

INDEPENDENT HOTEL

4583 W. Keiser Avenue,
Osceola, Arkansas.

GENERAL CONTRACTORS BID PACKAGE

JOB NO. 2345

February 19 2024

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MECHANICAL, ELECTRICAL, & PLUMBING,

FIRE PROTECTION ENGINEERING:

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SECTION 00 01 15

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SECTION 00 01 15

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SECTION 00 72 00

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

PART 1 – GENERAL

1.1 GENERAL

- A. The following form will be used for the General Conditions for the construction of this Project. It shall be the Contractor's responsibility to obtain original copies of the form for his use.

1.2 FORM

- A. Standard AIA Document AIA A201-2007 Edition of General Conditions of the Contract for Construction is applicable to this project and will be used with the Contract for this project.
- B. The failure on the part of the Contractor to familiarize himself, or examine these Documents, will in no way relieve him of the responsibilities and conditions set out herein.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

PART 1 – GENERAL

1.1 LOCATION OF SITE

- A. The Project includes the Construction of Independent Hotel at 4583 W. Keiser Avenue, Osceola, Arkansas all appurtenances and site improvements.

1.2 SCOPE OF WORK

- A. The Contractor shall furnish all materials, labor, tools, supplies, equipment, transportation, superintendent, temporary construction of every nature, necessary to complete this project as described in the documents.
- B. The work generally includes construction the building and all site improvements as described.

1.3 CONTRACTOR USE OF SITE AND PREMISES

- A. Refer to Section 00 72 00 – General Conditions.
- B. The Contractor shall be responsible for the staking out of all structures and the location of elevations, lines, stakes for cut and fills for grading benchmarks which may be necessary. Owner approval shall be required prior to excavation being started.
- C. All fire regulations shall be strictly observed at all times.
- D. Coordinate the use and construction with the Public construction of roadways, sidewalks, etc.

1.4 CONTRACTOR EXAMINATION OF SITE

- A. The Contractor shall examine the site, all existing conditions, including all utilities and all parts of the Contract Documents, and shall familiarize himself with the conditions of the proposed work.
- B. The Contractor shall be responsible for the verification of all measurements in the field, for his own work and that of his subcontractors, before ordering materials or equipment or any work begins.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1 CUTTING AND PATCHING

- A. Requests for substitution will be considered if received within 60 days after commencement of the Work. Requests received more than 60 days after commencement of the Work may be considered or rejected at the direction of the Architect.
- B. Contractor's request for substitution will be received and considered by the Architect when one or more of the following conditions are satisfied, as determined by the Architect; otherwise requests will be returned without action except to record noncompliance with these requirements:
 - 1. Extensive revisions to Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of Contract Documents.
 - 3. The request is timely, fully documented, and properly submitted.
 - 4. The request is directly related to an "or approved equal" clause or similar language in the Contract Documents.
 - 5. The specified product or method of construction cannot be provided within the Contract time.
 - 6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 - 7. 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.
 - 8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
 - 9. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
 - 10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 26 57

CHANGE ORDER PROCEDURE

PART 1 – GENERAL

1.1 CHANGE ORDER PROCEDURE

- A. Use AIA Document G701, 2001 Edition as the form for making changes in the Contract amount.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 SUMMARY

- A. Unless stipulated in the Construction Agreement, provide a Schedule of Values (Detailed Cost Allocation breakdown) of the agreed Contract Sum showing values allocated to each of the various parts of the Work, as specified herein and in other provisions of the Contract Documents. Schedule of Values will be used as the basis for Contractor's Application for Payment.

1.2 FORM OF SCHEDULE

- A. Use AIA Document G702 and G703. Contractor's standard forms and automated printout equivalent to the AIA documents will be considered for acceptance upon request by Contractor.
- B. Identify schedule with title of project, project number, name and address of contractor, date of submittal.

1.3 CONTENT OF SCHEDULE

- A. Itemize separate line item cost for each of the following:
 - 1. General Cost Items:
 - a. Performance Bond and Labor and Material Bond.
 - b. Field Supervision and Layout.
 - c. Temporary Utilities, Controls
 - 2. DIVISION 02 through 33 cost items.
 - a. Cost for work required by each Section.
 - b. Cost for portion of the work required by a Section when required for proper division of payment or by this specification.
 - c. Unit cost as required by this specification.
- B. Sum of total costs listed in Schedule shall equal total Contract Sum.

1.4 SUBMITTALS

- A. Submit Schedule of Values to Owner and Architect a minimum of 15 days prior to submitting first Application for Payment.
 - 1. Owner and Landscape Architect will review Schedule.
 - 2. Revise Schedule as required by Owner and Architect.

1.5 QUALITY ASSURANCE

- A. When so required by the Owner, provide copies of the Subcontracts or other data acceptable to the Owner substantiating the sums described.

SECTION 01 29 73

SCHEDULE OF VALUES

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 31 13

PROJECT COORDINATION

PART 1 – GENERAL

1.1 PROJECT COORDINATION

- A. Coordinate scheduling, submittal and work of the various sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.
- B. Hold coordination meetings and pre-installation conferences with personnel and subcontractors to assure coordination of Work at regular intervals throughout the life of the construction contract.
- C. Schedule and coordinate submittals.
- D. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate requests for substitutions to assure compatibility of space, of operating elements, and effect on work of other sections.
- F. Coordinate use of Project space and sequence of installation of mechanical and electrical work, utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs. In finished areas conceal pipe, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including:
 - 1. Shop Drawings
 - 2. Product Data
 - 3. Samples

1.3 ADMINISTRATIVE SUBMITTALS

- A. Refer to other Division-1 Section and other Contract Documents for requirements for administrative submittals. Such submittal include, but are not limited to:
 - 1. Permits
 - 2. Schedule of Values
 - 3. Application for Payments
 - 4. Performance and Payment Bond
 - 5. Insurance Certificate
 - 6. List of Subcontractors

1.4 SUBMITTAL PROCEDURES

- A. All submittals shall be accompanied by transmittal letter containing project name, contractor's name, number of drawings, titles and other pertinent data.
- B. Coordination: coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittal for related elements of the work, so processing will not be delayed by the need to review submittals concurrently for coordination.
 - 3. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals not received.
- C. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for re-submittals. Allow one week for initial review of any submittal, and an additional week for reprocessing of each re-submittal. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.
- D. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
 - 1. Provide the following information on the label for processing and recording the action to be taken;
 - a. Project Name
 - b. Date
 - c. Name and Address of Architect
 - d. Name and Address of Contractor
 - e. Name and Address of subcontractor
 - f. Name and Address of Supplier
 - g. Name of Manufacturer

SECTION 01 33 00

SUBMITTAL PROCEDURES

- h. Number and Title of appropriate Specification Section
 - i. Drawing Number and Detail References, as appropriate.
- E. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.

1.5 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicated deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.
- B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
 - 1. Dimensions
 - 2. Identification of products and material included
 - 3. Compliance with specified standards
 - 4. Notation of coordination requirements
 - 5. Notation of dimensions established by field measurements
- C. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8 1/2" x 11", but no larger than 24"x36", or 'D' Size paper. When possible, please also submit an electronic copy of the drawings.
- D. Submittal: Submit five copies of each shop drawing if a reproducible copy is submitted, it will be returned to the Contractor for distribution copies and to Record Documents.
- E. The General Contractor is deemed negligent and is liable for his work efforts and any material installation, if work proceeds with Shop Drawings that do not have the appropriate Stamp of Approval and signature indicating the action to be taken in connection with the Submittal for Construction.

1.6 SHOP DRAWING LOG

- A. Maintain a shop drawing log to record the status of all submittals made to the Architect.
 - 1. Submit three (3) copies with each Application for Payment
 - 2. Clearly identify the Project.
 - 3. Indicate for all shop drawings, product data, and samples submitted to date:
 - a. Title
 - b. Date submitted to the Architect
 - c. Date returned to the Architect
 - d. General nature of the Architects response

1.7 PRODUCT DATA

- A. Collect Product Data on to a single submittal for each element of construction or system. Product Data includes printed information such as, manufacturer's installation instruction, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."
- B. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate Manufacturer's printed recommendation. Compliance with recognized trade association standards, with recognized trade association standards, and with recognized testing agency standards. Application of testing agency labels and seals. Notation of dimensions verified by field measurement. Notation of coordination requirements.

SUBMITTAL PROCEDURES

- C. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
- D. Submittals: Submit five copies of each required submittal; The Architect will retain one and will return the other marked with action taken and corrections or modifications required. Note: Unless non-compliance with Contract Document provisions is observed; the submittal may serve as the final submittal.
- E. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
 - 1. Do not proceed with installation until an applicable copy of Product Data is in the installer's possession.
 - 2. Do not permit use of unmarked copies of Product Data in connection with construction.

1.8 SAMPLES

- A. Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.
- B. Submit samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
- C. Preliminary submittals: Where samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
 - 1. Preliminary submittals will be reviewed and returned with the Architect's mark indicating selection and other action.
- D. Submittals: Except for samples illustrating assembly details, workmanship, fabrication techniques, connection, operation and similar characteristic, submit 3 sets; one will be returned marked with the action taken. Maintain sets of samples, as returned, at the Project site for quality comparisons throughout the course of construction.
 - 1. Unless non-compliance with contract Document provisions are observed, the submittal may serve as the final submittal.
 - 2. Sample sets may be used to obtain final acceptance of the construction associated with each set.
- E. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturer's fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms. Process transmittal forms to the fullest to describe a complete record of activity.

1.9 VISITOR'S LOG

- A. Maintain visitor's log in the field office to record visits by the Owner, the Architect, his consultants and all official observers. This log will become the official record of all job visits, and will show the date, time of arrival, time of departure, the name of the visitor, and the entity represented. The General Contractor shall submit a copy of the visitor's log with each application for payment, indicating the Project Name, and the time period covered by the log.

1.10 ARCHITECT'S ACTION

- A. Except for submittals for record, information or similar purposes, where action and return are required or requested, the Architect will review each submittal, mark to indicate action taken, and return within fourteen (14) calendar days. Compliance with specified characteristics is the contractor's responsibility.

SECTION 01 33 00

SUBMITTAL PROCEDURES

- B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:
 - 1. Final Unrestricted Release: Where submittals are marked "Approved," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 - 2. Final-But-Restricted Release: When submittals are marked "Approved As Noted," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements on the Contract Documents; final acceptance will depend on that compliance.
- C. Returned for Re-submittal: When a submittal is marked "Not Approved, Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or any other related activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 - 1. Do not permit submittals marked "Not Approved, Revise and Resubmit," to be used at the Project Site, or elsewhere where Work is in progress.
 - 2. Other action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action Not Required."

1.11 AS BUILT DRAWINGS

- A. Maintain a set of construction documents showing all changes and deviations from the original plans. Indicate clearly any changes authorized by change order, or by authorization in the field. The drawings are to be kept current through the progress of the project and turned over to the "Architect of Record" upon completion of the Work.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 – GENERAL

1.1 QUALITY CONTROL

- A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- C. Perform work by persons qualified to produce workmanship of specified quality.
- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.
- E. Comply with manufacturer's instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- F. When required by individual Specifications Sections, submit manufacturer's certificate, in duplicate, that products meet or exceed specified requirements.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 45 29

TESTING LABORATORY SERVICE

PART 1 – GENERAL

1.1 LABORATORY TESTING

- A. Employ and pay for services of an approved (approved by the Architect) independent testing laboratory.
 - 1. Employment of laboratory services shall in no way relieve Contractor of his obligations to perform the work in accordance with the requirements of the Contract Documents.
 - 2. The Testing Laboratory's services are a supplemental adjunct to the quality verification efforts of the Architect and are subject to their oversight and direction as specified herein.
- B. Perform inspections and testing required by laws, ordinances, rules, regulations, orders, public authorities and Contract Documents.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.
 - 1. Temporary utilities to be arranged and maintained by the Contractor at his own expense including, but are not limited to:
 - a. Water service and distribution
 - b. Temporary electric power and light
 - c. Office/Trailer with heat & AC facilities
 - d. Telephone service: (2) dedicated lines
 - e. Fax transmission service: (1) dedicated line
 - f. Computer with Internet, and printer service
 - g. Drafting table or Plan lay table
 - h. Temporary project field signs
 - i. Common Men and Women Toilet
 - j. Drinking water capability
 - k. Rodent and pest control
 - l. Construction aids and services, as required by OSHA
 - m. Traffic controls; flagmen and use of staging areas.
 - n. Storage sheds or trailers with locking capability.
 - o. Night time and weekend security services

1.3 PROTECTION

- A. The Contractor shall continually maintain adequate protection of all of his work from injury due to weather, frost, accident or other cause, and shall protect the Owner's property from injury arising in connection with this Contract. All open trenches of a hazardous nature shall be covered at night and during non-working days.
 - 1. Security and protection facilities required include but are not limited to:
 - a. Temporary fire protection
 - b. Barricades, warning signs with lights
 - c. Enclosure fence for the site is requested, but at the Contractors option.
 - d. Environmental protection
 - 2. Security and protection facilities at Contractor's option include, but are not limited to:
 - a. Staging area fencing
 - b. Temporary on-street parking space barricades or designated parking areas for the subcontractors.

1.4 PROJECT CONDITIONS

- A. Conditions of use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.
- B. The Contractor shall use suitable precautions necessary to prevent damage or injury to pipes, conduits and other underground structures and water courses. The Contractor shall protect from disturbance or damage all land monuments and property markers until unauthorized agent of the Owner has witnessed or otherwise referenced their location and shall not remove them until directed; and shall not injure or destroy trees or shrubs nor remove or cut them without proper authority. Any such damage or injury to public or

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TEMPORARY FACILITIES AND CONTROLS

private property by any act, omission, neglect, or misconduct in the execution of the work shall be replaced by the Contractor, at his expense.

- C. Restore all staging areas and public rights of way to pre-existing conditions upon completion of the Contract for Work.

1.5 LAYING OUT THE WORK

- A. The Contractor shall lay out the work and shall be responsible for all lines, grades, elevations, and measurements of all work in this contract.

1.6 SUBSURFACE CONDITIONS

- A. No responsibility is assumed by the Owner for subsurface conditions. It will be assumed that the Contractor has visited the site and drawn his own conclusions there from the Existing Conditions.

1.7 DRAINAGE

- A. The Contractor shall prevent mud, plaster, cement, concrete and any other building materials from entering storm drains and sanitary sewers during the period of construction and he shall do all pumping, bailing and drainage of all water that may accumulate within or around the building during construction. He shall be responsible for cleaning and permanent piping in places that may become clogged. Under no conditions shall such water used in flushing concrete or other cement mixes be deposited in or about sanitary sewer lines.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials in all related construction methods and techniques, with the exception of undamaged concrete framing materials may be used for poured in place concrete slab work, and those wood products must be in good serviceable condition, and true to their shape and quality.
- B. Water: Provide potable water approved by local health authorities.

2.2 EQUIPMENT

- A. General: Provide new equipment; if acceptable to the Architect, undamaged previously used material in serviceable condition may be used. Provide equipment suitable for the use intended. All articles or equipment to be used on the work, shall come securely wrapped, boxed, or crated with every precaution taken to ensure safe delivery to the project. Any article or equipment whatsoever found to be damaged shall be promptly removed from the project or the site and properly replaced to the satisfaction of the Architect.
- B. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupter, reset button and pilot light, for connection of power tools and equipment.
- C. Electrical Power Cords: Provide grounded, double insulated extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.
- D. Temporary Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to moisture. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.
- E. Temporary Electrical Power Service: Provide weather proof, grounded electric power service and a distribution system of sufficient size, capacity, and power

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characteristics during the construction period. Include meters, overload protected disconnects and automatic ground-fault interrupters.

- F. Heating units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.
- G. Contractor Project Field Office: The Office should have the following furnishings and equipment as minimums.
 - 1. One room large enough to accommodate (I) Conference Table and chairs for (12) people.
 - 2. Voice and Fax Telephone Lines and Internet Service.
 - 3. Heat & Air Conditioning with adequate circulation.
 - 4. Men and Women restroom services with adequate ventilation
 - 5. Potable drinking water services
 - 6. The Office shall be provided with a Plan Layout Board for the Contractor and a Layout Board for the Architect.
- H. This office shall be in service for the duration of the construction period, until the space is ready to be renovated for the Owner's Services.
- I. Removal of the Field Office: Remove all temporary field office facilities ten (10) days prior to the Date of Substantial Completion and repair the site area for final clean up and inspection. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.
- J. Temporary Project Identification Sign: Shall be furnished according to Size, design, lettering and construction directed by the Architect as follows:
 - 1. Design: Graphic design, style of lettering and colors as designated by the Architect. Finished and painting material shall be adequate to resist weathering and fading for the scheduled construction period.
 - 2. Location: Unless noted otherwise, erect on the site and location, as approved by the Architect.
 - 3. Material: Structure and framing may be new or used, wood or metal, in sound condition and structurally adequate for the work and suitable for specified finish.
 - 4. Maintain signs and supports in a neat, clean condition, and repair damage to structures, framing or sign as required. Remove signs, framing, supports and foundation within ten days after substantial completion of the project.
- K. Temporary Toilet Units: The Existing Common Men and Women Toilet Rooms will be available for service throughout the Construction Improvements of this project and will be maintained and cleaned accordingly by the General Contractor.
- L. First Aid Supplies: Comply with governing OSHA, and NFPA Life Safety Regulations for minor medical jobsite related treatment.
- M. Fire Extinguishers: Provide hand-carried, portable UL-Rated, Class "A" Fire Extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL Rated, Class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for general exposures. Comply with NFPA 10 and 241 Classification, extinguishing agent and size required by location and class of fire exposure.
- N. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather and 3 days when the temperature is expected to rise above 80 degrees F (27degrees C). handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.
- O. Rodent and Pest Control: Before foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and the harboring of rodents, roaches or other pests. Employ this service to perform extermination and control procedures at regular intervals so the project will be relatively free of pests and their residues at Substantial Completion. Perform control

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operations in a lawful manner using environmentally safe materials. Provide copies of service reports to the Owner, Architect, and the Contractor for each application with a full disclosure of the service performed and if there were any unusual circumstances encountered and the results of the applied treatment.

