satisfy requirements of this Section. All subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Landscape Architect or Owner's Representative.

1.4 UTILITIES

- A. Before starting site operations verify that the earlier Contractors have disconnected all temporary utilities which might interfere with the fine grading work.
- B. Locate all existing, active utility lines traversing the site and determine the requirements for their protection. Preserve in operating condition all active utilities adjacent to or transversing the site that are designated to remain.
- C. Observe rules and regulations governing respective utilities in working under requirements of this section. Adequately protect utilities from damage, remove or relocate as indicated, specified or required. Remove, plug or cap inactive or abandoned utilities encountered in excavation. Record location of active utilities.
- D. Contact "Miss Dig" for existing utilities survey confirmation.

1.5 QUALITY ASSURANCE

- A. Requirements of all applicable building codes and other public agencies having jurisdiction upon the work.

- B. Primary emphasis should be given to the aesthetic appearance and functioning of berming and swales, as directed by the Landscape Architect or Owner's Representative. The Contractor shall employ skilled personnel and any necessary equipment to insure that finish grading is smooth, aesthetically pleasing, drains well and is ideal for receiving sod and plant materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Existing Soil:
 - 1. Strip existing topsoil for new construction unless otherwise directed by Owner's Representative, free from debris, sod, biodegradable materials and other deleterious materials. The Contractor shall insure that all existing soil has sufficient percolation and surface drainage to support grasses and plant material and that extreme compaction occurs only in areas to receive paving.
 - 2. In areas to receive seed, verify that soil is scarified to depth of 3 inches and that soil contains enough organic matter to support and encourage rooting of seeded lawn.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Job Conditions
 - 1. Dust control: Use all means necessary to prevent dust from construction operations from being a nuisance to adjacent property owners and from damaging finish surfaces on adjacent building, paving, etc. Methods used for dust control are subject to approval by the Architect or Owner's Representative.
 - 2. Burning: On-site burning will not be permitted.
 - 3. Protection: Use all means necessary to protect curbs, gutters, sprinklers, utilities and vegetation designated to remain, and, in the event of damage, immediately make all repairs, replacements and dressings to damaged plants necessary to the approval of the Landscape Architect. Contractor shall incur all cost for the replacement of damaged objects and vegetation.

3.2 SCHEDULING

- A. Schedule all work in a careful manner with all necessary consideration for adjoining property owners and the public.
- B. Coordinate schedule with other Contractors to avoid conflicts with their work.

3.3 EXCAVATION

- A. Excavate where necessary to obtain subgrades, percolation and surface drainage as required.
- B. Materials to be excavated are unclassified.
- C. Remove entirely any existing obstructions after approval by the Architect's or Owner's Representative.

- D. Remove from site and dispose of debris and excavated material not required.

3.4 GRADING

- A. The Contractor shall establish finished grades as shown on the construction plans and as directed by the Architect, including areas where the existing grade has been disturbed by other work.
- B. Finished grading shall be smooth, aesthetically pleasing, drain well and ready to receive sod and other plant material to full satisfaction of the Owner's Representative, Architect and Construction Manager.

3.5 COMPACTION

- A. Compact each layer of fill in designated areas with approved equipment to achieve a maximum density at optimum moisture, AASHTO T 180 - latest edition.
 - 1. Under buildings, roadways, curbs, walks and other paved areas: compaction shall be to 95% of maximum density.
 - 2. Under landscaped area, compaction shall not exceed 85% of maximum density.
- B. No backfill shall be placed against any masonry or other exposed building surface until permission has been given by the Owner's Representative, and in no case until the masonry has been in place seven days.
- C. Compaction in limited areas shall be obtained by the use of mechanical tampers or approved hand tampers. When hand tampers are used, the materials shall be deposited in layers not more than four inches thick. The hand tampers used shall be suitable for this purpose and shall have a face area of not more than 100 square inches. Special precautions shall be taken to prevent any wedging action against masonry or other exposed building surfaces.

3.6 CORRECTION OF GRADE

- A. Bring to required grade levels areas where settlement, erosion or other grade changes occur. Adjust grades as required to carry drainage away from buildings and to prevent ponding around the buildings and on pavements.
- B. Remove all rock or objectionable material larger than 1 inch in any direction prior to commencing landscaping.
- C. Contractor shall be responsible for stabilizing grades by approved methods prior to landscaping, and shall be responsible for correction of grades as mentioned above, and clean up of any wash outs or erosion.

END OF SECTION

SOIL EROSION CONTROL

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

1.2 SUMMARY

- A. The work under this Section includes, but not limited to all work necessary for effective soil erosion control in conformance with Part 91, Act 451, PA 1994, the Soil Erosion and Sedimentation Control Act, Michigan Department of Natural Resources Environmental Protection Act guidelines and all pertinent local enforcing agency rules and regulations, having jurisdiction.
- B. Related Sections include the following:
 - 1. Division 31 2000 Section "Earth Moving."

1.3 STANDARDS

- A. General: Perform all work under this Section in accordance with all pertinent rules and regulations, including, but not necessarily limited to those mentioned above and these Specifications.
- B. Conflicts: Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.

PART 2 - PRODUCTS

2.1 SEED, FERTILIZER, MULCH

- A. Refer to other Specification Section in Part 3.

PART 3 - EXECUTION

3.1 GENERAL

- A. Standards: Provide all materials and promptly take all actions necessary to achieve effective erosion control in accordance with the Soil Erosion and Sedimentation Control Act, Michigan Department of Natural Resources guidelines, local enforcing agency guidelines and these Specifications.
- B. Site evaluation: Prior to start of the Work, conduct a field evaluation of the site along with representatives of the Engineer/Architect and the local enforcing agency.

- C. Permits: Contractor is responsible for obtaining all pertinent permits including a Soil Erosion Control Permit if required from the county or local enforcing agency. Submit the NPDES Notice of Coverage when the soil erosion permit is received if not already done.

3.2 SEEDING AND MULCHING

A. General

1. All bare soil, unless otherwise required by the Contract Documents, shall be seeded, fertilized and mulched to create a protected condition. Use seed mix as indicated on the plans (if different seed mixes are indicated on the civil and landscape plans, the mix indicated on the landscape plans shall override). Critical areas shall be sodded as approved by the Engineer/Architect and as shown on the plans.
2. Seeding and mulching shall be performed immediately upon completion of a phase or section of the Work or as approved by the Engineer/Architect.
3. In all cases, seeding and mulching shall be performed within thirty (30) calendar days from the time the area was first disturbed.
4. During any period of time which the soil is unprotected, provide erosion control structures as necessary to minimize erosion and to keep any eroded soils on the site and out of ditches, rivers, storm sewers and wetlands.
5. Refer to the plans for notes regarding the use of turf reinforcement matting and/or mulch blankets (on all slope exceeding 1 vertical to 10 horizontal).

B. Seed: Seed shall be applied uniformly at a minimum rate of 48 pounds per acre.

C. Fertilizer: Fertilizer shall be applied uniformly at a minimum rate of 250 pounds per acre.

D. Mulch: Mulch shall be uniformly applied at a rate of two (2) tons per acre, or equal, on all seeded areas that have a slope of less than 1 vertical to 10 horizontal. Refer to note A5. above for additional slope stabilization requirements.

3.3 DITCH AND RIVERS

- A. When reasonably possible, banks of ditches and rivers disturbed under this Work shall be protected within 24 hours of disturbance, but in no case shall banks be left unprotected more than 7 calendar days.

3.4 STEEP SLOPES

A. Emulsion

1. On slopes greater than 10%, use erosion control blankets or turf reinforcement matting to hold seed in place. Refer to plan notes.

B. Other methods: Chemical self-adhering mulch and other mulch anchoring methods may be used as approved by the Engineer/ Architect.

3.5 SITE IMPROVEMENTS CONSTRUCTION

- A. During construction of the site improvements conform to the following general rules:
1. Minimize the amount of earth disturbed at any one time.
 2. Establish a construction sequence which includes adequate erosion control.
 3. Provide ground cover, even if only temporary, so as to stabilize an area and minimize erosion.
 4. As much as practicable, direct storm water away from the construction area. Direct diverted storm water to any stable area.
 5. Collect runoff from the site in sediment basins, traps or through filters.
 6. Establish an inspection and maintenance schedule, paying special attention to the beginning of the various stages of construction. Employ a certified storm water operator and keep a log of the soil erosion and sedimentation control measures in accordance with the NPDES requirements.
 7. Keep in mind that the primary objective is to keep the soil on the site.
 8. Once final stabilization of the site is complete, and the governing agency has granted its approval, remove all temporary erosion control structures.
 9. Control site runoff during all periods of site construction to ensure that excess surface runoff does not reach adjacent properties. This is especially critical during stages when the land has been stripped but not yet graded.

3.6 CLEANING

- A. Perform cleaning of all areas affected by work under this section and leave the site in a neat and tidy state. Contractor shall keep Adjacent Roads clean and free of debris.

END OF SECTION

EARTH MOVING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All earthwork operations shall conform to the current Michigan Department of Transportation standards and specifications.
- C. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
 - 2. Subbase course for concrete walks and pavements.
 - 3. Base course for asphalt paving.
 - 4. Excavation and backfill for utility trenches.
- B. Related Sections include the following:
 - 1. Division 31 1000 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.
 - 2. Division 32 9200 Section "Turfs and Grasses" for finished and fine grading, including placing and preparing topsoil for lawns and plantings.
 - 3. Division 33 4100 Section "Storm Sewers, Underdrains, and Drainage Structures" for storm drainage system.

1.3 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
- B. Base Course: Layer placed between the subbase course and asphalt paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- F. Engineered Fill: Fill placed and compacted to densities specified herein, in a controlled manner using lift thickness limited herein, monitored and tested by the Testing Agency or independent Geotechnical Inspector.

- G. Excavation: Removal of material encountered above subgrade elevations.
- H. Fill: Soil materials used to raise existing grades.
- I. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.
- L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- M. Undercutting: Necessary excavation of poor quality soils which occur below the existing Topsoil and any uncontrolled fill soils as described in the Geotechnical Investigation.
- N. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Drainage fabric if required for the project .
 - 2. Separation fabric if required for the project.
- B. Test Reports: Testing Agency shall submit the following reports directly to the architect and shall copy the contractor:
 - 1. Analysis of soil materials, whether procured on or off site, and including fill, backfill, and borrow materials.
 - 2. In-place density test reports.
 - 3. Moisture-density relationship test reports.
 - 4. Compressive strength or bearing test reports.
- C. Material Test Reports: Interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.

1.5 QUALITY ASSURANCE

- A. Testing Agency Services
 - 1. The Owner will secure and pay for the services of a qualified, independent geotechnical engineer to classify existing soil materials, to recommend and to classify proposed borrow materials when necessary, to verify compliance of materials with specified requirements, and to perform required field and laboratory testing. Geotechnical

engineer 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. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 01 3100 Section "Project Management and Coordination" for meetings.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect or Owner and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect and Owner not less than three (3) calendar days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's or Owner's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials without additional cost to Owner when sufficient satisfactory soil materials are not available from excavations. Contractor is responsible for doing an independent earthwork calculation and including any import of appropriate fill material required to bring the site to the proposed grades.
- B. Satisfactory Soil Material (ASTM D 2487): Free of stones larger than 2 inches in any dimension, trash, debris, organic material, other objectionable material and classified as follows:
 - 1. GP (poorly graded gravel).
 - 2. GM (silty gravel).
 - 3. GC (clayey gravel).
 - 4. SW (well-graded sand).
 - 5. SP (poorly graded sand).
 - 6. SM (silty sand).
- C. Unsatisfactory Soil Material (ASTM D 2487):
 - 1. SC (clayey sand).
 - 2. CL (lean clay).
 - 3. ML (silt).
 - 4. OL (organic clay).
 - 5. OL (organic silt).
 - 6. CH (fat clay).
 - 7. MH (elastic silt).
 - 8. OH (organic clay).
 - 9. OH (organic silt).

10. PR (peat).
- D. Backfill and Fill: Satisfactory soil materials.
- E. Subbase: 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. Refer to the plans for specific requirements.
- F. 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. Refer to the plans for specific requirements.
- G. Engineered Fill: 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.
1. Clean granular fill meeting MDOT Class II grading requirements.
 2. On-site granular deposits within the excavation can be used as engineered fill if approved by the geotechnical engineer and if selective excavation procedures are employed to manage existing clay deposits.
 3. Import fill as required to make-up volumes necessary to raise the building site.
 4. Refer to the plans for specific requirements.
- H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; Generally either an MDOT 3G, 5G, 6A, or 34R will meet this requirement. Bedding requirements of the agencies having jurisdiction over the utility installation take precedence over these specifications.
- I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; Generally either an MDOT 6A or 34R will meet this requirement. Refer to the plans for specific requirements.
- J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

- A. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; with minimum properties determined according to ASTM D 4759 and referenced standard test methods.
- B. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; with minimum properties determined according to ASTM D 4759 and referenced standard test methods.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion-control measures approved by agency having jurisdiction to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 EXPLOSIVES

- A. Explosives: Explosives are prohibited for use on the Project site.

3.4 EXCAVATION, GENERAL

- A. General: Excavation includes the removal of any materials necessary to achieve the required subgrade elevations and includes reuse or disposal of such materials.
- B. Unnecessary Excavation: The expense of excavation of materials outside of limits indicated or ordered in writing by the architect and the correction thereof to the satisfaction of the architect shall be borne by the contractor.
 - 1. Unnecessary excavation under footings: Either deepen footings to bear on actual subgrade elevation without changing top elevations or place concrete fill up to required elevation, as required by the architect.
 - 2. Unnecessary excavation other than under footings: Either place compacted fill or otherwise correct conditions, as required by the architect.
- C. Approval of Subgrade: Notify the Testing Agency when required elevations have been reached.
 - 1. When required by the architect due to the unforeseen presence of unsatisfactory materials or other factors, perform additional excavation and replace with approved compacted fill material in accordance with the architect's or geotechnical engineer's instructions.
 - 2. Payment for unforeseen additional work will be made in accordance with established unit prices or, if none, in accordance with provisions for changes in the work. No payment will be made for correction of subgrades improperly protected against damage from freeze-thaw or accumulation of water, or for correction of otherwise defective subgrades.
- D. Excavation Stabilization: Slope faces of excavations to maintain stability in compliance with requirements of governing authorities. Do not use shoring and bracing where faces can be sloped.

3.5 EXCAVATION FOR STRUCTURES

- A. Do not proceed with excavations for building structures until Subgrade Preparation operations are complete and tested.
- B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Pile Foundations: Stop excavations from 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.
- C. Coordinate excavations with Dewatering operations as required to allow construction of foundations to dry.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms in accordance with the plans and standard details. Excavate trenches a minimum 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course (excavate deeper as required by the regulating agency). Hand excavate for bell of pipe. Remove projecting stones and sharp objects along trench subgrade.
1. Excavate trenches a minimum 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course (excavate deeper as required by the regulating agency). Hand excavate for bell of pipe. Remove projecting stones and sharp objects along trench subgrade. Provide bedding course per the plan notes and/or details.

3.8 SUBGRADE PREPARATION AND INSPECTIONS

- A. Perform mass earthwork operations to remove all existing topsoil and other organic materials in their entirety within the footprint of the proposed building and pavement areas. Buried objects should be removed in their entirety.
- B. Notify Testing Agency when excavations have reached required subgrade elevations.
- C. Proof-roll subgrade in the presence of the Testing Agency to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Completely proof-roll subgrade in one direction repeating proof-rolling in direction perpendicular to the first direction. Limit vehicle speed to 3 mph.