- P. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of the contractor.
 2. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
 - a. Replace air filters and clean inside of ductwork and housings.
 - b. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
 - c. Replace lamps that are burned out or noticeably dimmed by Substantial hours of use.
- Q. Replace or repair any damaged surface improvements or fixtures in staging areas. Clean and restore to pre-existing conditions, i.e. general light landscape dirt grading, sod or sowing of grass seed.

PART 3 – EXECUTION

NOT USED

END OF SECTION

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and other Division-1 Specification Sections, apply to this section.
- B. Prevention of erosion due to construction activities.
- C. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewer due to construction activities.
- D. Restoration of areas eroded due to insufficient preventive measures.
- E. Performance bond.
- F. Compensation of Owner for fines levied by authorities having jurisdiction due to noncompliance by Contractor.

1.2 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Temporary and permanent grade changes for erosion control.

1.3 REFERENCE STANDARDS

- A. ASTM D 4355-Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2007.
- B. ASTM D 4491-Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2004).
- C. ASTM D 4533-Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2004.
- D. ASTM D 4632-Standard Test Method for Grab Breaking Load and Elongation of Geotextile; 2004.
- E. ASTM D 4751-Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2004.
- F. ASTM D 4873-Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002.
- G. EPA (NPDES)-National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.
- H. FHWA FLP-94-005-Best Management Practices for Erosion and Sediment Control; Federal Highway Administration; 1995.
- I. USDA TR-55-Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service, 1986.

1.4 PERFORMANCE REQUIREMENTS

- A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Also comply with all more stringent requirements of the State of Tennessee Department of Environment and Conservation (TDEC).
- C. Comply with all requirements of the City of Savannah for erosion and sedimentation control.
- D. Runoff Calculation Standard for Urban Areas: USDA NRCS TR-55, Urban Hydrology for Small Watersheds.
- E. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- F. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.

TEMPORARY EROSION AND SEDIMENT CONTROL

2. Owner will withhold payment to the Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- G. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
- H. Timing: Put preventative measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- I. Storm Water Runoff: Control increase storm water runoff due to disturbance of surface cover due to construction activities for this project.
 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- J. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 1. Control movement of sediment and soil from temporary stockpiles of soil.
 2. Prevent development of ruts due to equipment and vehicular traffic.
 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- K. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project including public streets surrounding the project limits.
 1. Prevent windblown soil from leaving the project site.
 2. Prevent tracking of mud onto public roads outside site.
 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to the Owner.
- L. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewer.
 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- M. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewer.
 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- N. Open Water: Prevent standing water that could become stagnant.
- O. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.5 SUBMITTALS

- A. Submit all submittals required in this section in accordance with procedures specified in the Specifications Submittal Sections.
- B. Erosion and Sedimentation Control Plan:
 1. Submit to the City of Memphis (if needed) within 2 weeks after receiving Notice to Proceed from TDEC and prior to beginning work.
 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventative measures.

TEMPORARY EROSION AND SEDIMENT CONTROL

- c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - f. Format required by law is acceptable, provided any additional information specified is also included.
- 3. Obtain the approval of the Plan by authorities having jurisdiction.
- 4. Obtain the approval of the Plan by the Owner.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values, identify fabric by roll identification numbers.
- D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Mulch: Use one of the following:
 - 1. Straw or hay.
 - 2. Erosion Control matting or netting
 - 3. Polyethylene film, where specifically indicated only.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Bales: Air dry, rectangular straw bales.
 - 1. Cross Section: 14 by 18 inches, minimum.
 - 2. Bindings: Wire or string, around long dimension.
- D. Bale Stakes: One of the following, minimum 3 feet long:
 - 1. Steel U-or T-section, with minimum mass of 1.33lb per linear foot (1.98 kg per linear m).
 - 2. Wood, 2 by 2 inches in cross section.
- E. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 - 1. Average Opening Size: 30 U.S. Std. Sieve (0.600 mm), maximum, when tested in accordance with ASTM D 4751.
 - 2. Permittivity: 0.05 sec⁻¹, minimum, when tested in accordance with ASTM D 4491.
 - 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D 4355 after 500 hours exposure.
 - 4. Tensile Strength: 100 lb⁰f (450 N), minimum, in cross-machine direction; 124 lb-f (550 N), minimum, in machine direction; when tested in accordance with ASTM D 4632.
 - 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D 4632.
 - 6. Tear Strength: 55 lb-f (245 N), minimum, when tested in accordance with ASTM D 4533.
 - 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- F. Silt Fence Posts: One of the following, minimum 5 feet long:
 - 1. Steel U-or T-section, with minimum mass of 1.33lb per linear foot (1.98 kg per linear m).
- G. Gravel: Coarse Aggregate for heavy equipment.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.2 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

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3.3 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 - 1. Width: As required; 20 feet, minimum.
 - 2. Length: 50 feet, minimum.
 - 3. Provide at each construction entrance from public right-of-way.
 - 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
 - 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less than 2 percent: 100 feet (30m).
 - b. Slope between 2 and 5 percent: 75 feet (23m).
 - c. Slope between 5 and 10 percent: 50 feet (15m).
 - d. Slope between 10 and 20 percent: 25 feet (7.5m).
 - e. Slope over 20 percent: 15 feet (4.5m).
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
 - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
 - 2. Straw bale row blocking entire inlet face area; anchor into pavement.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
 - 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
- I. Temporary Seeding: Use where temporary vegetated cover is required.

3.4 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
 - 1. Excavate minimum of 6 inches.
 - 2. Place geotextile fabric full width and length, with minimum 12 inches overlap at joints.
 - 3. Place and compact at least 6 inches of 1.5 to 3.5 inch diameter stone.
- B. Silt Fences:
 - 1. Store and handle fabric in accordance with ASTM D 4873.
 - 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
 - 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
 - 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
 - 5. Install with top of fabric at nominal height and embedment as specified.
 - 6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.

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7. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
8. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- C. Straw Bale Rows:
 1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
 2. Install bales so that bindings are not in contact with the ground.
 3. Embed bales at least 4 inches in the ground.
 4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
 5. Fill gaps between ends of bales with loose straw wedged tightly.
 6. Place soil excavated for trench against bales on the upslope side of the row, compacted.
- D. Temporary Seeding:
 1. When hydraulic seeder is used, seedbed preparation is not required.
 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq. ft.
 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
 5. Incorporate fertilizer into soil before seeding.
 6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
 7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
 8. Repeat irrigation as required until grass is established.

3.5 MAINTENANCE

- A. Inspect preventative measures weekly, within 24 hours after the end of any storm that produces 0.50 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Straw Bales Rows:
 1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
 2. Remove silt deposits that exceed one-half of the height of the bales.
 3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- E. Clean out temporary sediment control structures weekly and relocate soil on site.
- F. Place sediment in appropriate locations on site; do not remove from site.

3.6 MAINTENANCE

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architecture, Incorporated.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 – GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Storage, General
- B. Enclosed Storage
- C. Exterior Storage
- D. Maintenance Storage

1.2 RELATED REQUIREMENTS

- A. Section 01 11 00 - Summary of Work
- B. Section 01 50 00 – Construction Facilities and Temporary Controls
- C. Section 01 78 39 – Project Record Documents

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION

3.1 STORAGE

- A. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
- B. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.

3.2 ENCLOSED STORAGE

- A. Store products, subject to damage by the elements, in substantial weather tight enclosures.
- B. Maintenance temperature and humidity within ranges stated in manufacturer's instructions.
- C. Provide humidity control and ventilation for sensitive products as required by manufacturer's instructions.
- D. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

3.3 EXTERIOR STORAGE

- A. Provide substantial platforms, blocking, or skids, to support fabricated products above ground; slope to provide drainage. Protect products from soiling and staining.
- B. For products subject to discoloration or deterioration from exposure to the elements, cover with impervious sheet material. Provide ventilation to avoid condensation.
- C. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
- D. Provide surface drainage to prevent erosion and ponding of water.
- E. Prevent mixing of refuse or chemically injurious materials or liquids.

3.4 MAINTENANCE OF STORAGE

- A. Periodically inspect stored products on a scheduled basis. Maintain a log of inspections, make available to the Architect.
- B. Verify that storage facilities comply with manufacturer's product storage requirements.
- C. Verify that manufacturer required environmental conditions are maintained Continually.
- D. Verify that surfaces of products exposed to the elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents.

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PRODUCT STORAGE AND HANDLING REQUIREMENTS

3.5 MAINTENANCE OF EQUIPMENT STORAGE

- A. For mechanical and electrical equipment in long-term storage, provide manufacturer's service instruction to accompany each item, with notice of enclosed instructions shown on exterior of package.
- B. Service equipment on a regularly scheduled basis, maintaining a log of services; submit as a record document.

END OF SECTION

SECTION 01 74 23

FINAL CLEANING

PART 1 – GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Final cleaning of project.

1.2 RELATED REQUIREMENTS

- A. Section 01 77 00 – Closeout Procedures.
- B. Individual Specifications Sections: Specific cleaning for product or work.

1.3 DESCRIPTION

- A. Execute cleaning prior to inspection for Substantial Completion of the Work.

PART 2 – PRODUCTS

2.1 CLEANING MATERIALS

- A. Use materials which will not create hazards to health or property, and which will not damage surfaces.
- B. Use only materials and methods recommended by manufacturer of material being cleaned.

PART 3 – EXECUTION

3.1 CLEANING

- A. In addition to removal of debris and cleaning specified in other sections, clean interior and exterior exposed-to-view surfaces.
- B. Remove temporary protection and labels not required.
- C. Clean finishes free of dust, stains, and films.
- D. Clean transparent and glossy materials to a polished condition; remove foreign substances. Polish reflective surfaces to a clear shine.
- E. Vacuum clean carpeted and similar soft surfaces.
- F. Clean, wax, and polish resilient flooring.
- G. Clean surfaces of equipment; remove excess lubrication.
- H. Clean plumbing fixtures, to a sanitary condition.
- I. Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, clean ducts, blowers, and coils when units have been operated without filters during construction.
- J. Clean light fixtures and lamps.
- K. Maintain cleaning until Final Completion.

SECTION 01 74 23

FINAL CLEANING

- L. Remove waste, foreign matter, and debris from roofs, gutters, and area ways.
- M. Remove waste, debris, and surplus materials from site. Clean grounds; remove stains, spills, and foreign substances from paved areas and sweep clean. Rake clean other exterior surfaces.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.1 REQUEST FOR CLOSEOUT INSPECTIONS

- A. **SUBSTANTIAL COMPLETION:** When the Contractor considers work substantially complete, the Contractor shall submit to the Architect the following:
 - 1. Written assertion that Work is Substantially Complete
 - 2. A list of items to be completed or corrected and dates scheduled for completion or correction of each item.
 - 3. Certification that orientation and training for facility maintenance personnel is complete, or will be prior to inspection.
 - 4. Written assertion that Operating & Maintenance Data Binders are complete and available or will be prior to inspection.
- B. **FINAL INSPECTION:** When the Contractor considers the Work Complete, the Contractor shall submit to the Architect the following:
 - 1. Certification that a qualified person authorized by the Contractor has reviewed the Contract Documents and inspect the Work.
 - 2. Written assertion that the work is complete and in accordance with the Contract Documents and ready for Final Inspection.
 - 3. Written assertion that additional materials necessary to augment the Operation & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and available or will be prior to inspection.
 - 4. Written assertion that Project Binders and Construction Record Documents are complete and available or will be prior to final inspection.
- C. Upon receipt of an appropriate request for close-out inspection, the Architect will schedule an inspection meeting with the Contractor, the Owner's Representative, and any other related party with direct interest in the work, to determine the status of completion.

1.2 REQUEST FOR CLOSEOUT INSPECTIONS

- A. Should the Architect determine that the Work is not complete to the degree asserted by the Contractor, the Architect will promptly notify the Contractor in writing stating the deficiencies. The Contractor shall take immediate steps to remedy the deficiencies and make a request for Re-Inspection of the same interested parties.
- B. **SUBSTANTIAL COMPLETION:** The Architect will prepare a Certificate of Substantial Completion on an AIA Document G704, which is accompanied by a list of items to be completed or corrected, (known as "The Punch List") and will submit a Certificate to the Contractor, and to the Owner, for signature with an accounting of Liquidated Damages due, when the Architect verifies that:
 - 1. Work is Substantially Complete base on an inspection conducted pursuant to an appropriate request for close-out inspection.
 - 2. Orientation and training for facility maintenance personnel is complete, and
 - 3. Operating & Maintenance Data Binders are complete and have been delivered to the Owner.

1.3 FINAL ADJUSTMENTS

- A. When the Architect has certified that the Work is complete, The Architect will determine whether modifications are needed to reflect appropriate adjustments to the Contract Sum, which were not previously effected. If such modifications are necessary, the Architect shall prepare it and deliver it to the Contractor, who in the case of a change order, shall sign and return to the Architect for final approval and submission to the Owner.

SECTION 01 77 00

CLOSEOUT PROCEDURES

- B. When the Architect has certified that the Work and needed modifications to the Contract are complete, the Architect will request that the Contractor submit a final application for payment.

1.4 WARRANTY INSPECTION

- A. A Warranty Inspection will be scheduled and conducted at project site prior to One Year from the Date of Substantial Completion was achieved, but as close to the end of that year, as is reasonably possible.
- B. Warranty Inspection will be attended by a least one representative of the Owners, the Architect of Record, and the Contractor.
- C. Warranty Inspection is intended to be an opportunity for the Contractor to become aware of any outstanding corrections needed pursuant to the basic first-year warranty of Work.

PART 2 – PRODUCTS NOT USED

PART 3 – EXECUTION NOT USED

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes requirements for Contractor generated Red Line (As-built) Drawings.
- B. See Division 01 Section "Operation and Maintenance Data" for O&M manual requirements

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit [1] one set of marked-up Red Line drawings.

PART 2 – PRODUCTS

2.1 RED LINE DRAWINGS

- A. Record Prints: Maintain one set of black-line white prints of the Contract Drawings.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 3. Note RFI, Construction Change Directive, Change Order numbers, and similar identification, where applicable.
 - 4. Before requesting inspection for Substantial Completion, submit the Red Line drawings to the PM for review, comment, and transmission to the A/E.
- B. PM Review: The PM will review the Red Line drawings for completeness and accuracy. In the event of missing or incorrect information, PM will return the Red Line drawings for further work and documentation of as-built conditions. If the quality of the Red Line drawings is poor, the PM may declare that the first submission does not satisfy the prerequisite requirement for Substantial Completion.
- C. Resubmission of Red Line drawings: Resubmit the Red Line drawings to the PM. Upon successful review, these drawings will be transmitted to the A/E for review, comment, and when accepted incorporation to the electronic record drawings. Final acceptance of the Contractor's Red Line drawings by the A/E is a precondition for the Contractor's Final Completion.
- D. Format: Identify and date each sheet of the Red Line drawing; include the designation "ASBUILT DRAWING" in a prominent location.

2.2 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 – EXECUTION

3.1 RECORDING AND MAINTENANCE

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

- A. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Red Line Documents for Architect's reference during normal working hours.

END OF SECTION

SECTION 03 20 00

Concrete Reinforcing PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 04 2731 - Reinforced Unit Masonry: Reinforcement for engineered masonry.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete; 2016.
- B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.
- D. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2016.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire reinforcement, Plain and Deformed, for Concrete; 2017.
- F. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
- G. CRSI (P1) - Placing Reinforcing Bars; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
 - 1. Maintain one copy of each document on project site.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
 - 1. Deformed billet-steel bars.
- B. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.
 - 2. Unfinished.
- C. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
 - 1. WWR Style: As indicated on drawings.
- D. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch (1.29 mm).
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.02 RE-BAR SPLICING:

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full steel reinforcing design strength in tension and compression.
 - 1. Products:
 - a. Dayton Superior Corporation; Bar Lock Coupler System: www.daytonsuperior.com.

SECTION 03 20 00

Concrete Reinforcing

- B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; capable of developing full steel reinforcing design strength in tension and compression.

2.03 FABRICATION

- A. Welding of reinforcement is not permitted except as noted on the structural documents.

PART 3 EXECUTION

3.01 LACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Maintain concrete cover around reinforcing as follows:
 - 1. Beams: 3/4 inch (____ mm)
 - 2. Supported Slabs and Joists: 3/4 inch (____ mm).
 - 3. Column Ties: 1 1/2 inch (____ mm).
 - 4. Walls (exposed to weather or backfill): 1 1/2 inch (____ mm).
 - 5. Footings and Concrete Formed against Earth: 3 inch (____ mm).
 - 6. Slabs on Fill: 2 inch (____ mm).

3.02 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 4000, will inspect installed reinforcement for conformance to contract documents before concrete placement.

3.03 SCHEDULES

- A. Reinforcement for Superstructure Framing Members: Deformed bars, unfinished.