2. Proof-roll subgrade with heavy pneumatic-tired equipment or loaded 10-wheel, tandem-axle truck weighing not less than 15 tons.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Testing Agency, and replace with engineered fill as directed.
- D. If Testing Agency determines that unsatisfactory soil is present, continue excavations and replace with compacted backfill or fill materials as directed.
1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used at no additional cost to the Owner.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for record documents.
 3. Inspecting and testing underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit. All pipe backfill to be done according to the details shown on the plans or the requirements of the regulating agency.

- C. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material as long as the geotechnical engineer deems the material to be suitable and the compaction requirements can be met.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Behind walls, use engineered drainage fill.
 - 6. Under footings and foundations, use engineered fill.
 - 7. Over excavated areas, use engineered fill or lean concrete.

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within two (2) percent of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

3.15 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698 and ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 95 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 88 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish Subgrades to required elevations within plus or minus 1 inch.
- C. Grading Inside Grading Lines: Finish subgrade to a tolerance of ½ inch, when tested with a 10 foot straight-edge.
- D. Contractor shall confirm that the proposed grades shown on the plans will not create a ponding water condition (i.e. an unintended low spot or pavement grades of less than 1%).

3.17 SUBSURFACE DRAINAGE

- A. Drainage Piping: Drainage pipe is specified in Division 33 Section "Subdrainage" for foundation drainage and under-slab drainage systems.
- B. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench. Place a 6 inch course of filter material on drainage fabric to support drainage pipe. Encase drainage in a minimum of 12 inches of filter material and wrap in a drainage fabric, overlapping sides and ends at least 6 inches.
 - 1. Compact each course of filter material to 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least 6 inches.
 - 1. Compact each course of filter material to 95 percent of maximum dry density according to ASTM D 698.

3.18 SUBBASE AND BASE COURSES

- A. If indicated on the plans or deemed necessary by the geotechnical engineer, install separation fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
- B. Under pavements and walks, place subbase course on separation fabric according to fabric manufacturer's written instructions if fabric is called for on the plan or deemed necessary by the geotechnical engineer.
- C. Under pavements and walks, place base on prepared subbase or subgrade as follows:
 - 1. Place base course material over subbase (or subgrade if subbase is not indicated).

2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
 3. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.
- D. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layers to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 DRAINAGE COURSE

- A. Under slabs-on-grade, if indicated on the plans, place drainage fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
- B. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:
 1. Compact drainage course to required cross sections and thickness to no less than 95 percent of maximum dry unit weight according to ASTM D 698.
 2. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no more than 6 inches thick or less than 3 inches thick when compacted.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Construction Manager/Owner will engage a qualified independent Geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and to test any subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work. Comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate and remove and replace soil to depth required, recompact and retest until specified compaction is obtained.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces becomes eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Protect all existing trees, bushes, plants, etc. indicated to remain during construction activities.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Unless otherwise indicated on the drawings, remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.
 - 1. Do not burn materials on the Owner's property.

END OF SECTION

CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Vehicular pavements.
- 2. Pedestrian pavements.

B. Related Sections:

- 1. Section 033000 "Cast-in-Place Concrete" for footings and general building applications of concrete.
- 2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: As required in project documents.
- C. Other Action Submittals:

- 1. Design Mixtures: For each concrete paving and curb mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready-mix concrete manufacturer.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.

3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mix-Concrete 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" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
2. Require representatives of each entity directly concerned with concrete paving 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 paving subcontractor.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized-steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- I. Plain-Steel Wire: ASTM A 82/A 82M, galvanized.
- J. Deformed-Steel Wire: ASTM A 496/A 496M.
- K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, deformed.
- L. Joint Dowel Bars: (Speed Dowels): Greenstreak PSD09/ #4TX or Approved Equal.
- M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.
- N. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- O. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

- P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- R. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
1. Portland Cement: ASTM C 150, gray portland cement Type I/II. Mix designs may be supplemented with the following subject to Architect's review and approval:
 - a. Fly Ash: ASTM C 618, Class C or Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 2. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan cement.
- B. Normal-Weight Aggregates: ASTM C 33, , uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2.4 CURING MATERIALS

- A. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4000 psi
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 4 inches plus or minus 1 inch
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 6 percent plus or minus 1.0 percent for 1-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 requirements as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Test subgrades and subbase for specified compaction.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints as indicated on the drawings.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true

planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by curing compound as follows:
 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each ready mix load or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.11 WASTE MANAGEMENT

- A. Separate and recycle waste materials, packaging, and all other materials in accordance with the Waste Management Plan and to the maximum extent possible, send to reuse or recycle centers.
- B. Concrete Washout:
 - 1. Do not discharge concrete washout into storm drains, catch basins or to the sanitary sewer system. Perform washing of concrete trucks in designated areas or offsite.
 - a. Designated areas should be clearly labeled. They should be in a pit to prevent run-off of waste water. Place designated areas a minimum of 50 feet from storm drains, bodies of water and ditches. All designated areas should be lined to prevent seepage and should have a barrier.
 - b. Alternative to a designated area: Provide a concrete box. If only a small amount of concrete washing is to occur, one option is to line a roll-off box. For very small projects this could be done with a drum.
 - 2. Once concrete washout has hardened, break up and dispose of properly. Disposal of hardened concrete should occur on a regular basis.
- C. Washout facilities must be cleaned, or new facilities provided once the washout area is 75% full.

****END OF SECTION****

CEMENT CONCRETE RAMPS, CURBS AND GUTTERS

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 paving materials and construction methods shall conform to the current standards and specifications of the Michigan Department of Transportation. Where these specifications are less stringent than the requirements of MDOT, the MDOT standards shall govern.

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Curb ramps.
 - 2. Curbs and gutters.
- B. Related Sections include the following:
 - 1. Division 31 2000 Section "Earth Moving" for subgrade preparation, grading and subbase course.

1.3 PERFORMANCE REQUIREMENTS

- A. Refer to MDOT's current Standard Specifications for Construction.

1.4 SUBMITTALS

- A. Submit aggregate and concrete mix designs for review. Contractor shall confirm that the materials provided meet the required specifications, and provide material certification to the engineer. Material certification shall state that the products meet or exceed the requirements indicated on the plans and the requirements of the regulating authority.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer with at least three (3) years in business who has completed pavement work similar in material, design, and extent to that indicated for this Project.
- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment and approved by authorities having jurisdiction or the DOT of the state in which Project is located.

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1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.

C. 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.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Do not place concrete when base surface temperature is less than 40 degrees F (4 degrees C) or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curved conditions.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated flat sheets, unfinished.

B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed billet steel, unfinished.

C. Epoxy-Coated Reinforcement Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, deformed bars.

D. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

E. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

F. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.

G. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

- H. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- I. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete.
- J. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 CONCRETE MATERIALS

- A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project. All material to meet current MDOT specifications.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry where indicated on Contract Documents.
- B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- C. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
 - 1. Thickness: ½ inch minimum and thicker where indicated.
- B. Coloring Agent: Where indicated, ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
 - 1. Color: n/a
- C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- D. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- E. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.
- F. Detectable Warning Plates: Fabricated or field cut units case and/or anchored in the pavement to resist shifting or heaving. Detectable warning plates shall be red cast-in-place "Armor-Tile" or

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Engineer/Architect approval equal, in accordance with ANSI sections 406.13 and 705, and ADA cost of regulation A4.29.

2.6 CONCRETE MIXES

- A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.
- C. Proportion mixes to provide concrete for curb ramps, curbs and gutters with the following properties:
 - 1. Compressive Strength (28 Days): 3500 psi, unless otherwise indicated.
 - 2. Maximum Water-Cementitious Materials Ratio: 45% by weight.
 - 3. Maximum Aggregate Size: 1.5 inch (38 mm).
 - 4. MDOT P1 mix design.
- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.
- E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 5.0 to 8.5 percent.
- F. Use appropriate treatment per MDOT specifications where concrete will be placed under freezing conditions. Obtain approval of architect prior to placing concrete in freezing conditions.
- G. Coloring Agent: Where indicated, add coloring agent to mix according to manufacturer's written instructions.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94 and ASTM C 1116.
 - 1. When air temperature is between 85 deg F 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.
- B. Project-Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction and repair as required.

- B. Verify that grades are correct.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations.
- B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- C. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.4 JOINTS

- A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- B. At all locations where new concrete abuts existing concrete, building wall, or supported slabs, place expansion joint and joint sealant.
- C. Construction Joints: Set construction joints at side and end terminations of concrete and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
 - 1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
- D. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where required.
 - 1. Terminate joint filler 1 inch below finished surface to allow placement of joint sealant.
 - 2. Joint sealant is required for all projects even if not indicated on the plans.

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- E. Expansion Joints: Place 1 inch (25 mm) wide expansion joints at maximum 40 foot intervals, if not indicated on drawings. Joints to be full depth of pavement. Place joint sealant at all expansion joints.
- F. Install dowel bars and support assemblies at joints if indicated on the plans. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- G. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas. Construct ¼ inch wide contraction joints for a depth equal to at least one-third of the concrete thickness. Maximum spacing of contractions joints shall be 8'.
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch (10-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - 3. Doweled Contraction 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.
- H. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius.
 - 1. Radius: 3/8 inch (10 mm).

3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Do not add water to concrete during delivery, at Project site, or during placement.
- D. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
- E. Cold-Weather Placement: Comply with ACI 306.1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R when hot-weather conditions exist.

3.6 CONCRETE FINISHING

- A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
- B. Float Finish: Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots.
 - 1. Area Paving: Light broom, texture perpendicular to pavement direction.
 - 2. Curbs and Gutters: Light broom, texture parallel to pavement direction.
 - 3. Direction of Texturing: Parallel to pavement direction.
 - 4. Place sealer on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.
- C. Provide detectable warning surface at all handicap ramps to meet ADA requirements in accordance with ANSI sections 406.13 and 705.

3.7 CONCRETE PROTECTION AND CURING

- 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 follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions.
- C. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions.

3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation Variation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface Variation: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/4 inch.
 - 4. Maximum cross slope for curb ramps: 2%
 - 5. Maximum longitudinal curb ramp slopes: 8.33% (1 on 12 slope)

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified.
- B. Testing Services: Testing shall be performed according to the following requirements:
 - 1. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
 - 2. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
- C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete ramps, curb or gutter that is broken, damaged, or defective, or does not meet requirements as directed by the Architect.
- B. Remove and replace concrete ramps that do not comply with maximum slopes indicated in Section 3.8A above.
- C. Protect concrete from damage. Exclude traffic from pavement for at least fourteen (14) calendar days after placement.

END OF SECTION

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section applies to areas outside building footprint and includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers samples of materials that will contact or affect joint sealants. Use ASTM C 1087 manufacturer's standard test method to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Pavement-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.
- D. Product certificates.
- E. Product test reports.
- F. Preconstruction compatibility and adhesion test reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.
- B. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: To match color of adjacent materials and as selected by Architect from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant for Asphalt: ASTM D 6690, Types I, II, and III.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

- A. Primers: Product 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.
- C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

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- D. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of joint-sealant backings.
 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place joint sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
1. Remove excess joint sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- G. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.
- H. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

****END OF SECTION****

PAVEMENT MARKING

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.
- B. These specifications apply to private, on-site pavement marking. All pavement markings within public rights-of-way must comply with the standards of the regulating agency.

1.2 SUMMARY

- A. The work under this section includes, but is not necessarily limited to the furnishing and installation of all materials necessary for placing pavement markings as indicated on drawings and specifications.
 - 1. Markings on concrete pavement areas.
 - 2. Markings on asphalt pavement areas.
 - 3. Markings on existing concrete or asphalt areas.
 - 4. Markings on resurfaced existing pavements.
- B. Related Sections include the following:
 - 1. Division 321313 Section "Cement Concrete Pavements, Curbs and Gutters."

1.3 QUALITY ASSURANCE

- A. MDOT Specifications: Unless otherwise indicated on drawings or herein specification, all work under this section shall be performed in accordance with the current MDOT Standard Specifications for Highway Construction.
- B. Physically Handicapped: All marking shall be done in accordance with ADA Requirements.
- C. Paint Containers: Each paint container shall be plainly marked, with a durable, weather-resistant marking, showing the name and address of manufacturer or vendor, description of material, batch number, date of packaging and volume and weight of contents.
- D. Use only personnel completely trained and experienced in installation of materials and equipment.

1.4 SUBMITTALS

- A. Product Data, shop drawing submittals are not required. Contractor shall confirm that the materials provided meet the required specifications, and provide material certification to the engineer. Material certification shall state that the products meet or exceed the requirements indicated on the plans and the requirements of the regulating authority.

1.5 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect materials before, during and after installation and to protect the installed work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the architect at no additional cost to owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials and products for work under this section shall conform to current 1990 MDOT Standard Specifications for Highway Construction.

2.2 PAVEMENT MARKING PAINT

- A. Pavement marking paint shall be fast dry and comply with MDOT's current Standard Specifications for Highway Construction and shall be selected from the following list of approved products (or approved equal).

Company	Identification	YELLOW	WHITE
Ennis-Flint		982212	982211
Ennis-Flint		982222	982221
Ennis-Flint		982202	982201
Ennis-Flint		982282	982271
Sherwin-Williams		TM-2205	TM-2204
Sherwin-Williams		TM-5607	TM-5604

- B. Provide required colors for all physically handicapped markings, complying with governing agencies having jurisdiction.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection: Prior to all work of this section, carefully inspect installed work of all trades and verify all such work is complete to the point where installation may properly commence. Verify all pavement markings may be installed in accordance with all pertinent codes and regulations, authorities having jurisdiction and referenced standards.
- B. Discrepancies: In the event of discrepancy, immediately notify the architect. Do not proceed with installation in areas of discrepancies until all have been fully resolved.

3.2 SURFACE PREPARATION

- A. Cleaning: Prior to application of pavement marking, it shall be marking contractor's responsibility that pavement surfaces are clear, dry and free of all foreign materials.
- B. New pavement curing: new bituminous wearing surface shall be in place for period of not less than fourteen days prior to application of Fast Dry pavement markings.

3.3 CONSTRUCTION METHODS

- A. Application: Pavement markings shall be solid 4" wide yellow lines and laid out as indicated on drawings. Paint shall be applied uniformly at a minimum rate of sixteen gallons per mile for single 4" solid line. Markings shall be applied so that they adhere adequately to surface.
- B. Protection of wet paint shall be responsibility of contractor. Markings obliterated by traffic shall be retraced at contractor's expense.

3.4 DEFECTIVE WORK

- A. Improper location: Improperly located markings shall be removed at contractor's expense in a manner acceptable to architect and reapplied in correct locations at contractor's expense.
- B. Material shortage: Markings which are applied with material shortages shall be properly reapplied at contractor's expense.

3.5 CLEAN UP

- A. Upon completion of the work of this section, remove all rubbish, trash and debris resulting from work of this section. Leave site in neat and orderly condition.

****END OF SECTION****

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Chain-link fences.
- 2. Swing gates.