END OF SECTION

SECTION 03 3000

Cast In Place Concrete

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete for composite floor construction.
- B. Elevated concrete slabs.
- C. Floors and slabs on grade.
- D. Concrete shear walls, elevator shaft walls, and foundation walls.
- E. Concrete foundations and anchor bolts for pre-engineered building.
- F. Miscellaneous concrete elements, including equipment pads, light pole bases, flagpole bases, thrust blocks, and manholes.
- G. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 2000 - Concrete Reinforcing.
- C. Section 03 3511 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.
- D. Section 07 9200 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.
- E. Section 07 9513 - Expansion Joint Cover Assemblies.
- F. Section 32 1600 - Concrete Paving: Sidewalks
- G. Section 32 1613 – Concrete Paving: Curbs and Gutters.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; 1998 (Reapproved 2004).
- D. ACI 301 - Specifications for Structural Concrete; 2016.
- E. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- F. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- G. ACI 305R - Guide to Hot Weather Concreting; 2010.
- H. ACI 306R - Cold Weather Concreting; 2010.
- I. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
- J. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
- K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.
- L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2016b.
- M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2016a.
- N. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
- O. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- P. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

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Cast In Place Concrete

- Q. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.
- R. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- S. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2014.
- T. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- U. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.
- V. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014a.
- W. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2015.
- X. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 2014.
- Y. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric); 2014.
- Z. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
- AA. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
 - 1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
- D. Samples: Submit samples of underslab vapor retarder to be used.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
 - 1. Maintain one copy of each document on site.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Comply with requirements of Section 03 1000.

2.02 REINFORCEMENT

- A. Comply with requirements of Section 03 2000.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C 33.
- C. Lightweight Aggregate: ASTM C330/C330M.

SECTION 03 3000

Cast In Place Concrete

- D. Fly Ash: ASTM C618, Class C or F.
- E. Calcined Pozzolan: ASTM C618, Class N.
- F. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
- G. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260/C260M.

2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
 - 1. Installation: Comply with ASTM E1643.
 - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.
- B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Grout: Comply with ASTM C1107/C1107M.
 - 2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch (13.7 MPa).

2.06 CURING MATERIALS

- A. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
- B. Curing Agent, Water Replacement Type: Clear, water based, liquid water cure replacement agent complying with ASTM C309 standards for water retention, and with ACI 302.1R.
- C. Water: Potable, not detrimental to concrete.

2.07 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 recommendations.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- D. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
 - 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 - 3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
 - 4. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.
 - 5. Water-Cement Ratio: Maximum 4050 percent by weight.
 - 6. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
 - 7. Maximum Slump: 6 inches (____ mm).
- E. Structural Lightweight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
 - 2. Water-Cement Ratio: Maximum 50 percent by weight.
 - 3. Total Air Content: 3 percent, determined in accordance with ASTM C173/C173M.
 - 4. Maximum Slump: 6 inches (____ mm).

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Cast In Place Concrete

5. Maximum dry unit weight: 110 lb per cubic foot (____ kg per cubic meter).

2.08 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes. B. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
- C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as shown on the drawings. Do not use sand.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 72 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- F. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.04 SLAB JOINTING

- A. Anchor joint fillers and devices to prevent movement during concrete placement.
- B. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- C. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab.
- D. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs for conformance to specified tolerances.
- B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
1. Exposed to View and Foot Traffic: F(F) of 45; F(L) of 35, on-grade only.

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Cast In Place Concrete

2. Under Thick-Bed Tile: F(F) of 25; F(L) of 20, on-grade only.
 3. Under Carpeting: F(F) of 25; F(L) of 15, on-grade only.
 4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
- C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
- E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch (6 mm) or more in height. Provide finish as follows:
1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
 2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
 3. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.
- E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.07 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
1. Normal concrete: Not less than 7 days.
- C. Surfaces Not in Contact with Forms:
1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-fog spray, or saturated burlap.
 - a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
 - b. Spraying: Spray water over floor slab areas and maintain wet.
 - c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
 2. Final Curing: Begin after initial curing but before surface is dry.

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Cast In Place Concrete

- a. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- D. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.
- E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect and/or Engineer of Record. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

3.10 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 03 35 11

Concrete Floor Finishes

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments, such as sealing, for concrete floors. 1.02 RELATED REQUIREMENTS A. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.06 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W, incandescent, light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

- A. Liquid Densifier/Hardener:
 - 1. Use at locations where CONC-1 is indicated in the Room Finish Schedule on the drawings.

2.02 DENSIFIERS AND HARDENERS

- A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete prior to set.
 - 1. Composition: Sodium silicate.
 - 2. Products:
 - a. Curecrete Distribution Inc.; Ashford Formula: www.ashfordformula.com.
 - b. Dayton Superior Corporation ; Densifier J13: www.daytonsuperior.com.
 - c. Euclid Chemical Company; Euco Diamond Hard: www.euclidchemical.com.
 - d. L&M Construction Chemicals, Inc.; Seal Hard: www.lmcc.com.
 - e. W.R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com/sle.
 - f. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.03 PROTECTION

- A. Protect areas that received concrete sealer finish from damage and wear during the remainder of construction period.

SECTION 03 35 11

Concrete Floor Finishes

1. Use protective methods and materials, including temporary covering, recommended in writing by floor finish installer.
 2. Special emphasis shall be on ingress, egress and main foot traffic/working areas.
 3. When removed for cleaning, place carpet pad after floor has dried.
 4. In areas where masonry or similar work that occurs, materials or tools be dropped, include 1/2 inch thick plywood over carpet cushion.
- B. Maintain protective coverings until construction is complete in the areas of sealed concrete.
1. After construction activities of other trades are complete, touch up and restore damaged or defaced surfaces.
- C. Spills shall be cleaned up immediately.
1. Provide protection from rain or other moisture that may migrate or pass through uncompleted construction such as roof openings or exterior wall penetrations.
 2. Splatters of mortar, paint or similar construction materials shall be immediately cleaned-up.
 3. Spilled liquids shall be immediately cleaned-up.
- D. Cleaning: Clean at least once every evening after Work in the area of sealed floors are done for the workday.
1. Chemicals, detergents or other products shall not be added; only potable water is to be used.
 2. Water in the scrubber shall be continuously changed. Dirty water from scrubber shall not be left on sealed surfaces.

END OF SECTION

SECTION 03 5300

Kool Deck Concrete Topping

Part 1 GENERAL

I.O J SECTION INCLUDES

- A. Concrete topping.

1.2 RELATED SECTIONS

- A. Section 033000 - Cast-in-Place Concrete: Concrete as substrate for concrete topping system

1.3 REFERENCES

- A. ASTM C 109/C 109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch Cube Specimens).
- B. ASTM C666/C 666M - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
- C. ASTM C944- Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method.
- D. ASTM E 303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.

1.4 SUBMITTALS

- A. Comply with Section 01340 for submittal procedures.
- B. Product Data: Submit manufacturer's product data, including preparation, mixing, and installation instructions.
- C. Samples: Submit manufacturer's standard color chart for selection of color.
- D. Certificate of Compliance: Submit manufacturer's certificate of compliance indicating materials comply with specified requirements.
- E. Installer's Project References: Submit list of successfully completed concrete topping projects, including project name and location, name of architect, and type and quantity of concrete toppings installed.
- F. Maintenance Instructions: Submit manufacturer's maintenance and cleaning instructions.
- G. Warranty: Submit manufacturer's standard warranty.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer engaged, for preceding 5 years, in manufacture of concrete toppings of similar type to that specified.
- B. Installer's Qualifications: Employ persons trained for installation of concrete topping.
- C. Pre-installation Meeting:
 - 1. Convene pre-installation meeting before start of installation of concrete topping.
 - 2. Require attendance of parties directly affecting work of this section, including Contractor, Architect, installer, and manufacturer's representative.
 - 3. Review preparation, mixing, installation, protection, and coordination with other work.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage:
 - 1. Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
 - 2. Keep containers sealed until ready for use.
- C. Handling: Protect materials during handling and mixing to prevent contamination or damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Placing Base Slab Concrete in Hot or Cold Weather: Comply with requirements specified under Section 03300 and with concrete topping manufacturer's printed instructions.

SECTION 03 5300

Kool Deck Concrete Topping

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Mortex Manufacturing Company, Inc. of Tucson, Arizona.

2.02 CONCRETE TOPPING

- A. Concrete Topping: "Kool Deck Elite".
 - 1. Description: Powered concentrate that when mixed properly with water pack forms a non-skid, and a Color-Unit weather-resistant, colored, cementitious concrete topping.
- B. Test Results:
 - 1. Compressive Strength, ASTM C 109
 - a. 7-Day Curing: 1,300 psi.
 - b. 14-Day Curing: 1,800 psi.
 - c. 28-Day Curing: 2,800 psi.
 - 2. Rapid Freezing and Thawing, ASTM C 666: Beginning of failure of flat areas after 70 cycles.
 - 3. Abrasion Resistance, ASTM C 944
 - a. Maximum Loss, 2-gram load, with 50 percent flat texture: 1 gram.
 - b. Maximum Loss, 6-gram load, with 50 percent flat texture: 3 grams.
 - c. Surface Friction, ASTM E 303: 69 average.
- C. Color(s): As selected by the Architect from manufacturer's standard color selections.

2.03 ACCESSORIES

- A. One (1) Color-Unit Pack per bag of Kool Deck Elite
- B. Water: Potable.
- C. Bonding Agent: Mortex "PTA" bonding agent.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive base slab concrete and concrete topping.
- B. Notify Architect in writing of conditions that would adversely affect installation or subsequent use.
- C. Do not begin preparation or installation until unacceptable conditions are corrected.

3.02 PREPARATION

- A. Protection: Protect adjacent surfaces from contact with base slab concrete and concrete topping.
- B. Base Slab Concrete: Place base slab concrete as specified in Section 03300, unless otherwise specified in this section.
 - 1. Admixtures:
 - a. Use only admixtures approved by concrete topping manufacturer.
 - b. Do not use calcium chloride or admixtures containing chloride ions.
 - c. Do not use fibers containing iron.
 - 2. Do not begin finishing of base slab concrete until bleed water has left surface.
 - 3. Scarify surface of base slab concrete with one pass of broom behind finish troweling.
 - 4. Ensure finished of base slab concrete surface is in accordance with manufacturer's instructions for bonding to concrete topping.

3.03 MIXING

- A. Mix materials for concrete topping in accordance with manufacturer's instructions.
- B. Concrete Topping Materials:

SECTION 03 5300

Kool Deck Concrete Topping

1. Proportion the following materials in accordance with manufacturer's instructions:
 - a. "Kool Deck Elite".
 - b. Color Unit.
 - c. Water.
2. Do not add other materials to mixture.
- C. Mix materials to ensure a uniform color blend.
- D. Test for correct consistency of concrete topping mixture with Mortex Viscosity Cup in accordance with manufacturer's instructions.

3.04 INSTALLATION

- A. Install concrete topping to base slab concrete in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Bond concrete topping to base slab concrete with bonding agent applied in accordance with manufacturer's instructions.
- C. Concrete Topping Thickness: 1/8 inch.
- D. Trowel concrete topping in accordance with manufacturer's instructions.
- E. Ensure uniform color and texture of concrete topping.
- F. Curing compounds shall not be applied to concrete topping.

3.5 PROTECTION

- A. Protect completed concrete topping from contact for 48 hours Protect completed installations from damage until Date of Substantial Completion.
- B. Allow only light pedestrian traffic on completed concrete topping:
 1. Starting 48 hours after installation.
 2. Ending 14 days after installation.

END OF SECTION

SECTION 03 54 00

Gypsum Concrete Underlayment

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Includes required equipment, materials and installation of gypsum concrete underlayment installed with Acoustic-Mat over the prepared subflooring.

1.2 RELATED SECTIONS

- A. Section 06 1000 - Rough Carpentry: Coordination of framing erection with the placement of the gypsum concrete.
- B. Section 06 1600 - Sheathing: Plywood floor sheathing as substrate for gypsum concrete underlayment.
- C. Section 09 2500 - Gypsum Wallboard: Installation of the gypsum concrete underlayment after gypsum wallboard work is complete.
- D. Section 09 3100 - Tile: Installation of tile floorings over gypsum concrete
- E. Section 09 6600 - Resilient Flooring: Installation of resilient flooring over gypsum concrete
- F. Section 09 6800 - Carpeting: Installation of carpet over gypsum concrete.

1.3 QUALITY ASSURANCE

- A. Installation of the gypsum concrete shall be by a factory-approved applicator, using approved mixing/pumping equipment. Certification must be submitted for review.
- B. Slump Test: Gypsum concrete mix shall be tested for slump as it is being pumped using a 2" x 4" cylinder resulting in a patty size of approximately 8" diameter.
- C. Field Samples: At least one (1) set of three (3) molded cube samples shall be taken from each day's pour during the gypsum concrete application. Cubes shall be tested by the Maxxon Corporation in accordance with ASTM C 472. Test results shall be forwarded to the Architect.
- D. Fire rating: Comply with Underwriters Laboratories fire-rated assemblies detailed I indicated on Drawings.

1.4 SUBMITTALS

- A. Submit copies of technical literature for review. Submittal shall show materials, thickness to be installed, installation method(s) to be used and building code and fire-rating compliances. Submittals shall be in accordance with Section 01 3400.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered in their original unopened packages and protected from exposure to the elements. Damaged or deteriorated materials shall be removed from the job site.

1.6 ENVIRONMENTAL CONDITIONS

- A. Before and during the installation of the gypsum concrete, the building interior shall be enclosed and maintained at a temperature above 50°F until the structure and subfloor temperatures are stabilized.
- B. After gypsum concrete has set, provide continuous heat and adequate ventilation to rapidly remove the moisture from the area until underlayment is dry.

PART -PRODUCTS

2.1 MATERIALS

- A. Manufacturer: Maxxon Corporation of Hamel, Minnesota.
- B. Gypsum Concrete Underlayment (Gyp-Crete) shall have the following characteristics and features:
 - 1. Gypsum Cement: Gyp-Crete underlayment compound.
 - a. Minimum Dry Density: 115 Pound per cubic foot, 2,000 psi.
 - b. Minimum Compressive Strength: 2,000 psi.
 - c. Point Loading: 1 " Diameter disc, 1,000 pounds.
 - 2. Sealer: Gyp-Crete floor primer and sealer.
 - 3. Sand: 1/16" or less washed mason, mortar or plaster sand.

SECTION 03 54 00

Gypsum Concrete Underlayment

4. Water: Potable, free from impurities that affect the setting of gypsum.
- C. Acousti-Mat-1 Sound Mat: 3/16" Thickness entangled polymeric filament mat having a density of 2.64 pcf.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that subfloor is structurally sound, broom clean and free of mud, oil, grease or other contaminants. Fill cracks and voids in subfloor with a quick-setting taping compound. All surrounding drywall partitions must be in place before placement of Acoustic-Mat and gypsum underlayment.
- B. Fill cracks and voids with quick-setting patching or caulking material.
- C. Expansion Joints: Allow expansion joints to continue through the gypsum concrete underlayment at their same width.

3.2 SOUND MAT INSTALLATION

- A. Sound mat is loose laid over the entire subfloor.
- B. Isolation strips are installed, then taped, around the perimeter of the entire room, to eliminate flanking paths. Isolation strips are also installed, then taped, around any vertical penetration through the floor.
- C. Seams between sections of sound mat are adhered with zip-strips or taped. Once the mat has been loose laid, no further penetrations shall be made.

3.3 MIXING

- A. Thoroughly mix 6 to 8 gallon of water, 1.8 cubic feet of the specified sand per 80-pound bag of GypCrete. Mixture shall not be over watered. The amount of water used varies with the volume of sand used.

3.4 UNDERLAYMENT APPLICATION

- A. Install Gyp-Crete mixture over the installed Acoustic-Mat material to the thickness indicated, meeting U.L. rating(s) detailed, spreading and screeding to a smooth surface. Place Gyp-Crete mixture as continuously as possible until pour is complete, so that no cement is placed against cement that has obtained its initial set, unless detailed otherwise.
- B. Allow Gyp-Crete to set. Test for complete setting by taping a 24"x24" plastic mat over a section of the completed floor area. Allow to set overnight. Condensation forming on the plastic indicates that the underlayment has not fully set and must be protected for a longer period of time. Repeat the test until no condensation forms on the plastic sheet.

3.5 PREPARATION FOR INSTALLATION OF GLUE-DOWN FLOOR GOODS

- A. Sealing: Seal all areas that are scheduled to receive glue-down floor goods; comply with requirements of Maxxon Corporation. Any floor areas where the surface has been damaged shall be cleaned and sealed regardless of the floor covering to be installed. Apply Maxxon Overspray to seal the gypsum concrete prior to installation of the glue-down flooring materials.
- B. Where flooring manufacturer's require a special adhesive or installation system, their requirements shall supersede these specifications.
- C. Refer to Sections 09 2500, 09 3000, 09 6240, 09 6600 and 09 6800 for additional requirements.

3.6 CLEANUP

- A. Upon completion of the installation of the Gyp-Crete, remove from the job site all excess equipment, materials and debris. Leave the floor surface ready for the next sequence of construction.

END OF SECTION

SECTION 03 8000

Concrete Tests and Inspections

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Includes required equipment, materials and installation of gypsum concrete underlayment installed with Acoustic-Mat over the prepared subflooring.

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Includes required testing and inspections of Concrete Formwork, Concrete Reinforcement and Cast-In-Place Concrete.

1.02 RELATED SECTIONS

- A. Section 01 4100 - Testing Laboratory Services.
- B. Section 02 5150 - Site Concrete.
- C. Section 03 3000 - Cast-In-Place Concrete.

1.03 REFERENCE STANDARDS

- A. Published Specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to work in this Section where cited below:
 - 1. ASTM - American Society for Testing and Materials.
 - 2. ACI 318 - American Concrete Institute's "Building Code Requirements for Reinforced Concrete".
 - 3. AWS D1.4 - American Welding Society's "Reinforcing Steel Welding Code".