- B. Related Requirements:

- 1. Section 03 3000 "Cast-in-Place Concrete" for cast-in-place concrete perimeter edges and post footings.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Inspect and discuss electrical roughing-in, concrete perimeter edges, and other preparatory work specified elsewhere.
- 2. Review coordination of accessories specified in this Section and elsewhere.
- 3. Review required testing, inspecting, and certifying procedures.

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 the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Gates and hardware.
 - d. Miscellaneous accessories.

- B. Shop Drawings: For each type of fence and gate assembly.

- 1. Include plans, elevations, sections, details, dimensions, finishes, colors, and attachments to other work.
- 2. Include hardware, gates, and operational clearances.

- C. Samples for Initial Selection: For each type of factory-applied finish.

D. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fence components and accessories to include operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to set quality standards for fabrication and installation.
 - 1. Build mockup for typical chain-link fence and gate, including accessories.
 - a. Size: 10-foot Insert dimension length of fence.
 - b. If accepted by Architect, mockup may be incorporated into finished work.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

- A. Special Warranty: Provide Manufacturer and Installer warranty stating agreement to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Faulty operation of gates.
 - d. Leaning, tipping, heaving, settlement, or other misalignment.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Chain-link fence and gate frameworks including all hardware attachments shall withstand the design wind loads and stresses for fence height(s), chain link fabrics, and under exposure conditions indicated according to ASCE/SEI 7.

2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
1. Fabric Height: Multiple heights as indicated on Drawings.
 2. Steel Wire for Fabric: 9 gauge wire diameter of 0.148 inch.
 - a. Mesh Size: 1-1/4 inches.
 - b. Polymer-Coated Fabric: ASTM F 668, Class 2b over zinc-coated steel wire.
 - 1) Color: Black, according to ASTM F 934.
 - c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
 3. Selvage: Knuckled at both selvages.

2.3 FENCE FRAMEWORK

- A.
1. Posts and Rails: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:
 - a. Fence Height: Multiple heights as indicated on Drawings.
 - b. Post Sizes: 2.875-inch O.D. and 4-inch O.D. as indicated on drawings.
 - 1) Material Designation: SS-40
 - c. Horizontal Framework Members:
 - 1) Rail Sizes: 1.875-inch O.D. as indicated on drawings.
 - 2) Material Designation: SS-40
 - d. Brace Rails:
 - 1) Rail Sizes: 1.875-inch O.D. as indicated on drawings.
 - 2) Material Designation: SS-40
 - e. Metallic Coating for Steel Framework:
 - 1) Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
 - f. Polymer coating over metallic coating.
 - 1) Color: Black, according to ASTM F 934.

2.4 SWING GATES

- A. General: ASTM F 900 for gate posts and single swing gate types.
 - 1. Gate Leaf Width: As indicated on drawings.
 - 2. Framework Member Sizes and Strength:
 - a. 1.875-inch O.D. minimum.
- B. Pipe and Tubing:
 - 1. Zinc-Coated Steel: ASTM F 1083; protective coating and finish to match fence framework.
 - 2. Gate Posts: Round tubular steel.
 - 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded.
- D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend as indicated on drawings above top of chain-link fabric at both ends of gate frame.
- E. Hardware:
 - 1. Hinges: 180-degree outward swing.
 - 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
 - 3. Padlock: To be provided by Owner.

2.5 FITTINGS

- A. Provide fittings according to ASTM F 626.
- B. Post Caps: Provide for each post.
 - 1. Provide flat (slightly domed) post caps.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 - 1. Line and corner clamps for connecting top, intermediate, and bottom rails to posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

- a. Hot-Dip Galvanized Steel: 0.148-inch- diameter wire; coatings and finishes matching chain-link fence fabric.

H. Finish:

- 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.
 - a. Polymer coating over metallic coating.

2.6 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 - 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of all fence lines, gates, and terminal posts. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
- B. Coordinate preparation and installation with integral concrete work.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
 - 1. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Excavate holes for post footings to diameters and spacings indicated, in firm, undisturbed soil. Widen bottom of excavated holes to create belled footing bottom. Holes shall be approved by Architect prior to placement of posts or concrete.
- C. Post Setting: Set posts or post sleeves in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts or post sleeves are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts or post sleeves to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

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- a. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
 - D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
 - E. Line Posts: Space line posts uniformly as indicated on drawings.
 - F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
 - G. Top, Intermediate, and Bottom Rails: Secure to posts with fittings.
 - H. Chain-Link Fabric: Apply fabric to inside of enclosing framework. Leave 1/2-inch bottom clearance between tennis court pavement and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
 - I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
 - J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
 - K. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- 3.4 FIELD QUALITY CONTROL
- A. Testing Agency: Owner will engage a qualified testing agency to perform tests.
 - B. Prepare test reports.
- 3.5 ADJUSTING
- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
 - B. Lubricate hardware and other moving parts.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust and maintain chain-link fences and gates.

****END OF SECTION****

TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lawn Seeding.

1.2 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- I. Surface Soil: Whatever soil is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of grass seed.
- C. Product certificates.

1.4 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 1. Pesticide Applicator: State licensed, commercial.
- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.
 - 1. The soil-testing laboratory shall oversee soil sampling.
 - 2. Report suitability of tested soil for turf growth.
 - a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

1.6 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
 - 1. Seeded Turf: 60 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

PART 2 - PRODUCTS

2.1 SEED

- A. Low Maintenance Lawn Seed Mix: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
 - 1. Grass Seed Mix: Proprietary seed mix as follows: "School Lawn Mix" by Rhino Seed and Landscape Company, Brighton, MI.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Fertilizers: Use only phosphorus-free fertilizers on turfgrass. Phosphorus may be added to turfgrass only if soils are tested for nutrients and a need for phosphorus is demonstrated. Phosphorus fertilizers shall be applied only as prescribed by the soil test results.
- B. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
- C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen and 2 percent potassium, by weight.
- E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen and 10 percent potassium, by weight.

2.5 PLANTING SOILS

- A. Planting Soil for Lawn: Stockpiled topsoil from on-site, imported topsoil or manufactured topsoil from off-site sources; do not obtain from agricultural land, bogs or marshes. Verify suitability of soil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
- B. Contractor shall have stockpiled and imported topsoil sampled and analyzed by an approved laboratory for suitability for lawn and native seeding. The contractor shall amend the stockpiled and/or imported topsoil as recommended by the laboratory.
 - 1. Report suitability of tested soil for lawn and native seeding.
 - a. Based on the test results, state recommendations in weight per 1000 sq. ft. nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, heavy metals; if present, provide additional recommendations for corrective action.
 - c. Test report shall also indicate pH levels, organic content and clay content.
- C. Beyond the laboratory recommendations, the amended lawn and native seeding planting soil shall have the following attributes:
 - 1. Organic matter content between 3% and 30%.
 - 2. pH range between 5.0 and 7.5
 - 3. soluble salts maximum 500 parts per million (ppm)
 - 4. clay content between 5% and 12%

2.6 MULCHES

- A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.7 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets (Double Net): Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed on both sides with in a photodegradable plastic mesh. Include manufacturer's recommended steel wire or wood staples, 6 inches long.

2.8 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 SEED AREA PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 18 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer as recommended by soils tests directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - 3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- B. For erosion-control blanket, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

3.3 SEEDING

- A. Sow seed with drill type machine. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at rate recommended by seed supplier.
- C. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- D. Protect seeded areas with slopes not exceeding 1:4 by spreading hydromulch with tackifier. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre

3.4 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings.
- C. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.5 SATISFACTORY SEEDING

- A. Seed installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeding: At end of maintenance period, a healthy, uniform, close stand has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches

- B. Use specified materials to reestablish areas that do not comply with requirements and continue maintenance until establishment is satisfactory.

****END OF SECTION****

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Planting soils.
 - 3. Steel edging.
 - 4. Organic mulch.