1.04 SUBMITTALS

- A. This Section Shall Submit:
 - 1. Certified copies of mix designs for each concrete class specified including compressive strength test reports.
 - 2. Certification that materials meet requirements specified.
 - 3. Samples only as requested by the Engineer.
- B. The Testing Agency shall submit reports on tests and inspections performed to the Engineer, Contractor and the material suppliers.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Supply labor, transport, and on-site storage facilities required by the Testing Agency and for this Section for taking and preparing samples for testing.

1.06 JOB CONDITIONS

- A. Provide the Testing Agency with free access to places whether on or off the job site where materials are stored, proportioned, mixed, or fabricated, to places where equipment is stored or services, and to job site during times of preparation, installation, erection, placement, curing, and patching.
- B. Sequencing, Scheduling: Notify the Engineer in sufficient time prior to fabrication, field welding, mixing, or placement to permit testing and inspecting without delaying work.

PART 2 - PRODUCTS

2.01 CAST-IN-PLACE CONCRETE

- A. The Testing Agency and This Section Under This Contract Shall:
 - 1. Review mix designs, certificates of compliance, and samples of materials the Contractor proposes to use.
 - 2. Test and inspect materials, as necessary, in accordance with ACI 318, for compliance with requirements specified in Section 03 3000 - Cast-In-Place Concrete.
 - 3. Take samples as required from the designated sources.
 - 4. Inspect plant prior to any work to verify following:

SECTION 03 8000

Concrete Tests and Inspections

- a. Plant is equipped with approved metering devices for determining moisture content of fine aggregate.
- b. Other plant quality controls are adequate.

PART 3 - EXECUTION

3.01 REINFORCEMENT

- A. The Testing Agency Under This Contract Will:
 1. Test and inspect field welds as deemed necessary.
 2. Inspect placement of reinforcement for conformance with Contract Documents.

3.02 CAST-IN-PLACE CONCRETE

- A. The Testing Agency and This Section Under This Contract Shall:
 1. Inspect concrete placement.
 2. Test concrete to control slumps according to ASTM C 143.
 3. Test concrete for required compressive strength as follows:
 - a. Make and cure six specimen cylinders according to ASTM C 31 for each 75 cubic yards, or fraction thereof, or 4,000 square feet of concrete surface area, or fraction thereof, of each class poured at site each day.
 - b. Retain one cylinder for seven day test and three for 28 day test.
 - c. Number each cylinder 1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D, etc; date each set; and keep accurate record of pour each set represents.
 - d. Transport specimen cylinders from job to laboratory after field curing a minimum of two days.
 - e. Test two cylinders at seven days and two at 28 days. If both pass, test remaining two to be tested at a time to be determined at a later date.
- B. This Section Shall:
 1. Submit ticket for each batch of concrete delivered to job site. Ticket shall bear following information:
 - a. Design mix number for the Testing Laboratory.
 - b. Signature or initials of ready mix representative.
 - c. Time of batching.
 - d. Weight of cement, aggregates, water, and admixtures in each batch with maximum aggregate size.
 - e. Total volume of concrete in each batch.
 - f. Indication that all ingredients are as previously certified or approved for use as required.
 - g. Notation to indicate equipment was checked for contaminants prior to batching.
 - h. Time of final placing.

END OF SECTION

SECTION 04 27 31

REINFORCED MASONRY

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Concrete Block.
- B. Mortar and Grout.
- C. Reinforcement and Anchorage.
- D. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 04 05 11 - Mortar and Masonry Grout.

1.03 REFERENCE STANDARDS

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.
- C. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016.
- D. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- E. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2016a.
- F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- G. ASTM C476 - Standard Specification for Grout for Masonry; 2016.
- H. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2016a.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar and grout.
- C. Shop Drawings: Indicate bar sizes, spacings, reinforcement quantities, bending and cutting schedules, reinforcement supporting and spacing devices, and accessories.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of the contract documents.

SECTION 04 27 31

REINFORCED MASONRY

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.07 FIELD CONDITIONS

- A. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

PART 2 – PRODUCTS

2.01 SECTION INCLUDES

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth of 8 inches (200 mm).
 - 2. Special Shapes: Provide non-standard blocks configured for corners.
 - 3. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.

2.02 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 04 05 11.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: Type specified in Section 03 2000; size as indicated on drawings; galvanized finish.
- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

2.04 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.05 MORTAR MIXES

- A. Mortar: As specified in Section 04 05 11.

2.06 GROUT MIXES

- A. Bond Beams and Lintels: 3,000 psi (21 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; provide premixed type in accordance with ASTM C 94/C 94M.

SECTION 04 27 31

REINFORCED MASONRY

2.07 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.

PART 3 – EXECUTION

3.01 GROUT MIXING

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Clean reinforcement of loose rust.
- C. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.

3.04 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar as work progresses.
- E. Interlock intersections and external corners.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.05 REINFORCEMENT AND ANCHORAGE

- A. Reinforcement Bars: Secure at locations indicated and to avoid displacement during grouting. Minimum spacing between bars or to masonry surfaces shall be one bar diameter.

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REINFORCED MASONRY

1. Welding of splices is not permitted.
- B. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
 1. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.

3.06 GROUTING

- A. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.
- B. Low-Lift Grouting:
 1. Limit height of pours to 12 inches (300 mm).
 2. Limit height of masonry to 16 inches (400 mm) above each pour.
 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

3.07 CONTROL AND EXPANSION JOINTS

- A. Continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joints as indicated on drawings; if not indicated, 3/4 inch (19 mm) wide and deep.

3.08 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft (3 mm/m).
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Mortar Tests: Test each type of mortar in accordance with recommended procedures in ASTM C780, testing with same frequency as masonry samples.

SECTION 04 27 31

REINFORCED MASONRY

- C. Test and evaluate grout in accordance with ASTM C1019 procedures.
 - 1. Test with same frequency as specified for masonry units.

3.10 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

3.11 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 04 0511

Mortar and Masonry Grout

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.2 RELATED REQUIREMENTS

- A. Section 04 0100 - Maintenance of Masonry: Bedding and pointing mortar for masonry restoration work.
- B. Section 04 2000 - Unit Masonry: Installation of mortar and grout.
- C. Section 04 2731 - Reinforced Unit Masonry: Installation of mortar and grout.

1.3 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
- B. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2010.
- C. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- F. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- I. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2011b.
- J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- K. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- L. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- M. M. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2013.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.7 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

PART 2 - PRODUCTS

2.1 MORTAR AND GROUT APPLICATIONS

- A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
- B. Mortar Color: Natural gray unless otherwise indicated.
- C. Mortar Mix Designs: ASTM C270, Property Specification.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Exterior, Loadbearing Masonry: Type N.

SECTION 04 0511

Mortar and Masonry Grout

3. Interior, Loadbearing Masonry: Type N.
- D. Grout Mix Designs:
 1. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C94/C94M.
 - a. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
 - b. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.2 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 1. Type: Type N.
 2. Color: Standard gray.
- B. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, hydrated lime, and graded sand; capable of producing Type O mortar in accordance with ASTM C270 with the addition of water only.
 1. Color: Standard gray.
- C. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
- D. Portland Cement: ASTM C150/C150M.
 1. Type: Types I, II, or III only.
 2. Color: Standard gray.
- E. Masonry Cement: ASTM C91.
 1. Type: Type N.
- F. Hydrated Lime: ASTM C207, Type S.
- G. Quicklime: ASTM C5, non-hydraulic type.
- H. Mortar Aggregate: ASTM C144.
- I. Grout Aggregate: ASTM C404.
- J. Water: Clean and potable.
- K. Accelerating Admixture: Non-chloride type for use in cold weather.

2.3 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, re-temper only within two hours of mixing.

2.4 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.
- D. Do not displace reinforcement while placing grout.

3.2 GROUTING

- A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of contract documents.
- B. Low-Lift Grouting:

SECTION 04 0511

Mortar and Masonry Grout

1. Limit height of pours to 12 inches.
 2. Limit height of masonry to 16 inches above each pour.
 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- C. High-Lift Grouting:
1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
 2. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
 3. Place grout for spanning elements in single, continuous pour.

3.3 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 4000 - Quality Requirements.
- B. Test and evaluate mortar in accordance with ASTM C780 procedures.
 1. Test with same frequency as specified for masonry units.
- C. Test and evaluate grout in accordance with ASTM C1019 procedures.
 1. Test with same frequency as specified for masonry units.

3.4 SCHEDULES

- A. Exterior Cavity Wall: Type S mortar with Type N pointing mortar.

END OF SECTION

SECTION 04 2000

Unit Masonry

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Concrete Block.
- B. Reinforcement and Anchorage.
- C. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 2000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 04 0511 - Mortar and Masonry Grout.
- C. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
- C. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- D. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- E. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
- F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- G. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- H. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- I. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2014.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.
 - 2. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.

2.2 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 04 0511.

SECTION 04 2000

Unit Masonry

- B. Hydrated Lime: ASTM C207, Type S.
- C. Grout Aggregate: ASTM C404.

2.3 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: specified in Section 03 2000; size as indicated on drawings; uncoated finish.
- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- C. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

2.4 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - 1. Manufacturers:
 - a. Blok-Lok Limited; www.blok-lok.com.
 - b. Hohmann & Barnard, Inc; www.h-b.com/sle.
 - c. WIRE-BOND: www.wirebond.com.
- B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Interlock intersections and external corners.
- D. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- E. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

SECTION 04 2000

Unit Masonry

3.6 REINFORCEMENT AND ANCHORAGE – GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Lap joint reinforcement ends minimum 6 inches.

3.7 LINTELS

- A. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
 - 1. Openings to 42 inches: Place two, No. 4 reinforcing bars 1 inch from bottom web.
 - 2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
 - 3. Openings over 78 inches: Reinforce openings as detailed.
 - 4. Do not splice reinforcing bars.
 - 5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
 - 6. Place and consolidate grout fill without displacing reinforcing.
 - 7. Allow masonry lintels to attain specified strength before removing temporary supports.
- B. Maintain minimum 8 inch bearing on each side of opening.

3.8 GROUTED COMPONENTS

- A. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web.
- B. Lap splices minimum 24 bar diameters. See lap length schedule for additional requirements.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.

3.9 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.10 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.

3.11 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

3.12 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.

END OF SECTION

Unit Masonry/Clay Unit Masonry/Brick Masonry

PART 1: GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clay Masonry Units
2. Steel Reinforcement
3. Brick Anchors and Ties
4. Expansion Joints
5. Flashing/Weep Materials
6. Mortar

1.2 REFERENCES

A. ASTM International List of Applicable Standards:

1. ASTM A36 Standard Specification for Carbon Structural Steel.
2. ASTM A82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
3. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
5. ASTM A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
6. ASTM A996 Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
7. ASTM A1008 Standard Specification for Steel Sheet, Cold-Rolled Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
8. ASTM C67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
9. ASTM C144 Standard Specification for Aggregate for Masonry Mortar.
10. ASTM C150 Standard Specification for Portland Cement.
11. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes.
12. ASTM C216 Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
13. ASTM C270 Standard Specification for Mortar for Unit Masonry.
14. ASTM C652 Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale).
15. ASTM D1056 Standard Specification for Flexible Cellular Materials, Sponge or Expanded Rubber.

B. The Brick Industry Association (BIA):

1. Technical Note 20, Cleaning Brickwork.

1.1.1 SUBMITTALS: BORAL® Clay Face Brick www.boralbricks.com 1-800-5BORAL5

General: Submit listed submittals in accordance with Conditions of the Contract and Section 01 33 00 - Submittal Procedures.

Product Data: Submit product data for specified products.

Samples: Submit brick samples showing range of color and texture to be expected.

Test Reports: Submit reports of brick tests specified in Part 2.

1.4 QUALITY ASSURANCE

Unit Masonry/Clay Unit Masonry/Brick Masonry

A. Regulatory Requirements: In accordance with Section 01 41 00 - Regulatory Requirements.

B. Mock-Ups:

1. Provide a mock-up panel for each type of brick specified and as indicated on the drawings.
 2. Build the mock-up(s) according to the Architect's direction; do not move, alter or destroy the mock-up(s) until directed to do so by the Architect.
 3. For each mock-up, provide brick of color and texture that represents the brick to be used on the project.
 4. Do not begin installation of brickwork until the Architect accepts the mock-up(s). Build as many mock-ups as required to obtain the Architect's acceptance. Remove unacceptable mock-ups from the site.

1.5 DELIVERY, STORAGE & HANDLING

A. General: Comply with Section 01 61 00 - Common Product Requirements.

B. Storage and Protection:

1. Store materials to prevent damage due to moisture, contamination, breakage, chipping or other causes.
2. Store materials on pallets or stable aggregate bed to reduce contamination and soiling. Cover with a non-staining waterproof membrane allowing for airflow around brick while protecting it from airborne contaminants and wind-borne dirt.

PART 2 - PRODUCTS

2.1 CLAY MASONRY UNITS

A. Face brick shall be A Grade units manufactured by the following member of the Brick Industry Association (BIA): Name: BORAL BRICKS INC. Address: 200 Mansell Ct East, Suite 305, Roswell, GA 30076 Phone: (800) 526-7255 centralized customer service BORAL® Clay Face Brick www.boralbricks.com 1-800-5BORAL5

B. Brick Specification

1. Size: Modular Brick (2 1/4"x3 5/8"x 7 5/8")
2. Color/Product Name: "Pebble" Freedom Collection, Wire Cut; Final Selection per Architect
3. Compressive Strength: 2500 lbs per square inch, minimum.
4. Initial Rate of Absorption (IRA): 4 grams per minute per 30 square inches, maximum.
5. ASTM Designation: Face Brick: ASTM C216, Grade SW, Type Hollow Brick: ASTM C652, Grade SW, Type 2.2
 - A.Steel Reinforcement: galvanized in accordance with ASTM A153, Class B-2.
6. Joint Reinforcement: ASTM A82, galvanized in accordance with ASTM A153, Class B-2.
7. Wire Wall Ties, ASTM A82: Galvanized Adjustable Wire
 - a. Wire Size: 10ga.
 - b. Galvanized in accordance with ASTM A153, Class B-2.
8. Dovetail Anchors, ASTM A1008, at Concrete Columns or Walls Only.
 - a. Gauge: 10ga.
 - b. Galvanized in accordance with ASTM A153, Class B-2.

C. Expansion Joints: BORAL® Clay Face Brick www.boralbricks.com
1-800-5BORAL5

Unit Masonry/Clay Unit Masonry/Brick Masonry

1. Portland Cement: ASTM C150, Type I.
2. Hydrated Lime: ASTM C207, Type S.
3. Sand: ASTM C144.
4. Water: Potable. Mortar should be mixed by proportion according to ASTM C270 for Type N mortar.

2.3 FLASHING/WEEP MATERIALS

- A. Flashing for all masonry openings and drainage planes should be installed according to prevailing building codes and industry best-practice and are covered separately under Division 07: Thermal and Moisture Protection.
- B. Weeps are to be used in conjunction with flashing materials for proper functioning of the masonry wall drainage system. The specified weep material is:
 1. Cotton sash cord, 12 inches long with end laid in air cavity
 2. Plastic Neoprene tube, (3/8") inch diameter
 3. Plastic vents or cells

2.4 PRODUCT SUBSTITUTIONS

- A. Substitutions are ACCEPTABLE, but not with compromise of quality.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and industry best practice.
Clay Face Brick www.boralbricks.com 1-800-5BORAL5

3.2 PREPARATION

- A. Prepare all surfaces using the methods recommended by the manufacturer and industry best practice for achieving the best result for the substrate under the project conditions.
- B. Remove mud, loose rust, ice and contaminants that may interfere with mortar-to-unit bonding or mortar-to-footing/brick ledge bonding.

3.3 INSTALLATION

- A. Bond Pattern: Units will be installed in a pattern.
- B. Laying Clay Masonry Units:
 1. Lay brick making sure head joints and bed joints are full of mortar.
 2. Lay brick units plumb and true to line.
 3. Where fresh mortar joins partially set mortar, remove loose brick and mortar and lightly wet the exposed surface of set masonry.
 4. When adjustment must be made after mortar begins to harden, remove hardened mortar and replace it with fresh mortar.
- C. Tooling and Pointing:
 1. Tool mortar joints to a appearance. Other joint profiles are less durable and allow water to more easily penetrate the wall.
 2. Tool exposed joints when they are thumbprint hard.
 3. Flush-cut all joints when they are not tooled.
4. When re-pointing a section in a wall, rake the mortar joints to a depth of not less than 1/2 inch. Fill the joint completely with pointing mortar and tool to match the surrounding masonry.
- D. Flashing:
 1. Remove any projections on the brick surface or mortar bed that might

Unit Masonry/Clay Unit Masonry/Brick Masonry

- puncture the flashing material.
- 2. Place through-wall flashing on a bed of mortar so that the flashing projects 1/4 inch from wall face and forms a drip edge. Overlap flashing a minimum of 6 inches.
- 3. Cover flashing with mortar.
- E. Weeps:
 - 1. Install weeps in the head joints of the first brick course immediately above The through-wall flashing. Place weeps at not more than 24 inches on Center horizontally.
 - 2. Keep the air cavity free of mortar as much as possible.
- F. Expansion Joints:
 - 1. Install expansion joints as indicated on drawings.
 - 2. Keep joints free of mortar and any debris that may hinder movement.
 - 3. Install expansion joint material and finish the joint with a sealer.
- G. Cold Weather Procedures: JOB SPECIFICATION BORAL® Clay Face Brick
www.boralbricks.com 1-800-5BORAL5
 - 1. Preparation:
 - a. If ice or snow has formed on the masonry bed, remove it by carefully applying heat not to exceed 120 degrees F until the surface is dry to the touch.
 - b. Remove any brick units or mortar that is frozen or damaged.
 - c. When the clay masonry unit suction exceeds 30 grams per minute per
 - 1) 30 square inches, sprinkle with heated water as follows: When units are 32 degrees F or above, heat water to 70 degrees F or above.
 - 2) When units are below 32 degrees F, heat water to 130 degrees F Or above.
 - 2. Work in Progress:
 - a. Air temperature 40 degrees F to 32 degrees F:
 - 1) Heat sand or mixing water to produce mortar temperatures that match air temperature.
 - b. Air temperature 32 degrees F to 25 degrees F:
 - 1) Heat sand and mixing water to produce mortar temperatures Between 40 degrees F and 120 degrees F.
 - 2) Maintain temperature of mortar on boards above freezing. Installation in colder air temperatures will require heat sources on the wall and the use of windbreaks or tents to create a controlled environment suitable for proper bonding and curing.
 - 3. Completed Work and Work Not in Progress:
 - a. Mean daily air temperature of 40 degrees F to 32 degrees F: Protect masonry from rain and snow for 24 hours by covering with a weather-resistive membrane.
 - b. Mean daily air temperature of 32 degrees F to 25 degrees F: Cover masonry with a weather-resistive membrane for 24 hours.
 - c. Mean daily air temperature of 25 degrees F to 20 degrees F: Cover masonry with insulating blankets for 24 hours.
- H. Hot Weather Procedures:
 - 1. When ambient temperature exceeds 90 degrees F and wind exceeds 8 miles per hour:
 - a. Maintain temperature of mortar and grout between 70 degrees F and 120 degrees F.
 - b. Limit the spread of the mortar bed to 4 feet and place units within 1 minute of spreading mortar.

Unit Masonry/Clay Unit Masonry/Brick Masonry

- c. Control moisture evaporation in partially or newly completed walls by fog spraying with potable water, covering with opaque plastic or canvas or both.
- I. Protection of Work in Progress:
 - 1. Covering:
 - a. Cover tops of walls with a strong waterproof membrane at the end of each day or work shutdown. JOB SPECIFICATION BORAL® Clay Face Brick
www.boralbricks.com 1-800-5BORAL5
 - b. Extend the waterproof membrane cover a minimum of 24 inches down the side of each wall.
 - c. Hold cover securely in place.
 - 2. Load Application:
 - a. Do not apply uniform floor or roof loading for at least 12 hours after completing columns and walls.
 - b. Do not apply concentrated loads for at least 3 days after completing columns and walls.
 - 3. Staining:
 - a. Prevent grout and mortar from staining the face of masonry.
 - b. Remove grout and mortar that comes in contact with masonry units immediately.
 - c. Protect sills, ledges and projections from mortar droppings.
 - d. Protect base of wall from rain-splashed mud and mortar splatter

END of SECTION

SECTION 05 21 00

STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Open web steel joists, with bridging, attached seats and anchors.
- B. Supplementary framing for floor and roof openings greater than 18 inches (450 mm).

1.02 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Grouting base plates and bearing plates. Superstructure framing.
- B. Section 05 3100 - Steel Decking: Bearing plates and angles.
- C. Section 05 5000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).
- F. SJI (SPEC) - Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders; 2011.
- G. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; 2008.
- H. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- I. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- J. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.

1.05 QUALITY ASSURANCE

- A. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI (SPEC) Standard Specifications Load Tables and SJI Technical Digest No. 9.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Open Web Joists: SJI Type K Joists:

SECTION 05 21 00

STEEL JOIST FRAMING

1. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.
 2. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
 3. Finish: Shop primed.
- B. Anchor Bolts, Nuts and Washers: ASTM A307, hot-dip galvanized per ASTM A153/A153M, Class C.
- C. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.
- D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FINISH

- A. Galvanize joists as specified by architect.
1. Do not prime surfaces that will be fireproofed.
- B. Prepare surfaces to be finished in accordance with SSPC-SP 2.
- C. Galvanizing: Provide minimum 1.7 oz/sq ft (530 g/sq m) galvanized coating to ASTM A123/A123M requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 ERECTION

- A. Erect joists with correct bearing on supports.
- B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
- C. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
- D. Install supplementary framing for floor and roof openings greater than 18 inches (450 mm).
- E. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- F. Do not field cut or alter structural members without approval of joist manufacturer.
- G. After erection, prime welds, damaged shop primer, damaged galvanizing, and surfaces not shop primed, except surfaces specified not to be primed.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm).
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

END OF SECTION

SECTION 05 12 00

Structural Steel Framing

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Concrete Block.
- B. Reinforcement and Anchorage.
- C. Accessories.

SECTION 51200 - STRUCTURAL STEEL FRAMING

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Structural steel framing members, support members, suspension cables, sag rods, and struts.
- B. Base plates, shear stud connectors and expansion joint plates.
- C. Grouting under base plates.

1.2 RELATED REQUIREMENTS

- A. Section 05 3100 - Steel Decking: Support framing for small openings in deck.

1.3 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; 2011.
- B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; 2010.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
- E. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.
- F. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2010.
- G. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a (Reapproved 2014).
- H. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts [Metric]; 2007.
- I. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink); 2014.
- K. ASTM E94 - Standard Guide for Radiographic Examination; 2004 (Reapproved 2010).
- L. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2013.
- M. ASTM F436 - Standard Specification for Hardened Steel Washers; 2011.
- N. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2007a.
- O. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- Q. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Connections not detailed.
 - 3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

SECTION 05 12 00

Structural Steel Framing

1.5 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."
- B. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- C. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- D. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Rolled Steel Structural Shapes: ASTM A992/A992M.
- D. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 or ASTM A325M, Type 1, medium carbon, galvanized, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers.
- E. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436 Type 1 washers.
- F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- G. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C1107M and capable of developing a minimum compressive strength of 7,000 psi at 28 days.
- H. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

- A. Shop fabricate to greatest extent possible.

2.3 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 20.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.2 ERECTION

- A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".
- B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components indicated on shop drawings.
- D. Do not field cut or alter structural members without approval of the Structural Engineer and Architect.
- E. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.3 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

SECTION 05 12 00

Structural Steel Framing

- B. Maximum Offset From True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds using one of the following:
 - 1. Radiographic testing performed in accordance with ASTM E94.
 - 2. Ultrasonic testing performed in accordance with ASTM E164.

END OF SECTION

SECTION 05 3100

Steel Decking

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Roof deck.
- B. Supplementary framing for openings up to and including 18 inches.
- C. Bearing plates and angles.

1.2 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2008.
- E. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems; ICC Evaluation Service, Inc; 2010 (R2013).
- F. ICC-ES AC70 - Acceptance Criteria for Fasteners Power Driven into Concrete, Steel and Masonry Elements; ICC Evaluation Service, Inc; 2013.
- G. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.
- H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- C. Certificates: Certify that products furnished meet or exceed specified requirements.
- D. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Deck:
 - 1. Nucor-Vulcraft Group; www.vulcraft.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 STEEL DECK

- A. Roof Deck: Non-composite type, fluted steel sheet:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.

2.3 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.

SECTION 05 3100

Steel Decking

- B. Welding Materials: AWS D1.1/D1.1M.
- C. Fasteners: Galvanized hardened steel, self tapping.
- D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point.
Comply with applicable requirements of ICC-ES AC70.
 - 1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43.
- E. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
 - 1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43.

2.4 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips and cover plates, 22 gage, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.2 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On steel supports provide minimum 1-1/2 inch bearing.
- C. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
- D. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
- E. Weld deck in accordance with AWS D1.3/D1.3M.
- F. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.
- G. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.
- H. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION

SECTION 05 4000

BSD-COLD-FORMED METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formed steel stud exterior wall and interior wall framing.
- B. Exterior wall sheathing.
- C. Water-resistive barrier over sheathing.

1.02 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2015.
- E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2011a (Reapproved 2015).
- F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).
- G. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2008.
- H. PS 1 - Structural Plywood; 2009.
- I. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations and _____.
- C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
- E. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention, and _____.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

2.02 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
 - 1. Gage and Depth: As indicated on the drawings.
 - 2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.

SECTION 05 4000

BSD-COLD-FORMED METAL

- B. Framing Connectors: Factory-made, formed steel sheet.
 - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch (3.42 mm), and factory punched holes and slots.
 - 2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 - 3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
 - a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical movement of slab without affecting studs; allow for minimum movement of 1/2 inch (13 mm).
 - b. Where top of non-load bearing stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical movement of slab without affecting studs; allow for minimum movement of 1/2 inch (13 mm).
 - 4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

203 WALL SHEATHING

- A. Wall Sheathing: Plywood; PS 1, Grade C-C, Exterior Exposure.

204 ACCESSORIES

- A. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- B. Water-Resistive Barrier: As specified in Section 07 2500.

205 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated.

PART 3 EXECUTION

301 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- C. Install load bearing studs full length in one piece. Splicing of studs is not permitted.
- D. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
- E. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- F. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

302 WALL SHEATHING

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
 - 1. Use plywood at all exterior walls.

SECTION 05 4000

BSD-COLD-FORMED METAL

2. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

END OF SECTION

SECTION 05 5000

Metal Fabrications

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.

1.2 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Structural steel column anchor bolts.
- B. Section 05 3100 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- C. Section 05 5100 - Metal Stairs.

1.3 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
- E. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
- F. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2015.
- I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; Society for Protective Coatings; 1999 (Ed. 2004).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1.5 QUALITY ASSURANCE

- A. Design stair runs under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

PART 2 - PRODUCTS

2.1 MATERIALS – STEEL

- A. Steel Sections: ASTM A36/A36M or ASTM A992
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, plain.
- F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

SECTION 05 5000

Metal Fabrications

- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

- A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- C. Lintels: As detailed; prime paint finish.
- D. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.
- E. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

SECTION 06 05 73

WOOD TREATMENT

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Site applied termiticide for wood materials.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Factory treatment for wood products.
- B. Section 06 15 00 - Wood Decking: Factory treatment for wood products.
- C. Section 06 1753 - Shop-Fabricated Wood Trusses: Factory treatment for wood products.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.5 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Site Applied Termiticide and Mildicide: Correct defective Work within a twenty-five year period after Date of Substantial Completion.

PART 2 – PRODUCTS

2.1 SITE APPLIED WOOD TREATMENT

- A. Site Applied Termiticide for Wood: Borate mineral salt based, spray applied, penetrating termiticide.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Remove dust, dirt and other contaminants from treatment surfaces. Remove tarpaulins, dropcloths, strippable protective films, etc., from areas to be treated. Move equipment and stored materials that block or prevent product application.

SECTION 06 05 73

WOOD TREATMENT

3.2 SITE APPLIED WOOD TREATMENT

- A. Comply with manufacturers written mixing and installation instructions.
- B. Termiticide: Apply to foundations, structure and other items as listed.
 - 1. All structural wood and sill plates within 24 inches, minimum, of point of contact with foundation.
 - 2. All wood, wood based and cellulosic sheathing within 24 inches, minimum, of point of contact with foundation.
 - 3. Concrete foundations 2 inches, minimum, from sill plate.

END OF SECTION

SECTION 06 1000

ROUGH CARPENTRY

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Rough opening framing for doors, windows, and roof openings.
- C. Sheathing.
- D. Subflooring.
- E. Underlayment.
- F. Preservative treated wood materials.
- G. Fire retardant treated wood materials.
- H. Miscellaneous framing and sheathing.
- I. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 3000 - Cast-in-Place Concrete: Setting anchors in concrete.
- C. Section 03 5400 - Cast Underlayment.
- D. Section 05 1200 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- E. Section 06 0573 - Wood Treatment: Field-applied termiticide and mildicide for wood.
- F. Section 06 1753 - Shop-Fabricated Wood Trusses.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2015.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- E. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- G. AWP A U1 - Use Category System: User Specification for Treated Wood; 2017.
- H. PS 1 - Structural Plywood; 2009.
- I. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
- J. PS 20 - American Softwood Lumber Standard; 2015.
- K. SPIB (GR) - Grading Rules; 2014.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
- D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and water immersion and to allow air circulation.

SECTION 06 1000

ROUGH CARPENTRY

- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Spruce Pine Fir, unless otherwise indicated.
 - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
- B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Stud Framing (2 by 2 through 2 by 6 (50 by 50 mm through 50 by 150 mm):
 - 1. Species: Spruce Pine Fir.
 - 2. Grade: No. 2.
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 STRUCTURAL COMPOSITE LUMBER

- A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.

2.04 CONSTRUCTION PANELS

- A. Subfloor/Underlayment Combination: Oriented strand board wood structural panel; PS 2, rated Single Floor.
 - 1. Bond Classification: Exterior.
 - 2. Performance Category: 23/32 PERF CAT.
 - 3. Span Rating: 24.
 - 4. Edges: Tongue and groove.
 - 5. Surface Finish: Fully sanded face.
 - 6. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 200 days.
- B. Roof Sheathing: Oriented strand board wood structural panel; PS 2.
 - 1. Grade: Sheathing.
 - 2. Bond Classification: Exposure 1.
 - 3. Performance Category: 5/8 PERF CAT.
 - 4. Span Rating: 40/20.
 - 5. Edges: Square.
- C. Wall Sheathing: Any PS 2 type.
 - 1. Grade: Sheathing.
 - 2. Span Rating: 24.
 - 3. Performance Category: 7/16 PERF CAT.
 - 4. Edge Profile: Square edge.

SECTION 06 1000

ROUGH CARPENTRY

- D. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.05 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
- B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 (Z550) galvanizing complying with ASTM A653/A653M.
- C. Subfloor Glue: Waterproof, air cure type, cartridge dispensed.
- D. Water-Resistive Barrier: Plastic sheet complying with ICC-ES AC38.

2.06 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
- B. Fire Retardant Treatment:
 - 1. Exterior Type: AWWA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat all exterior rough carpentry items.
 - c. Do not use treated wood in direct contact with the ground.
 - 2. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat rough carpentry items as indicated.
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

SECTION 06 1000

ROUGH CARPENTRY

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
- E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Provide the following specific non-structural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Wall paneling and trim.
 - 8. Joints of rigid wall coverings that occur between studs.

3.05 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS

- A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.
- B. Subflooring: Glue and nail to framing; staples are not permitted.
- C. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
 - 1. Nail panels to framing; staples are not permitted.
- D. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails or screws.
 - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

SECTION 06 1000

ROUGH CARPENTRY

- E. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Size and Location: As indicated on drawings.

3.07 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.08 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.09 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Framing Inspections shall be performed by a qualified testing agency or the Engineer after first floor wood framing has been erected, after roof framing has been erected, and prior to installing concealing finish materials. Additional framing inspections shall be called for as required.

3.10 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 15 00

WOOD DECKING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Plywood structural wood decking.
- B. Composite wood decking.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Bearing support.

1.3 REFERENCED STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. AWWA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2012.
- C. PS 1 - Structural Plywood; 2009.
- D. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2010.
- E. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc.; 2014.
- F. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience and certified by AITC.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 – PRODUCTS

2.1 WOOD MATERIALS

- A. Wood fabricated from old growth timber is not permitted.
- B. Regulatory Requirements:
 - 1. Conform to applicable code for fire retardant requirements.

SECTION 06 15 00

WOOD DECKING

- C. Marking: Mark each piece with producer's stamp indicating compliance with specified requirements; for pieces exposed to view in completed construction, submit manufacturer's certificate certifying that products conform to specified requirements in lieu of grade stamping.
- D. Plywood Decking: PS 1 veneer plywood; APA Rated Sheathing, Span Rating 24/16; Exterior grade; 1 A interior veneer appearance grade; sanded.

2.2 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Fastener Type and Finish: Hot-dipped galvanized steel for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Screws: Bugle head, hardened steel, power driven type, length three times thickness of decking.

2.3 WOOD TREATMENT

- A. Factory-Treated Lumber and Plywood: Comply with requirements of AWWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that support framing is ready to receive decking.

3.2 INSTALLATION – PLYWOOD DECKING

- A. Install decking perpendicular to framing members with ends staggered over firm bearing. On sloped surfaces, lay decking with tongue upward.
- B. Engage plywood tongue and groove edges.
- C. Allow expansion space at edges and ends.

END OF SECTION

SECTION 06 1753

SHOP-FABRICATED WOOD TRUSSES

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated wood trusses for roof and floor framing.
- B. Bridging, bracing, and anchorage.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Installation requirements for miscellaneous framing.
- B. Section 06 1000 - Rough Carpentry: Material requirements for blocking, bridging, plates, and miscellaneous framing.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
- C. SPIB (GR) - Grading Rules; 2014.
- D. TPI 1 - National Design Standard for Metal-Plate-Connected Wood Truss Construction; 2007 and errata.
- E. TPI BCSI 1 - Building Component Safety Information Booklet: The Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses; 2011.
- F. TPI DSB-89 - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses; 1989.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on plate connectors, bearing plates, and metal bracing components.
- C. Shop Drawings: Show truss configurations, sizes, spacing, size and type of plate connectors, cambers, framed openings, bearing and anchor details, and bridging and bracing.
 - 1. Include identification of engineering software used for design.
 - 2. Provide shop drawings stamped or sealed by design engineer.

1.05 QUALITY ASSURANCE (NOT USED)

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle and erect trusses in accordance with TPI BCSI 1.
- B. Store trusses in vertical position resting on bearing ends.
- C. Trusses shall be stacked to prevent contact with earth or standing water.
- D. Warped or damaged trusses shall be discarded and not used in construction.
- E. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 TRUSSES

- A. Wood Trusses: Designed and fabricated in accordance with TPI 1 and TPI DSB-89 to achieve structural requirements indicated.
 - 1. Floor Deflection: 1/360, maximum. See construction drawings for additional limitations.
 - 2. Roof Deflection: 1/240, maximum. see construction drawings for additional limitations.