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- C. Finish Grade: Elevation of finished surface of planting soil.
- D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- G. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- H. Structural Soil: Specialized planting mix designed specifically for structural support under pavements.
- I. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- J. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

- K. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- L. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
- B. Samples of soils, soil amendments, and mulches.
- C. Product certificates.
- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.4 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 1. Pesticide Applicator: State licensed, commercial.
- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.
 - 1. The soil-testing laboratory shall oversee soil sampling.
 - 2. Report suitability of tested soil for plant growth.
 - a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.
- C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- D. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide

protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

- C. Handle planting stock by root ball.
- D. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.6 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse or incidents that are beyond Contractor's control.
 - b. Death and unsatisfactory growth due to lack of water.
 - c. Structural failures including plantings falling or blowing over.
 - 2. Warranty Periods from Date of Substantial Completion:
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 24 months.

1.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
 - 1. Maintenance Period for Trees and Shrubs: 24 months from date of Substantial Completion.
 - 2. Maintenance Period for Ground Cover and Other Plants: 24 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated

when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

- B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
 - 2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

- D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
- E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 - 1. Size: 21-gram tablets.
 - 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.5 PLANTING SOILS

- A. Planting Soil: Planting soil for use in all landscape beds and planters except areas specified to receive structural soil. Use imported topsoil or manufactured topsoil from off-site sources; do not obtain from agricultural land, bogs or marshes. Verify suitability of soil to produce viable planting soil. Screen soil with ¾" screen to be free of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
 - 1. Ratio of Loose Compost to Topsoil by Volume: 1:3.
 - 2. Ratio of Loose Sand to Topsoil by Volume: 1:3.
 - 3. Fertilizers and amendments as recommended by soil tests.

4. Contractor shall have imported topsoil used in planting mixes sampled and analyzed by an approved laboratory for suitability for planting. The contractor shall amend the imported topsoil as recommended by the laboratory.
 - a. Report suitability of tested soil for planting beds.
 - 1) Based on the test results, state recommendations in weight per 1000 sq. ft. nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - 2) Report presence of problem salts, minerals, heavy metals; if present, provide additional recommendations for corrective action.
 - 3) Test report shall also indicate pH levels, organic content and clay content.
5. Beyond the laboratory recommendations, the amended planting soil shall have the following attributes:
 - a. Organic matter content between 3% and 30%.
 - b. pH range between 5.0 and 7.5
 - c. soluble salts maximum 500 parts per million (ppm)
 - d. clay content between 5% and 12%

2.6 MULCHES

- A. Organic Mulch: Double shredded hardwood bark.

2.7 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum.

2.8 LANDSCAPE EDGINGS

- A. Steel Edging: Standard commercial-steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
 1. Edging Size: 3/16 inch wide by 4 inches deep.
 2. Stakes: Tapered steel, a minimum of 15 inches long.
 3. Accessories: Standard tapered ends, corners, and splicers.
 4. Finish: Standard paint.
 5. Paint Color: Black.

2.9 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

- A. Areas to receive Planting Mix: Loosen subgrade of planting areas to a minimum depth of 12 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - 2. Spread planting soil to a depth of 12 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.2 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 1. Excavate approximately three times as wide as ball diameter.
 - 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
- B. Subsoil and topsoil removed from excavations may not be used as planting soil.

3.3 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Use planting soil for backfill.
 - 2. Balled and Burlapped: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting.

Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Container-Grown: Carefully remove root ball from container without damaging root ball or plant.
 4. Fabric Bag-Grown Stock: Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 5. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 6. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 7. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.4 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

3.5 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING AREA MULCHING

- A. Install weed-control barriers before spreading mineral mulch according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 12 inches and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Tree-like Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.
 - 3. Mineral Mulch in Planting Area and Maintenance Areas: Apply 4-inch average thickness of mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.7 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use practices to minimize the use of pesticides and reduce hazards.
- D. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION

WATER MAIN

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. Where these specifications differ from the standard details or specifications of the governing agency, the agency standards shall apply.
- B. Materials and installation requirements are generally indicated on the plans. Materials indicated in these specifications only apply if indicated on the plans and allowed by the regulating authority. Contractor is responsible for confirming allowable materials and installation requirements with the regulating authority and including these requirements in their bid.
- C. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for the water supply system (for both fire protection and domestic water systems).
- B. Water meters may be provided by the regulating authority. Contractor shall confirm with the regulating authority and pay the required fees for the meter.

1.3 DEFINITIONS

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. HDPE: High density polyethylene plastic
- C. PVC: Polyvinyl chloride plastic.
- D. DI – Ductile Iron.

1.4 SUBMITTALS

- A. Product Data and shop drawing submittals are not required. Contractor shall confirm that the materials provided meet the requirements of the regulating authority, and provide material certification to the engineer. Material certification shall state that the products meet or exceed the requirements indicated on the plans and the requirements of the regulating authority.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water, including materials, installation, tapping of water mains, testing, and disinfection.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify construction manager (or architect if there is no construction manager) no fewer than three days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without construction manager's or architect's written permission.

1.8 COORDINATION

A. Coordinate connection to water main with utility company and make connection per their requirements.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Copper, Pressure-Seal Fittings:
 - a. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 (DN 65) Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- B. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.
1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - a. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 (DN 65): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
1. Grooved-End, Ductile-Iron Pipe Appurtenances:

- a. Available Manufacturers: Subject to compliance with requirements of regulating authority.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - c. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.
- 2.3 PE PIPE AND FITTINGS (use only if indicated on the drawings and allowed by the regulating authority)
- A. PE, ASTM Pipe: ASTM D 2239, SDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 160 psig.
 - 1. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
 - 2. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
 - B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 160 psig.
 - 1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 160 psig.
- 2.4 PVC PIPE AND FITTINGS (use only if indicated on the drawings and allowed by the regulating authority)
- A. PVC, Schedule 80 Pipe: ASTM D 1785.
 - 1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
 - 2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.
 - B. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket, and with spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. PVC Fabricated Fittings: AWWA C900, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
 - 5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.5 CORROSION-PROTECTION PIPING ENCASEMENT (use only if specified on the plans or required by the regulating authority)

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.
2. Form: Sheet or tube.
3. Material: LLDPE film of 0.008-inch (0.20-mm) minimum thickness.
4. Color: Black

2.6 GATE VALVES

A. AWWA, Gate Valves:

1. Available Manufacturers: Subject to compliance with requirements of the regulating authority.
2. Stem (rising or non-rising), and Gate Valve seating (metal seated or resilient seated) to meet requirements of the regulating authority and/or as shown on the standard detail sheets included with the plan:

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Available Manufacturers: Subject to compliance with requirements of the regulating authority.
2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: per requirements of regulating authority.

B. Valve Boxes: If requirements are not indicated on the plans or standard detail sheets, comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts (only if indicated on the plan or required by the regulating authority): UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.8 WATER METERS

A. Water meters will be furnished by utility company. Contractor is responsible for paying the cost of the water meter.

2.9 FIRE HYDRANTS

A. Fire Hydrants:

1. Available Manufacturers: Subject to compliance with requirements of the regulating authority or as indicated on the standard detail sheets.

2.10 FIRE DEPARTMENT CONNECTIONS

A. General – this section only applies if free standing fire department connections (FDC) are indicated on the plans. All building mounted FDC will be part of the plumbing specifications.

1. Available Manufacturers: Subject to compliance with requirements of the regulating authority:

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications and in accordance with the regulating authority. Where these specifications differ from the requirements of the regulating authority, those requirements shall govern.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping [NPS 3/4 to NPS 2 1/2] shall be the following:
1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings.
- F. Underground watermain piping [NPS 4 to NPS 16] shall be as indicated in the plans and standard detail sheets, and as allowed by the regulating authority:

3.3 VALVE APPLICATIONS

- A. General Application: As indicated in the plans and standard detail sheets, and as allowed by the regulating authority.