2.02 MATERIALS

- A. Lumber:

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SHOP-FABRICATED WOOD TRUSSES

1. Moisture Content: Between 7 and 9 percent.
2. Lumber fabricated from old growth timber is not permitted.
- B. Steel Connectors: Hot-dipped galvanized steel sheet, ASTM A653/A653M Structural Steel (SS) Grade 33/230, with G90/Z275 coating; die stamped with integral teeth; thickness as indicated.
- C. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.03 ACCESSORIES

- A. Wood Blocking, Bridging, Plates, and Miscellaneous Framing: Softwood lumber, any species, construction grade, 19 percent maximum and 7 percent minimum moisture content.
- B. Fasteners: Electrogalvanized steel, type to suit application.
- C. Bearing Plates: Electrogalvanized steel.

2.04 WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that supports and openings are ready to receive trusses.

3.02 PREPARATION

- A. Coordinate placement of bearing items.

3.03 ERECTION

- A. Install trusses in accordance with manufacturer's instructions and TPI DSB-89 and TPI BCSI 1; maintain a copy of each TPI document on site until installation is complete.
- B. Set members level and plumb, in correct position.
- C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.
- D. Do not field cut or alter structural members without approval of Architect.
- E. Install permanent bridging and bracing.

3.04 TOLERANCES

- A. Framing Members: 1/2 inch (12 mm) maximum, from true position.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Includes but is not limited to the materials and installations of:
 - 1. Fixed and adjustable shelving, including wall standards.
 - 2. Wardrobe shelf and rod system.
 - 3. Slat Wall System.
 - 4. Other items shown or as may be required to complete the Work.

1.2 RELATED SECTIONS

- A. Section 06 10 00 – Rough Carpentry: Treated wood nailers and blocking required for the installation of finish carpentry items.
- B. Section 06 22 11 – Millwork and Cabinetry: Applicable portions of this Section apply to Section 06 22 11 as if repeated therein.
- C. Section 09 29 00 – Gypsum Board: Coordination of gypsum wallboard construction with the finish carpentry installations.
- D. Section 09 30 13 – Ceramic Tiling: Coordination of installation of finish carpentry items with the tile installations.
- E. Section 09 90 00 – Painting: Surface preparation and finishing of finish carpentry items.

1.3 QUALITY ASSURANCE

- A. Woodworking Standards:
 - 1. Design and Construction Features: Comply with details and profiles shown. Where not otherwise shown, comply with applicable AWI Quality Standards, with alternate details at fabricator's option.
 - 2. All shelving shall be manufactured to meet the quality standards of the Architectural Woodwork Institute, AWI Section 600, Custom Grade.
 - 3. All wood trim shall be manufactured and installed to meet the quality standards of the Architectural Woodwork Institute, AWI Section 300, Custom Grade for opaque finish.
 - a. Comply with details shown for profile and construction wood trim and millwork items. Where not otherwise shown, comply with applicable AWI Quality Standards, with alternate details at fabricator's option.
 - 4. Installation of Interior Millwork Items: comply with requirements of the Architectural Woodwork Institute, AWI Section 1700.
- B. Grading Standards:
 - 1. Moisture Content: The maximum moisture content of treated or untreated finish lumber, trim and millwork is not to exceed 10% at the time of delivery.
 - 2. Grading Standards: Softwood framing lumber shall comply with Product Standard 20 and with the specific grading association standards and specifications listed below:
 - a. Southern Pine: Standard Grading Rules for Southern Pine Lumber, published by Southern Pine Inspection Bureau and trademarked SPIB.
 - 3. All plywood shall be manufactured in accordance with U.S. Product Standard PS-10 and grademarked.
 - 4. All board lumber shall comply with PS 20 and trademarked by either of the associations listed in paragraph above.
 - 5. Hardwood lumber shall comply with national Hardwood Lumber Association rules.

SECTION 06 20 00

FINISH CARPENTRY

1.4 SUBMITTALS

- A. Submit shop drawings for the following:
 - 1. Shelving: Show shelving layouts, shelf spacing and standards anchorage as well as types of anchorages for the substrates involved. Submittals shall also show shelf construction and materials used in manufacture.
 - 2. Shelf standards and brackets, include manufacturer's suggested anchorage requirements.
 - 3. Wardrobe Rod Assembly: Manufacturer's product data and shop drawings. Indicate materials, finish and suggested anchorage devices for the substrate(s) involved.
 - 4. Slat Wall System: Show materials, finishes and anchorage techniques.
- B. Samples:
 - 1. Plastic Laminate: Color chips for review and color selection.

1.5 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Protect materials during transit, delivery and handling to prevent damage, soiling and deterioration.
- B. Inspect all materials delivered and reject all not qualifying completely with the requirements, damaged in transit or in handling, or otherwise unsatisfactory.
- C. Deliver, store and handle finish carpentry items in a manner to prevent damage and deterioration. Defer delivery to job until the installation and storage areas are complete and dry of all wet-type construction. Relative humidity in storage areas shall be maintained at and shall not exceed 60 percent.
- D. Deliver, receive and store paneling materials in the manufacturer's original cartons with all labels intact. Material shall be stored in the area of the building that it is to be installed for a period of 48 hours prior to installation of same. Building shall be conditioned to its normal operating temperature and humidity during this time.

1.6 JOB CONDITIONS

- A. Do not install finish carpentry until required temperature and relative humidity conditions have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of the installed finish carpentry within 1.0% tolerance of optimum moisture content, from date of installation through remainder of construction period.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Shelving - All shelving shall be painted.
 - 1. In areas as detailed, shall be 3/4" thick A-B interior APA plywood with hardwood nosing on all edges.
 - 2. For adjustable shelving, provide wall standards for shelf supports, Knap & Vogt #187 Heavy-Duty Brackets with #87 Heavy-Duty Standards, zinc finish.
- B. Wardrobe Shelf and Rod:
 - 1. Shelf: 3/4" Thick plywood with high-pressure plastic laminate on all surfaces and edges, except front edge. Provide hardwood nosings, as detailed, with high-pressure plastic laminate over surfaces and edges.

SECTION 06 20 00

FINISH CARPENTRY

2. Coat Rod and Bracket: Manufacturer as specified in details on Drawings
 3. Provide rods in length(s) as required.
- C. Plastic Laminate: Plastic laminate shall comply with NEMA LD-3. Provide the following:
1. GP 50: Horizontal Grade.
 2. GP28: Vertical Grade.
 3. Acceptable Manufacturers of Plastic Laminate are:
 - a. FonnicaCorporation.
 - b. Nevamar Corporation.
 - c. Ralph Wilson Plastics Company.
- D. Plywood: Comply with U.S. Product Standard PS 1, Group 1, Douglas Fir unless otherwise specified or noted. Use exterior grade only, without visible patches or repairs on exposed sides.
1. A-B Grade: Where both faces are exposed.
 2. A-C Grade: Where only one face is exposed.
- E. Wood Glue: Waterproof type as recommended by AWI standards for the particular application.
- F. Adhesive - Non-Flammable:
1. DAP Weld-Wood, Non-Flammable Type as manufactured by Beecham Products Inc. of Dayton, Ohio.
 2. Penacolite - G 1149A/G1131B or G 1124, as manufactured by Koppers Company, Inc. of Pittsburgh, Pennsylvania.
- G. Slat Wall System: Wall display system shall be Spacewall™ Slotwall™ (metal slot), as manufactured by Spacewall, Inc. of Stone Mountain, Georgia. Color and finish as selected by Interior Designer.
1. System shall be designed for "Heavy-Duty" use.
 2. Slot spacing shall be 4".
 3. Face finish shall be wood veneer as selected by the Architect; slot finish shall be bronze.
 4. Coordinate with the Owner the type and quantity of display hooks, supports, bars, brackets, etc., required for installation with this wall system.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Inspect all materials delivered and reject all not qualifying completely with the requirements, damaged in transit or in handling, or otherwise unsatisfactory.
- B. All finish carpentry shall be executed by skilled mechanics in strict accordance with the details. Protect finish carpentry items against dampness during and after delivery. Store under cover in well ventilated spaces, not exposed to extreme changes in temperature and excess humidity. Make field measurements where required for close fit.
- C. Install with minimum number of joints possible, using full-length material to greatest extent possible. Stagger joints in adjacent and related members. Cope at returns; miter at comers, to produce tight fitting joints with full surface contact throughout the length of the joint. Use scarf joints for end-to-end joints.
- D. Secure work to grounds, otherwise fasten in position to hold correct surfaces, Jines, levels. Make finished work flat, plumb, true.
- E. Loose Joints: Use judgment in locating loose joints to render them inconspicuous as possible in finished work.

SECTION 06 20 00

FINISH CARPENTRY

- F. Fastenings: As far as possible conceal fastenings; where not possible locate then in inconspicuous places. Where nailing is pennitted through wood work face, conceal nail heads.
- G. Expansion Joints: Construct to permit sections to expand and contract without buckling, warping, causing other conditions which will detract from appearance, durability.
- H. Set all nail heads. Countersink all screw heads.

3.2 SLAT WALL SYSTEM

- A. Wall Display System: Install Slotwall™ in areas as indicated/scheduled. Attach through metal slot to solid wood blocking (refer to Section 06100), using fasteners of size, length and spacing as recommended by the manufacturer of the wall system for "Heavy-Duty" applications. Wall panels shall be cut to size for the particular installation, using a fine saw blade and table saw, with exposed faces protected from damage. Install wall system in strict compliance with manufacturer's instructions, with all slot level and parallel and joints tightly butted.

3.3 CLEANING

- A. At the completion of this work, remove from the job site all excess materials and debris. Leave entire work ready to receive the specified or scheduled finish.

3.4 PROTECTION

- A. Protect finished installations from damage until Date of Substantial Completion. Repair or replace any damage at no additional cost to the Owner as directed by the Architect.

END OF SECTION

SECTION 06 20 23

INTERIOR FINISH CARPENTRY

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Plywood paneling.
 - 3. Shelving and clothes rods.

1.2 SUBMITTALS

- A. Product Data: And/Or Shop Drawings for each type of process and factory-fabricated product.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

- A. Certified Wood: The following wood products shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
- B. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by ALSC's Board of Review.
- C. Softwood Plywood: DOC PS 1. D. Hardboard: AHA A135.4. E. MDF: ANSI A208.2, Grade 130 made with binder containing no urea-formaldehyde resin.
- D. Particleboard: ANSI A208.1, Grade M-2 made with binder containing no urea-formaldehyde resin.
- E. MDF: ANSI A208.2, Grade 130 made with binder containing no urea-formaldehyde resin.
- F. Hardboard: AHA A 135.4.
- G. Quality standards of the Architectural Woodwork Institute.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. Lumber: Comply with performance requirements in AWPA C20, Exterior type. Kiln dry after treatment to a maximum moisture content of 19 percent.
- B. Plywood: Comply with performance requirements in AWPA C27, Exterior type. Kiln dry after treatment to a maximum moisture content of 15 percent.
- C. Application: Where indicated as Fire Retardant.

SECTION 06 20 23

INTERIOR FINISH CARPENTRY

2.3 PANELING

- A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1, made without urea-formaldehyde adhesive.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Chesapeake Hardwood Products, Inc.
 - b. Davidson Plywood; a division of Do+Able Products, Inc.
 - c. Georgia-Pacific Corp.
 - d. Louisiana-Pacific Corporation.
 - 2. Thickness and Face Veneer Species and Cut: As Shown on Drawings.
 - 3. Finish: Class I.
 - 4. Surface-Burning Characteristics: As follows, tested per ASTM E 84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - c. Board Paneling: Interior wood board paneling complying with WMPMA WM 9.
 - (1) Species: As detailed on Drawings Southern pine.
 - (2) Grade: Clear No. 1.
 - (3) Maximum Moisture Content: 15 percent

2.4 SHELVING AND CLOTHES RODS

- A. Shelving: Made from 3/4 inch thick Particleboard solid wood front edge.
- B. Shelf Cleats: 3/4-by-3-1/2-inch boards 3/4-by-5-1/2-inch boards [3/4-by-5-1/2-inch boards with hole and notch to receive clothes rods, as specified above for shelving.
- C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.
- D. Shelf Brackets without Rod Support: BHMA A156.16, B04041; prime-painted formed steel.
- E. Clothes Rods: 1-1/2-inch- diameter, clear, kiln-dried hardwood alternate to install 1 1/2" round galvanized pipe rod.

2.5 CABINETRY MILLWORK

- A. Plastic Laminate
 - 1. General Purpose type, minimum one-sixteenth of an inch (1/16") thick; FS L-P-508F; Wilson-Art, Nevamar, Formica or Pionite in colors selected by Architect.
 - 2. Adhesive: FS MMM-A-130A, and as recommended by manufacturer of plastic laminate for the particular condition of use.
- B. Accessories
 - 1. Nails, bolts, nuts, washers, lags, pins and screws.
- C. Cabinet Hardware
 - 1. Shelf Standards and Rests: KV No. 255 standards with No. 256 supports.
 - 2. Drawer and Door Pulls: 'Quality Hardware' Sugatsune Kogyo Co., Ltd. No. DL-130S with stainless steel handles.
 - 3. Drawer Slides: 'KV' No. 8400 at desks. 'KV' No. 1300 at vanities, lunch room and bar Drawers.
 - 4. Hinges: 'Blum' Model No. 90 Series 170 degree opening concealed hinges.
 - 5. Locks: 'Quality Hardware' Sugatsune Kogyo Co., Ltd No. 2310 with satin nickel finish.
 - 6. Receding Door Slide: EZ hinged door slide "KV Model 8050EZ".

INTERIOR FINISH CARPENTRY**D. Fabrication**

1. Fabricate cabinetwork and finish carpentry times in accordance with recommendations of AWI, custom grade.
2. Bases: Cabinet bases to be three-fourths of an inch (3/4") plywood, four inches (4") high with recessed toe space. Visible exterior sides faces with high pressure laminate.
3. Cabinet Sides, Tops, Bottoms and Backs:
 - a. Cabinet Tops to be three-fourths of an inch (3/4"). Exposed top surfaces up to eighty-four inches (84") high to be laminated with horizontal surface grade high pressure laminate. Tops of units over eighty-four inches (84") high to be Melamine board finished one (1) side. Refer to floor plans for stainless steel and solid surface materials Countertops and Splashes.
 - b. Bottoms to be three-fourths of an inch (3/4"). Exposed exterior surface laminated with vertical surface grade high pressure laminate. Interior surface to be Melamine board finished one (1) side.
 - c. Sides to be three-fourths of an inch (3/4"). Exposed exterior surface laminated with vertical surface grade high pressure laminate. Interior surfaces to be Melamine board finished one (1) side.
 - d. Interior Surface to be Melamine board finished one (1) side. Exterior surface laminated with backing sheet. When finished back is required, provide three fourths of an inch (3/4") thick plywood finished with plastic laminate. Exterior surface to be vertical surface grade high pressure laminate.
4. Cabinet Edges, Dividers and Shelves: Cabinet edges to be self-edged with high pressure laminate, cabinet dividers and shelves to be three-fourths of an inch (3/4") thick, Melamine board finished two (2) sides.
5. Cabinet Doors: Hinged or Sliding Doors to be three-fourths of an inch (3/4") thick. Exterior surface to be vertical surface grade high pressure laminate. On hinged doors interior surface to be Melamine board finished one (1) side. Sliding door interior surface to be Melamine board finished one (1) side. Door edges to be self-edged with high pressure laminate.
6. Drawers:
 - a. Drawer Body (sides, front and backs) to be one half of an inch (1/2") thick. Drawer bottom to be one-fourth of an inch (1/4") hardboard.
 - b. Drawer Front to be three-fourths of an inch (3/4") thick laminated with vertical surface grade high pressure laminate on exterior surface and finished Melamine board on interior side.
 - c. Interior Surface: Drawer front edges to be self-edge. Drawer front to be replaceable without disturbing or removing drawer body.
7. Countertops: All countertops to be three-fourths of an inch (3/4") thick, top surface laminated with high pressure laminate. Backsplash and end splash to be four inches (4") high mechanically fastened to countertop. Underside of counter and unexposed surfaces of backsplash and side splash to be Melamine board finished one (1) side. Tops to be self-edged with high pressure laminate. Sink cutouts provided as required.
8. Apply high pressure laminate finish in full uninterrupted sheets consistent with manufactured sizes. Corners and joints shall have hairline joints.
9. Shop assemble cabinetwork and finish carpentry items, whenever possible.

2.6 CABMISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
 1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.

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INTERIOR FINISH CARPENTRY

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.
 1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 – EXECUTION

3.1 PREPARATION

- A. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 1. Scribe and cut interior finish carpentry to fit adjoining work.
 2. Countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.
 3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset.

3.3 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Cope at returns and miter at corners to produce tight-fitting joints. Use scarf joints for end-to-end joints.

3.4 PANELING INSTALLATION

- A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Leave 1/4-inch gap to be covered with trim at top, bottom, and openings. Install with uniform tight joints between panels.
 1. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners as recommended by panel manufacturer.
 2. Conceal fasteners to greatest practical extent.
- B. Hardboard Paneling: Install according to manufacturer's written recommendations. Leave 1/4-inch gap to be covered with trim at top, bottom, and openings. Butt adjacent panels with moderate contact. Use fasteners with prefinished heads matching paneling color.
- C. Board Paneling: Install according to manufacturer's written instructions. Arrange in random width pattern suggested by manufacturer unless boards or planks are of uniform width.
 1. Install in full lengths without end joints.
 2. Stagger end joints in random pattern to uniformly distribute joints on each wall.
 3. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards.
 4. Fasten paneling by face nailing, setting nails, and filling over nail heads.
 5. Glue and Paneling Adhesive: Comply with paneling manufacturer's written recommendations.