3.4 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated. Coordinate with the water utility company to provide necessary inspection of watermain installation.
- B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105 if indicated on the plans or if required by the regulating authority. Contractor is responsible for confirming this requirement and including this cost as necessary.
- C. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- E. Install fiberglass AWWA pipe according to AWWA M45.
- F. Bury piping with depth of cover over top at least 60 inches but not less than the minimum required by the regulating authority.
- G. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed. These locations will be indicated on the plans, however, the contractor can propose this installation method in areas where it would be beneficial to minimize disturbance to existing conditions.
- H. Extend water-service piping inside building wall and stub at 12" above floor elevation at the location dictated on the mechanical plans. Coordinate with the interior plumbing plans and the construction manager, owner, or general contractor to confirm this location.
 - 1. Terminate piping with caps, plugs, or flanges as required for piping material. Connections to building-water-piping systems will be done by the interior plumbing contractor.
- I. Install underground piping with restrained joints and/or thrust blocks at horizontal and vertical changes in direction (as indicated on the standard detail sheets or as required by the regulating authority). Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
 - 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 3. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
 - 4. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - 5. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.

6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.6 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following (as long as the regulating authority approves of their use):
 1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for all piping systems:
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box unless gate well is indicated on the plan.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

3.8 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position. Follow the standard details included with the plans and/or the requirements of the regulating authority.

3.9 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. For external FDC, install protective pipe bollards on three sides of each fire department connection if located closer than 5' from a driveway.

3.10 CONNECTIONS

- A. Connect water-distribution piping to existing water main. Use connection method indicated on the plan and as dictated by the regulating authority.

3.11 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests according to requirements of the regulating authority. If testing methods are not dictated by the regulating authority, test as follows: Conduct tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.12 IDENTIFICATION

- A. If required by the regulating authority, install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.13 CLEANING

- A. Clean and disinfect water-distribution piping in accordance with the requirements of the regulating authority. When requirements are not given clean and disinfect as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Where these specifications differ from the standard details or specifications of the governing agency, the agency standards shall apply.
- B. Materials and installation requirements are generally indicated on the plans. Materials indicated in these specifications only apply if indicated on the plans and allowed by the regulating authority. Contractor is responsible for confirming allowable materials and installation requirements with the regulating authority and including these requirements in their bid.
- C. CAD files will be made available for use in construction staking. Contact the engineer regarding applicable fee and requirements for signing of the CAD File Transfer Agreement.

1.2 SUMMARY

- A. This Section includes gravity-flow, non-pressure sanitary sewerage outside the building, with the following components:
 - 1. Cleanouts.
 - 2. Corrosion-protection piping encasement.
 - 3. Precast concrete manholes.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene-monomer rubber.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data and shop drawing submittals are not required. Contractor shall confirm that the materials provided meet the requirements of the regulating authority, and provide material certification to the engineer. Material certification shall state that the products meet or exceed the requirements indicated on the plans and the requirements of the regulating authority.
- B. Field quality-control test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without written permission.

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. Available Manufacturers: Subject to compliance with requirements of the regulating authority.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
- B. Materials are generally indicated on the plans. Materials indicated in these specifications only apply if indicated on the plans and allowed by the regulating authority. Contractor is responsible for confirming allowable materials and installation requirements with the regulating authority and including these requirements in their bid

2.3 ABS PIPE AND FITTINGS

- A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.
 - 1. NPS 3 to NPS 6: SDR 23.5.
 - 2. NPS 8 to NPS 12: SDR 35.
 - 3. Gaskets: ASTM F 477, elastomeric seals.

2.4 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- C. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.5 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class IV, with groove and tongue ends for gasketed joints with ASTM C 443, rubber gaskets.

2.6 CLEANOUTS

- A. Gray-Iron Cleanouts: Use in pavement areas. ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 - 1. Top-Loading Classification: Heavy duty.
 - 2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.7 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints. Refer to plans for standard detail.

2.8 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 1 percent through manhole.
 - 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.9 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 - 1. Manufacturers:
 - a. Josam Company.
 - b. MIFAB Manufacturing Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Wade Div.; Tyler Pipe.
 - e. Watts Industries, Inc.
 - f. Watts Industries, Inc.; Enpoco, Inc. Div.
 - g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
 - 2. Top-Loading Classification: Heavy duty.
 - 3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
 - 1. Manufacturers:
 - a. Canplas Inc.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

- A. Gravity-Flow, Non-pressure Sewer Piping: Pipe material is indicated on the plans. Use only pipe materials indicated on the plans and acceptable to the regulating authority.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
- F. Install gravity-flow, nonpressure, sewer piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated on the drawings.
 - 2. Install piping at depths indicated on the plans.
 - 3. Install piping below frost line.
 - 4. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 5. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 6. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.4 PIPE JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, non-pressure, piping according to the following:

1. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
2. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
3. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
4. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
5. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
6. Join dissimilar pipe materials with non-pressure-type, flexible couplings.

3.5 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops of manholes in lawn areas to the rim elevations indicated on the plan.

3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.7 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade.
 1. Use light-duty, top-loading classification cleanouts in earth areas.
 2. Use heavy-duty, top-loading classification cleanouts in paved areas.
- B. Set with tops one inch above surrounding grade in non-paved areas.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.8 CONNECTIONS

- A. Extend sewer piping to within 5' of building. Connection to building piping will be made by the plumbing contractor.
- B. Make connections to existing piping and underground manholes.
 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.9 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Fill with flowable grout prior to enclosing if indicated on the plans. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use procedure indicated on the plans:
- C. Backfill to grade according to Division 31 Section "Earth Moving."

3.10 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes only if required by the regulating authority.
 1. Use detectable warning tape over piping and over edges of underground manholes.

3.11 FIELD QUALITY CONTROL

- A. Test new piping system according to requirements of regulating authority and provide test reports as required. If a testing method is not specified, test as follows:
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 1. Submit separate report for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Re-inspect and repeat procedure until results are satisfactory.
 - C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 - f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - b. Option: Test concrete gravity sewer piping according to ASTM C 924.
 - D. Leaks and loss in test pressure constitute defects that must be repaired.
 - E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- 3.12 CLEANING
- A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

END OF SECTION

STORM SEWERS, UNDERDRAINS AND DRAINAGE STRUCTURES

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. Where these specifications differ from the local or City's standard detail sheets, the detail sheets shall govern.

1.2 SUMMARY

- A. The work under this Section includes, but is not necessarily limited to, the furnishing and installation of all storm sewers, underdrains and drainage structures and leads and connections as indicated on the Drawings, herein specified and as necessary for the proper and complete performance of this Work for foundations and underslab areas.

1. Storm Sewer Pipe
2. Culverts
3. Perforated Underdrain Pipe
4. Castings
5. Manhole Sections and Steps
6. Catch Basin
7. Brick and Concrete Block Masonry

- B. Related Sections may include, but not be limited to, the following:

1. Division 31 2000 Section "Earth Moving" for excavation and backfill.

1.3 QUALITY ASSURANCE

- A. Use only personnel completely trained and experienced in installation of the materials.
- B. Compliance to City/Township Codes and all other agencies having jurisdiction shall govern material and installation procedures.

1.4 SUBMITTALS

- A. Shop Drawings: Shop drawing submittals are not required for storm sewer materials. Contractor is expected to conform to the plans, specifications, and details for this work. Submit material certificates in lieu of shop drawings. Material certificates shall be signed by manufacturer and contractor certifying that each material item complies with or exceeds requirements.

1.5 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials before, during and after installation.
- B. Replacements: In the event of damage, immediately make all necessary repairs and replacements acceptable to the Engineer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 STORM SEWER PIPE

- A. General: Storm sewer pipe material shall be as indicated on the plans. If indicated on the plans, pipe materials shall conform to the following requirements.
- B. Reinforced Concrete Pipe
 - 1. Reinforced concrete pipe shall conform to ASTM C-76.72A, Type III & Type IV.
 - 2. Joints shall be premium rubber joint as acceptable to the Engineer unless otherwise specified on the drawings.
- C. Corrugated Polyethelene Tubing (CPT)
 - 1. Corrugated Polyethelene Tubing (CPT) shall conform to ASTM F405 and shall be perforated with sock where indicated on the plans.
 - 2. Joints shall be secured with a factory made snap-on or screen-on coupler for 4" and 6" diameter. Joints for 8" diameter and larger shall be a factory made coupler ties, bolts or screws on.
- D. Smooth Lined Corrugated Polyethylene Pipe (SLCPP)
 - 1. Corrugated polyethylene pipe shall have a smooth interior wall, Manning's "n" of 0.012 or better and shall conform to AASHTO M294.
 - 2. Joints shall be secured with a tied or bolted polyethylene coupler or shall be a factory made coupler which can be screw turned on to the end corrugations.
 - 3. Corrugated polyethylene pipe shall be Advanced Drainage Systems N-12, Hancor HiQ or accepted equal.

2.3 CULVERTS

- A. Culverts shall be 16 gauge corrugated galvanized steel pipe unless otherwise indicated on drawings.
- B. Joints shall be restrained by Hugger bands or accepted equal.
- C. Metal end sections shall conform to current MDOT Standard Specifications for Highway Construction.

2.4 PERFORATED UNDERDRAIN PIPE (PE or CPP)

- A. General
 - 1. Perforated underdrain pipe shall be perforated, corrugated polyethelene pipe.
 - 2. The pipe shall have a factory installed geotextile pipe wrap.
 - 3. Perforation shall meet the requirements of AASHTO M 278.
- B. Polyethylene Pipe (PE): Polyethylene pipe and fittings shall be standard strength and conform to ASTM F 405 and AASHTO M 252.
- C. Polyvinyl Chloride Pipe (PVC): Polyvinyl Chloride pipe and fitting shall be standard strength and conform to ASTM F 800.

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- D. Geotextile Pipe Wrap: Geotextile pipe wrap shall weigh at least 3.5 ounces per square yard and shall conform to AASHTO M 288. It shall not be ripped or torn. The minimum tensile strength shall be 100 pounds.

2.5 CASTINGS

- A. General: All castings shall be of cast iron, conforming to ASTM A 48 unless otherwise indicated. Conform to details and notes indicated on the plans. Where details or notes are not indicated, conform with the following requirements.
- B. Manhole frames and covers: Material shall be MDOT Type A with perforated covers.
- C. Catch basins and inlet castings: Catch basin and inlet castings shall be MDOT Type K when located in curbs and gutter, MDOT Type E in non-paved locations, and MDOT Type A when located in paved areas.

2.6 MANHOLE SECTIONS

- A. Manhole walls
 - 1. Standard manhole walls shall be Precast concrete units conforming to ASTM C 478, or be concrete block masonry.
- B. Manhole bases: Manhole bases shall be precast concrete units of the dimensions indicated on the Drawings.

2.7 MANHOLE STEPS

- A. Manhole steps shall be of cast iron conforming to ASTM A 48 or equal, and shall meet pertinent safety rules and regulations.

2.8 CATCH BASINS

- A. Construct catch basins of brick, block, masonry, or Precast units. Precast concrete catch basin units, if used, shall have reinforcing steel conforming to ASTM C 76 II, Wall B.

2.9 INLETS

- A. Construct inlets of brick, block, masonry, or Precast units. Precast inlet units, if used, shall have reinforcing steel conforming to ASTM C 76 II, Wall B.

2.10 CLEANOUTS

- A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

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2.11 MORTAR

- A. Mortar for brick masonry or plastering manholes shall be made of one part Portland cement to two parts sand, and materials and mixing shall correspond, in general, to Division 04 2000 Section "Unit Masonry."

2.12 BRICK

- A. Brick Work shall meet the requirements of Medium Brick of ASTM C 13.

2.13 CONCRETE BLOCK MASONRY

- A. Concrete block masonry shall conform to ASTM C 139.

2.14 OTHER MATERIALS

- A. All other materials not specifically described but required for a complete and proper installation of the work of this Section, shall be new, first quality of their respective kinds, and as selected by the Contractor subject to review by the Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection

1. Verify that all work under this Section may be installed in accordance with all pertinent codes and regulations, the original design and the reference standards.
2. All materials shall be inspected immediately before installation, and if found defective, immediately removed from the site.

B. Discrepancies

1. In the event of discrepancy, immediately notify the Engineer.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 EARTHWORK

- A. All earthwork required for the performance of the work of this Section shall be installed in accordance with Division 31 2000 Section "Earth Moving."

3.3 INSTALLATION

- A. General: Install all pipe and fittings in strict accordance with the manufacturer's recommendations as acceptable to the Engineer and other authorities having jurisdiction.
- B. Handling
1. Distribute pipe and materials at the site as required, care to prevent damage to the pipe and materials.
 2. Use proper tools and implements for safely handling and installing the pipe and other materials.
 3. Protect the pipe and other materials from falling to the ground or into the trench.
 4. Protect distributed pipe and materials from the public and passing vehicles.
- C. Laying pipe
1. Lay all pipe true to line and grade with pipe ends abutting each other and the bell end facing the direction of laying.
 2. Use laser alignment equipment to establish and maintain proper line and grade, unless otherwise directed.
 3. Correct any deviation from line and grade at no additional cost to the Owner.
 4. Protect workers at all times from cave-in and other hazardous conditions.
- D. Joints: Inspect each joint immediately after being completed and, if defective, shall be corrected before any more pipe is laid.
- E. Concrete encasement
1. Place concrete encasements in locations and to the form and dimensions indicated.
 2. Concrete for encasements shall be Class SE with that below the pipe dry mixed.
 3. Take particular care to place the concrete under the pipe, and lay pipe in fresh concrete so that a complete support of the pipe will be made. Encasement at the sides and top may be placed after the concrete under this pipe has been set.
- F. Manholes
1. Construct manholes as indicated on the Drawings and Specifications.
 2. Take special care in forming the channels in the concrete bottom and use wooden templates or half sewer pipe for this work.
 3. Plaster masonry work and castings as indicated on the Drawings.
 4. In precast concrete manholes, the bottom section shall have cast openings of sufficient size to receive the sewer pipe. If such openings are not provided, the bottom portion may be constructed of masonry work from the concrete base to at least 6" above the top of the largest pipe entering the manhole and Precast sections placed from the masonry to the desired top elevation.
 5. All the annular space between the sewer pipe and the opening in the manhole section shall be filled with brick and/or masonry to provide a waterproof seal.
 6. Place the manhole casting on a minimum of 3 courses of masonry brick and a maximum of 5 courses of manhole brick. Install bricks radially. Precast concrete adjusting rings may be used in place of brick.
 7. Mortar joints have to be smooth tooled joints.

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G. Catch basins and inlets

1. Construct catch basins and inlets as indicated on the Drawings and Specifications.
2. Place catch basin and inlet castings on a minimum of 3 courses of manhole brick and a maximum of 5 courses of manhole brick. Install brick radially. Precast concrete adjusting rings may be used in place of brick.

H. Trench bracing: Install trench bracing in accordance with safety and other pertinent rules and regulations, and Division 31 Section "Earth Moving."

I. Erosion control and sedimentation: Contractor to provide erosion control to minimize introduction of sedimentation into the system.

3.4 CLEANING

A. Prior to acceptance of storm sewers, underdrains, manholes and drainage structures, thoroughly clean those structures and remove all dirt and debris of whatever nature from inside sewer pipes, manholes and the like, and leave the site in a neat and clean condition.

****END OF SECTION****