3.5 SHELVING AND CLOTHES ROD INSTALLATION

- A. Cut shelf cleats at ends of shelves at 1/2 inch less than width of shelves; sand exposed ends smooth.

SECTION 06 20 23

INTERIOR FINISH CARPENTRY

- B. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than 16 inches o.c. Install shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- C. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.

END OF SECTION

SECTION 06 22 11

MILLWORK AND CABINETRY

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Includes but is not limited to the materials and installations of:
 - 1. Plastic laminate countertops, aprons and backsplashes.
 - 2. Custom manufactured cabinetry, casework and millwork.
 - 3. Registration desk.
 - 4. Vanities in Guestrooms.
 - 5. Other items as indicated on the Drawings and as required to complete the Work.

1.2 RELATED SECTIONS

- A. Section 06 10 00 – Rough Carpentry: Treated wood blocking required for the installation of millwork and cabinetry items.
- B. Section 06 20 00 – Finish Carpentry: Applicable portions of this Section for materials, manufacture, and installation.
- C. Section 09 29 00 – Gypsum Board: Completion of the gypsum wallboard installations prior to cabinetry and millwork installations. Substrate for window sills
- D. Section 09 30 13 – Ceramic Tiling: Coordination of tile flooring and base installation with the setting in place of the cabinetry and millwork.
- E. Section 09 72 00 – Wall Coverings: Coordination of wall covering installation with installation of cabinetry and millwork.
- F. Section 09 90 00 – Painting: Completion of painting operations prior to installing cabinetry and millwork items.
- G. Section 12 36 00 – Countertops: Quartz tops for cabinetry and millwork.

1.3 QUALITY ASSURANCE

- A. Woodworking Standards:
 - 1. Design and Construction Features: Comply with details shown for profile and construction of tops and cabinetry. Where not otherwise shown, comply with applicable AWI Quality Standards, with alternate details at fabricator's option.
 - 2. Architectural Cabinets, Plastic Laminate Clad: AWI Section 400 for Reveal Overlay for plastic laminate construction, Custom Grade.
 - 3. Architectural Cabinets, Tops: AWI Sections 400 for High Pressure Decorative Laminate Tops and 400C; Custom Grade.
 - 4. Miscellaneous Ornamental Items: AWI Section 700; Custom Grade.
 - 5. Installation: Comply with requirements of the Architectural Woodwork Institute, AWI Section 1700.
- B. Provide complete installation of cabinetry and millwork sample Guest Room for Architect's review prior to installation in any other areas. This installed and approved installations shall establish the standard of workmanship in all other Guest Rooms.

1.4 SUBMITTALS

SECTION 06 22 11

MILLWORK AND CABINETRY

- A. Submit copies of shop drawings and technical data and two (2) physical samples of cabinet material and top with finishes applied, to the Architect. Shop drawings shall show all cabinet/millwork layouts with Room Numbers indicated, materials, construction, joinery, species of wood and finish(es).
- B. Submit plastic laminate color chips for Architect's color selection. Submit millwork samples with finish applied, as directed by the Architect.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle cabinetry and millwork items in a manner to prevent damage and deterioration. Defer delivery to job until the installation and storage areas are complete and dry of all wet-type construction. Relative humidity in storage areas shall be maintained at and shall not exceed 60 percent.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All Cabinetry, Millwork and Tops shall be factory fabricated and delivered to the job site completely finished with hardware installed. All glue used in millwork manufacturing shall be waterproof, as recommended by AWI for the particular application involved. Cabinetry will be provided with plastic laminate finish and transparent finish; refer to Drawings for locations of each type cabinetry. All cabinets shall have almond color melamine liner.
- B. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures and fittings.

2.2 PLASTIC LAMINATE COUNTERTOPS, APRONS, BACKSPLASHES

- A. Plastic Laminate: Shall be standard grade, 1/16" thick, general purpose material complying with current NEMA Standard and LD-3. Comply with ANSI A 161.2. Provide the following:
 - 1. GP 50: Horizontal Grade.
 - 2. GP28: Vertical Grade.
 - 3. CL 20: Cabinet Liner.
 - 4. BK 20: Backing Sheet.
 - 5. PF-40: Post Forming Grade.
 - 6. FR 32: Vertical application, fire retardant material.
- B. Plastic Laminate Acceptable Manufacturers
 - 1. Formica Corporation
 - 2. WilsonArt International, Inc.
 - 3. Laminart
 - 4. Nevamar/International Paper Decorative Products
- C. Core:
 - 1. Particleboard, complying with ANSI A208.1, 45-lb. Minimum density, 3/4" thick fire-retardant type in accordance with ASTM E 84 and the following:
 - a. Flame Spread: 25 maximum
 - b. Smoke Developed: 25 maximum
 - c. Fuel Contributed: 25 maximum
 - 2. Manufacturers:
 - a. "X-Flame"; Masonite Corporation
 - b. "Duraflake FR"; Willamette Industries, Inc.

- D. Adhesives:

SECTION 06 22 11

MILLWORK AND CABINETRY

1. Wood Glue: Waterproof types as recommended by AWI standards for the particular application.
2. Plastic Laminate: Provide one (1) of the following products subject to conformance with the requirements specified.
 - a. Non-Flammable:
 - (1) "OAP Weld-Wood, Non-Flammable Type" - OAP, Inc.
 - (2) Molded Trim Adhesive - As recommended by molding manufacturer for intended use.
- E. Where shown, all countertops shall have 3/4" x 4" high separate matching backsplash and matching aprons.
- F. In locations as required by local codes or ordinances, provide fire retardant countertop assemblies, as tested in accordance with ASTM E 84.

2.3 PLASTIC LAMINATE COUNTERTOPS, APRONS, BACKSPLASHES

- A. General:
 1. All cabinetry shall be factory fabricated and delivered to the job site completely finished with hardware installed. The inside surfaces of all cabinets shall have liner panel. All glue used in millwork manufacturing shall be waterproof, as recommended by AWI for the particular application involved.
 2. Cabinet Construction: Comply with requirements specified herein.
 - a. Reveal overlay design with plastic laminate finish on all exposed surfaces and edges.
 - b. Cabinet Front Frame: Solid hardwood, 3/4" thick. Provide plastic laminate applied to exposed surfaces and edges.
 - c. Backing Sheet: Provide hacking sheet on all doors and drawer heads.
 - d. Particleboard, plastic laminate and adhesives shall be as specified for plastic laminate countertops, except that particleboard for cabinet construction shall be 53 lb. density.
- B. Hardwood Plywood: ANSI/HPMA HP hardwood and decorative plywood, of thickness, species, cut, and core construction as selected by the Interior Designer.
- C. Hardwood Lumber: Clear, dry, sound, and free of defects selected from First Grade lumber (NHLA), of species as selected by the Interior Designer.
- D. Hardboard: ANSI A1 35.4, Class 1, tempered.
- E. Solid Lumber: Dry, sound, selected to eliminate appearance defects, of any species of hardwood or softwood with color and grain characteristics similar exposed portions.
- F. Style of face construction for base, wall, and full-height units, if any, with drawer fronts, doors, and fixed panels as follows:
 1. Panel, concealing face frames of cabinet body.
 2. Panel Door Construction: Lumber core plywood
 3. Drawer Front Construction: Same as door or, where standard with manufacturer, solid or glued-up lumber, not less than 1/2" thick.
- G. Construction for face frame style casework as follows:
 1. Rails and Stiles: Not less than 1-inch by 1-5/8-inch solid lumber with glued mortise and tendon joints.
 2. Exposed Ends: Not less than 1/2-inch-thick, medium-density particle board core and not less than 4-mil vinyl laminate on interior surfaces. Connect to stile with pressure-glued tongue and plow joint and supplement by concealed mechanical fasteners.

SECTION 06 22 11

MILLWORK AND CABINETRY

3. Unexposed Ends: Not less than 1/2-inch-thick, medium-density particle board with not less than 4-mil prefinished vinyl laminate on interior surfaces. Attach to front frame in same manner as exposed ends.
 4. Back, Top, and Bottom Rails: Not less than 3/4 inch by 3-inch solid lumber, machined to interlock with end panels, and rabbeted to receive top and bottom panels; with back rails secured under pressure with glue and mechanical fastening devices.
 5. Shelving: Not less than 5/8-inch-thick particle board core plywood or 1/2-inch-thick medium-density particle board prefinished with melamine finish on top, bottom, and exposed (front) edge.
- H. Construction for wall units with doors and fixed panels as follows:
1. Tops and Bottoms: Not less than 1/2-inch-thick particle board or 3/8-inch-thick hardwood plywood, fully supported by and secured in rabbets in end panels, front frame, and back rail.
 2. Backs: Not less than 1/8 inch hardboard or 3/16 inch plywood fastened to machined rear edge of ends and to top and bottom hanger rails.
 3. Where glass is indicated in doors, provide 1/8" tempered glass set in authentic muntins.
- I. Construction for base units with doors and fixed panels as follows:
1. Front Frame Drawer Rails: Not less than 1 inch by 1-1/4-inch lumber mortised and fastened into face frame.
 2. Bottoms: Not less than 1/2-inch-thick particle board with 4-mil vinyl laminate finish or 3/8 inch thickness plywood, fully supported by and secured in rabbets in end panels, front frame, and back bottom rail.
 3. Back Panels: Not less than 1/8-inch-thick hardboard fastened to machine rear edge of end panels and to top and bottom rails. Interior surface prefinished with 4-mil vinyl laminate.
 4. Toe Boards: Not less than 5/8-inch particle board core attached between end panels and extended from bottom panel to floor.
 5. Corner Blocks: Glued and fastened in each of four top corners to maintain cabinet squareness and rigidity.
- J. Construction for Drawer Units: Drawer body shall be not less than 3/8-inch-thick vinyl faced particle board subfront, back, and sides. Provide box-type construction with subfront and back rabbeted into sides and secured with glue and mechanical fasteners. Exposed fronts fastened to subfront with mounting screws from interior of body. Drawer bottom of not less than 1/4-inch-thick hardboard, set into rabbets in back, sides, and front.

2.4 CABINET HARDWARE

- A. Hardware: As manufactured by Hafele America Company of Archdale, North Carolina. Coordinate hardware finishes with cabinet finishes and that of the surrounding finish hardware items.

2.5 FABRICATION

- A. General:
1. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
 2. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
 3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.
 4. Carefully fit equipment to be installed into millwork. Provide filler pieces when required.
 5. Protection: Exposed ends of millwork to be sealed with two coats of spar varnish. See Section 09 90 00 - Painting and 1 Coatings.
- B. Plastic Laminate Work:

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MILLWORK AND CABINETRY

1. Self-edge tops with same grade of laminate as top surface unless indicated otherwise.
2. Counters and work tops with sinks: Apply trim and edging prior to surface sheet. Substrate for back splashes and at edges shall be trimmed lumber, Use only exterior grade or marine grade Plywood near wet areas. All adhesives used near water shall be formulated to be specially water resistant.
3. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Make comers and joints hairline. Locate counter butt joints minimum 2 feet from sink cut-outs.
4. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces, where shown on Drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation of all cabinetry and millwork items shall comply with the Quality Assurance section of this specification.
- B. Cabinetry and millwork items shall be mounted and set into place in accordance with the approved shop drawings. All work shall be straight, plumb, level and in true alignment. Fit all joints closely and fasten all pieces rigidly in place. Coordinate installation of cabinetry in Suites with Owner-provided appliance installations.
 1. Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
 2. Carefully scribe casework which is against other building materials, leaving gaps of 1/32-inch maximum. Do not use additional overly trim for this purpose.
 3. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
 4. Countersink anchorage devices at exposed locations used to wall-mount components, and conceal with solid plugs of species to match surrounding wood. Finish flush with surrounding surfaces.
- C. All hardware shall be demonstrated to operate properly. Drawer units shall slide freely without bind. Doors shall remain open in any position beyond the closing mechanism of the hinges.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.
- B. Clean casework, counters, shelves, hardware, fittings and fixtures.
- C. Clean surfaces of plastic laminate with a damp cloth or ordinary bar soap and water. Harsh abrasive cleansers shall not be used.

3.3 PROTECTION

- A. Completed installations shall be protected from damage until the Date of Substantial Completion. Cabinet work, millwork and other items damaged prior to Date of Substantial Completion shall be repaired or replaced at no expense to the Owner.

END OF SECTION

SECTION 07 1113

Bituminous Damp proofing

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials and workmanship for bituminous damp proofing on concrete and masonry surfaces.

1.2 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Product description.
 - 2. Application instructions.

1.3 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - D226-09 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - D449-03(R2008) Asphalt Used in Damp proofing and Waterproofing
 - D1227-95(R2007) Emulsified Asphalt Used as a Protective Coating for Roofing

PART 2 - PRODUCTS

2.1 ASPHALT (HOT APPLIED):

ASTM D449, TYPE I.

2.2 ASPHALT SATURATED FELT:

ASTM D226, TYPE I, 7 KG (# 15).

2.3 ASPHALT EMULSION (COLD APPLIED):

ASTM D1227, TYPE III (SPRAY GRADE)

PART 3 - EXECUTION

3.1 SURFACE PREPARATION:

- A. Surfaces to receive damp proofing shall be clean and smooth.
- B. Remove foreign matter, loose particles of mortar or other cementitious droppings.
- C. Clean and wash soil or dirt particles from surface.
- D. Remove free water; surfaces may remain damp.

3.2 APPLICATION:

- A. Comply with Manufacturer written instructions for methods and rates of damp proofing application, cleaning and installation of any protection course.
- B. Apply each coat at the rate of not less than 1 L/m² (2-1/2 gallons per 100 square feet) and allow not less than 24 hours drying time after application.

SECTION 07 1113

Bituminous Damp proofing

3.3 LOCATION:

- A. Apply to surfaces where shown.
- B. Apply to exterior surface of inner wythe of masonry cavity walls where shown.
Coordinate application with masonry work.

END OF SECTION

SECTION 07 2100

Thermal Insulation

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation and integral vapor retarder at cavity wall construction and exterior wall behind Gypsum Wallboard wall finish.
- B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Supporting construction for batt insulation.
- B. Section 07 8400 – Firestopping: Insulation as part of fire-rated through-penetration assemblies.
- C. Section 09 2116 – Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

- A. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2012.
- B. ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2010.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2012.
- E. ASTM D2842 – Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2006.
- F. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.
- G. ASTM E136 – Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.

1.04 SUBMITTALS

- A. See Section 01 3000 – Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation on inside of Concrete and Masonry Exterior Walls: Fiber Board.
- B. Insulation in Metal Framed Walls: Batt Insulation with separate Exterior Substrate Boards with built in Fiberglass Exterior Vapor Air and Moisture Barrier.

2.02 LIMITATIONS:

- A. Do not use un-faced insulation in exposed applications where there is potential for skin contact and irritation.
 - a. Kraft and standard foil facings will burn and must not be left exposed. The facing must be installed in substantial contact with the unexposed surface of the ceiling, wall or floor finish.
 - b. Protect facing from any flame or heat source.

2.03 INSULATION SCHEDULE

Location:	Type:	Thickness:
Exterior Wall (E.I.F.S.)	Polystyrene	1 ½" = (R-7.5)
Exterior 6" Stud Wall.....	Batt Insulation	6" = (R-19)
Interior 6" Stud Wall.....	Sound Blanket	1 ½" = R-
Ceiling	Batt Insulation	6" = (R-19)

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Thermal Insulation

3 1/2" Stud Wall..... Batt Insulation	3 1/2' = (R-11)
3 5/8" Stud Wall..... Batt Insulation	3 1/2" = (R-13)
Perimeter Horizontal Slab Polystyrene	1 1/2" = (R-7.5)
Foundation Vertical Wall..... Polystyrene	1 1/2" = (R-7.5)
Roof Deck Polyisocyanurate	1 1/2" min. = (R-9.6) (R-3.2 per 1/2")

2.04 SOUND ATTENUATION BLANKET

- A. Type: Unfaced glass fiber acoustical insulation complying with ASTM C665, Type I.
- B. Size: Thickness: 1 1/2" Width: 16" Length: 96"
- C. Surface Burning Characteristics:
- D. Maximum flame spread: 10
- E. Maximum smoke developed: 10 when tested in accordance with ASTM E84.
- F. Combustion Characteristics:
 - a. Passes ASTM E 136.
- G. Fire Resistance Ratings:
 - a. Passes ASTM E 119 as part of a complete fire tested wall assembly.
- H. Sound Transmission Class: STC – Reduction between 4 and 6 db's.
- I. Dimensional Stability:
 - a. Linear Shrinkage less than 0.1%
- J. Manufacturer: Owens-Corning

2.05 FOAM BOARD INSULATION

- A. Expanded Polystyrene Board Insulation: ASTM C578; with the following characteristics:
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Size: 48 x 96 inch (1220 x 2440 mm)
 - 4. Board Thickness: 1 1/2" (38 mm)
 - 5. Board Edges: Square.
 - 6. Water Absorption: 4 percent by volume, maximum, when tested in accordance with ASTM D2842.
 - 7. Board Density: 0.7 lb/cu ft (12 kg/cu m).
 - 8. Compressive Resistance: 5 psi (35 kPa).
 - 9. Thermal Conductivity (k factor) at 25 degrees F (-3.9 degrees C): (0.28, 0.48).
 - 10. Manufacturer: Dow Chemical Co.
- B. Extruded Polystyrene Board Insulation: ASTM C578, Type X; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Size: 48 x 96 inch (1220 x 2440 mm)
 - 4. Board Thickness: 1 1/2" (38 mm)
 - 5. Board Edges: Shiplap
 - 6. Water Absorption: 3 percent by volume, maximum, when tested in accordance with ASTM D2842.
 - 7. Compressive Resistance: 25 psi (173 kPa).
 - 8. Water Absorption, maximum: 0.3 percent, volume.
 - 9. Manufacturers: Dow Chemical Co.
- C. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289: Type I, aluminum foil faces; Class 2, glass fiber-reinforced core.
 - Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

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2. Board Size: 48 x 96 inch (1220 x2440 mm)
3. Board Thickness: 2" (50 mm)
4. Board Edges: Shiplap on long edges.
 - i. Tape from accessories at all edges when installing boards.
5. Water Absorption: 4 percent by volume, maximum, when tested in accordance with ASTM D2842.
6. Compressive Strength: 16 psi (110 kPa).
7. Flexural Strength: 40.0 psi, minimum, per ASTM C203.
8. Dimensional Stability: 0.5 percent lineal change, maximum, per ASTM D2126
9. Water Absorption: 0.3 percent by volume, maximum, per ASTM C209.
10. Water Permeance: less than 0.03 perms, maximum, per ASTM E96.
11. Thermal Resistance: R-value of 13.
12. Manufacturers: Dow Chemical Co.

2.05 FIBER BOARD INSULATION MATERIALS:

- A. Where fiber board insulation is indicated, either glass fiber or mineral fiber board insulation may be used, at Contractor's option.
- B. Glass Fiber Board Insulation Rigid glass fiber, ASTM C612.
Expanded Polystyrene Board Insulation: ASTM C578; with the following characteristics:
 1. Facing: None, unfaced.
 2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 4. Board Size: 48 x 48 inch (1220 x1220 mm)
 5. Board Thickness: 1" (25 mm)
 6. Board Edges: Square.
 7. Water Absorption: 4 percent by volume, maximum, when tested in accordance with ASTM D2842.
 8. Board Density: 0.7 lb/cu ft (12 kg/cu m).
 9. Compressive Resistance: 5 psi (35 kPa).
 10. Thermal Conductivity (k factor): 0.26 (0.45).
 11. Maximum Density: 8.0 lb/cu ft (128 kg/cu m).
 12. Combustibility: Except for facing, if any, non-combustible when tested in accordance with ASTM E136.
 13. Manufacturers:
 - a. Certain Teed Corporation: www.certainteed.com
 - b. Johns Manville Corporation: www.jm.com
 - c. Owens Corning Corporation: www.owencorning.com
 - d. Substitutions permitted of equal quality and size.
- C. Mineral Fiber Board Insulation: Rigid mineral fiber, ASTM C612; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

2.06 BATT INSULATION MATERIALS:

- A. Where batt insulation is tested, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84. Unfaced.
 3. Substitutions: See Section 01 6000 – Product Requirements.
 4. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.

SECTION 07 2100

Thermal Insulation

5. Formaldehyde Content: Zero.
 6. Facing: Unfaced
 7. Substitutions: See Section 01 6000 – Product Requirements.
- C. Mineral Fiber Batt Insulation: Flexible performed batt or blanket, complying with ASTM C665:
1. Provide foil facing on one side; with flame spread index of 23 or less, when tested in accordance with ASTM E84.
 2. Smoke Development Index: 450 or less, when tested in accordance with ASTM E84.

2.07 ACCESSORIES:

- A. Tape: Bright aluminum self-adhering Type, 2 inch (50 mm) wide.
- B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- C. Spray Foam: Pressurized-in-can style for filling gaps, cracks and crevices.

PART 3 EXECUTION

3.01 EXAMINATION:

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of irregularities.

3.02 BOARD INSTALLATION AT CAVITY WALLS:

- A. Install boards to fit snugly between wall ties.
- B. Install boards horizontally on walls.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BATT INSULATION:

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
- F. Tape seal tears or cuts in vapor retarder.
- G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.05 PROTECTION:

- A. Do not permit installed insulation to be damaged prior to its concealment.
 1. Board insulation with aluminum facer may be repaired with aluminum tape.

END OF SECTION

SECTION 07 21 20

Board Insulation

PART I - GENERAL

1.1 WORK INCLUDED

- A. Rigid insulation at the roof

1.2 RELATED WORK

- A. Section 03300 - Cast-In-Place Concrete: Slab on grade construction.

1.3 REFERENCES

- A. ANSI/ASTM C209 - Insulating Board (Cellular Fiber), Structural and Decorative.
- B. FS L-P-375 - Plastic Film, Flexible, Vinyl Chloride.
- C. FS HH-I-524 - Insulation Board, Thermal (Polystyrene).
- D. ASTM E96 - Water Vapor Transmission of Materials

1.4 QUALITY ASSURANCE

- A. Refer to Section 01400 - Quality Control

1.5 SYSTEM DESCRIPTION

- A. Materials of this Section shall provide a continuous thermal, vapor and air barrier continuously at the underside of the structural concrete slab on grade. The insulation board shall be 1-1/2 inch x 24 inches.

PART 2 - PRODUCTS

2.1 ACCEPTABLE INSULATION MANUFACTURERS

- A. Formular
- B. Celotex
- C. Substitutions or Equal accepted

2.2 MATERIALS

- A. Insulation: Extruded cellular polystyrene; thermal resistance "R" per inch of 5.0; minimum compressive strength of 30 psi; water absorption by volume in accordance with ANSI/ASTM D284.2 0.3 percent; Square Edges; 1-1/2" thick by 24".

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify substrate and adjacent materials, and that insulation boards are dry, free from debris, and ready to receive insulation.
- B. Verify substrate surface is flat, and free of irregularities and materials that will impede adhesive bond.
- C. Verify new insulation boards are unbroken, and free of damage.

3.2 INSTALLATION

- A. Place New Insulation Boards directly on the plastic vapor barrier, which is on top the sand bed. Place the structural slab reinforcing on top of the insulation board, including any Low or High Steel Rebar Support Chairs, and prepare to pour the concrete slab.
- B. Prevent the insulation from being displaced or damaged while installing other adjacent work.

END OF SECTION

SECTION 07 22 00

ROOF AND DECK INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Roof and deck insulation, vapor retarder and on new construction ready to receive roofing or waterproofing membrane.
- B. Repairs and alteration work to existing roof insulation.

1.2 RELATED WORK

- A. Wood cants, blocking, and edge strips: Section 06 10 00, ROUGH CARPENTRY.
- B. Perimeter, rigid, and batt or blanket insulation not part of roofing system:
- C. Sheet metal components and wind uplift requirements for roof-edge design: Section 07 60 00, FLASHING AND SHEET METAL.

1.3 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.
- B. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE):
 - 90.1-07 Energy Standard for Buildings Except Low-Rise Residential Buildings
- C. ASTM International (ASTM):
 - C208-08 Cellulosic Fiber Insulating Board
 - C552-07 Cellular Glass Thermal Insulation
 - C726-05 Mineral Fiber Roof Insulation Board
 - C728-05 Perlite Thermal Insulation Board
 - C1177/C1177M-08 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - C1278/C1278M-07 Standard Specification for Fiber-Reinforced Gypsum Panel
 - C1289-10 Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
 - C1396/C1396M-09 Standard Specification for Gypsum Board
 - D41-05 Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
 - D312-06 Asphalt Used in Roofing
 - D1970-09 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - D2178-04 Asphalt Glass Felt Used in Roofing and Waterproofing
 - D2822-05 Asphalt Roof Cement
 - D4586-07 Standard Specification for Asphalt Roof Cement, Asbestos-Free

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- E84-09.....Standard Test Method for Surface Burning Characteristics of Building Material
- F1667-05.....Driven Fasteners: Nails, Spikes, and Staples
- D. FM Approvals: RoofNav Approved Roofing Assemblies and Products.
 - 4450-89Approved Standard for Class 1 Insulated Steel Deck Roofs
 - 4470-10Approved Standard for Class 1 Roof Coverings
 - 1-28-09Loss Prevention Data Sheet: Design Wind Loads.
 - 1-29-09Loss Prevention Data Sheet: Above-Deck Roof Components
 - 1-49-09Loss Prevention Data Sheet: Perimeter Flashing
- E. National Roofing Contractors Association: Roofing and Waterproofing Manual
- F. U.S. Department of Agriculture (USDA): USDA BioPreferred Catalog, www.biopreferred.gov
- G. Underwriters Laboratories, Inc. (UL): Fire Resistance Directory (2009)
- H. U.S. Department of Commerce National Institute of Standards and Technology (NIST):
 - DOC PS 1-09U.S. Product Standard for Construction and Industrial Plywood
 - DOC PS 2-04Performance Standard for Wood-Based Structural-Use Panels.

1.4 PERFORMANCE REQUIREMENTS

- A. Thermal Performance: Provide roof insulation meeting minimum overall average R-value of 33, with minimum R-value at any location of 10.
- B. FM Approvals: Provide roof insulation complying with requirements in FM Approvals 4450 and 4470 as part of specified roofing system, listed in FM Approvals "RoofNav" as part of roofing system meeting Fire/Windstorm Classification in Division 07 roofing section.

1.5 QUALITY CONTROL

- A. Requirements of Division 07 roofing section for qualifications of roofing system insulation Installer; Work of this Section shall be performed by same Installer.
- B. Requirements of Division 07 roofing section for inspection of Work of this Section and qualifications of Inspector.
- C. Unless specified otherwise, comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to insulation for storage, handling, and application.
- D. Requirements of roofing system uplift pressure design for specified roofing system.
- E. Requirements of applicable FM Approval for specified roofing system insulation attachment.
- F. Requirements of applicable Miami-Dade County approval for high-wind zone design.
- G. Bio-Based Materials: Where applicable, provide products designated by USDA and meeting or exceeding USDA recommendations for bio-based content, and products meeting Rapidly Renewable Materials and certified sustainable wood content definitions; refer to www.biopreferred.gov.

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ROOF AND DECK INSULATION

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
 - 1. Asphalt and adhesive materials, each type.
 - 2. Roofing cement, each type.
 - 3. Roof insulation, each type.
 - 4. Substrate board, each type.
 - 5. Cover board, each type.
 - 6. Fastening requirements.
 - 7. Insulation span data for flutes of metal decks.
- C. LEED and Federal Sustainable Design Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 - 2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 3. Product Data for Federally-Mandated Bio-Based Materials: For roof materials, indicating USDA designation and compliance with definitions for bio-based products, Rapidly Renewable Materials, and certified sustainable wood content.
- D. Shop Drawings: Include plans, sections, details, and attachments.
 - 1. Nailers, cants, and terminations.
 - 2. Layout of insulation showing slopes, tapers, penetration, and edge conditions.
- E. Samples:
 - 1. Roof insulation, each type.
 - 2. Nails and fasteners, each type.
- F. Certificates:
 - 1. Indicating type, thermal conductance, and minimum and average thickness of insulation.
 - 2. Indicating materials and method of application of insulation system meet the requirements of FM Approvals for specified roofing system.
- G. Laboratory Test Reports: Thermal values of insulation products.
- H. Layout of tapered roof system showing units required.
- I. Documentation of supervisors' and inspectors' qualifications.

1.7 DELIVERY, STORAGE AND MARKING

- A. Comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to built-up roofing for storage, handling and installation requirements.

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ROOF AND DECK INSULATION

1.8 QUALITY ASSURANCE:

- A. Roof insulation on combustible or steel decks shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E84, or shall have successfully passed FM Approvals 4450.
 - 1. Insulation bearing the UL label and listed in the UL Building Materials Directory as meeting the flame spread and smoke developed ratings will be accepted in-lieu-of copies of test reports.
 - 2. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the particular type used for this project and the construction is listed as fire-classified in the UL Building Materials Directory or listed as Class I roof deck construction in the FM Approvals "RoofNav."
 - 3. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

PART 2 - PRODUCTS

2.1 ADHESIVE MATERIALS

- A. Adhesive Materials, General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane.
 - 1. Liquid-type adhesive materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Multipurpose Construction Adhesives: 70 g/L.
 - c. Fiberglass Adhesives: 80 g/L.
 - d. Contact Adhesives: 80 g/L.
 - e. Other Adhesives: 250 g/L.
 - f. Nonmembrane Roof Sealants: 300 g/L.
 - g. Sealant Primers for Nonporous Substrates: 250 g/L.
 - h. Sealant Primers for Porous Substrates: 775 g/L.
- B. Primer: ASTM D41.
- C. Asphalt: ASTM D312, Type III or IV for vapor retarders and insulation.
- D. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphaltic, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.

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ROOF AND DECK INSULATION

- E. Bead-Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- F. Full-Spread Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- G. Roof Cement: Asbestos free, ASTM D2822, Type I or Type II, ; or, D4586, Type I or Type II.

2.2 ROOF AND DECK INSULATION

- A. Roof and Deck Insulation, General: Preformed roof insulation boards approved by roofing manufacturer and listed as component of FM Approvals-approved roofing system.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- C. Cellular Glass Board Insulation: ASTM C552, Type IV, kraft-paper sheet faced.
- D. Perlite Board Insulation: ASTM C728, expanded perlite, cellulosic fibers, binders, and waterproofing agents with top surface seal coated.
- E. Cellulosic Fiber Board Insulation: ASTM C208, Type II, Grade 1 for built-up asphalt or modified bitumen roofing Grade 2 for single-ply roofing.
- F. Tapered Roof Insulation System:
 - 1. Fabricate of mineral fiberboard, polyisocyanurate, perlite board, or cellular glass. Use only one insulation material for tapered sections. Use only factory-tapered insulation.
 - 2. Cut to provide high and low points with crickets and slopes as shown.
 - 3. Minimum thickness of tapered sections; 38 mm (1-1/2 inch).
 - 4. Minimum slope 1:48 (1/4 inch per 12 inches).
- G. Composite Nail Base Insulated Roof Sheathing:
 - 1. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: polyisocyanurate thermal insulation ASTM C1289, Type V, insulation thickness as indicated, with oriented strand board laminated to top surface.
 - 2. Oriented Strand Board: NBS DOC PS 1, Exposure 1, 11 mm (7/16 inch) 15.9 mm (5/8 inch)thick.
 - 3. Bottom surface faced with felt facers.

2.3 INSULATION ACCESSORIES

- A. Glass (Felt): ASTM D2178, Type VI, heavy duty ply sheet.
- B. Cants and Tapered Edge Strips:
 - 1. Wood Cant Strips: Refer to Division 06 Section "Rough Carpentry."
 - 2. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
 - 3. Tapered Edge Strips: 1:12 (one inch per foot), from 0 mm (0 inches), 300 mm to 450 mm (12 inches to 18 inches) wide.

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ROOF AND DECK INSULATION

- a. Cellulosic Fiberboard: ASTM C208.
 - b. Mineral Fiberboard: ASTM C726.
 - c. Perlite Board: ASTM C728.
- C. Vapor Retarder:
1. Glass-Fiber Felts: ASTM D2178, Type IV, asphalt impregnated.
 2. Self-Adhering Sheet Vapor Retarder: ASTM D1970, minimum of 1.0-mm- (40-mil-) thick, polyethylene film laminated to layer of rubberized asphalt adhesive, or 0.76- to 1.0-mm- (30- to 40-mil-) thick, polyethylene film laminated to layer of butyl rubber adhesive; maximum permeance rating of 6 ng/Pa x s x sq. m (0.1 perm).
- D. Substrate Board: (N/A)
1. Type X gypsum board, ASTM C1396/C1396M, 16 mm (5/8 inch) thick.
 2. Glass-mat, water-resistant gypsum substrate, ASTM C1177/C1177M, //13 mm (1/2 inch)// //Type X, 16 mm (5/8 inch)// thick, factory primed.
 3. Cellulosic-fiber-reinforced, water-resistant gypsum substrate, ASTM C1278/C1278M, //6 mm (1/4 inch)// //10 mm (3/8 inch)// //13 mm (1/2 inch)// //16 mm (5/8 inch)// thick.
 4. Perlite Board Insulation, ASTM C728, //(19 mm (3/4 inch)// //25 mm (1 inch)//.
- E. Cover Board: (N/A)
1. Glass-mat, water-resistant gypsum substrate, ASTM C1177/C1177M, //6 mm (1/4 inch)// //13 mm (1/2 inch)// //16 mm (5/8 inch)// thick, factory primed.
 2. Cellulosic-fiber-reinforced, water-resistant gypsum substrate, ASTM C1278/C1278M, //6 mm (1/4 inch)// //10 mm (3/8 inch)// //13 mm (1/2 inch)// //16 mm (5/8 inch)// thick.
 3. Cellulosic-fiber insulation board, ASTM C208, Type II, Grade 2, 13 mm (1/2 inch) thick.
 4. Oriented Strand Board, DOC PS 2, Exposure 1, 11 mm (7/16 inch) thick.

2.4 FASTENERS

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with FM Approvals 4470, designed for fastening substrate board to roof deck.
- B. Staples and Nails: ASTM F1667. Type as designated for item anchored and for substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Comply with requirements of Division 07 roofing section.

3.2 PREPARATION

- A. Comply with requirements of Division 07 roofing section.

3.3 SUBSTRATE BOARD INSTALLATION

- A. Fasten substrate board to top flanges of steel deck to resist uplift pressures according to roofing system manufacturers instructions and requirements of FM Approvals listing for specified roofing system.

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3.4 VAPOR RETARDER INSTALLATION

- A. General:
 - 1. Install continuous vapor retarder on roof decks where indicated.
 - 2. At vertical surfaces, turn up vapor retarder to top of insulation or base flashing.
 - 3. At all pipes, walls, and similar penetrations through vapor retarder, seal openings with roof cement to prevent moisture entry from below.
 - 4. Seal penetrations with roof cement.
- B. Cast in Place Concrete Decks, Except Insulating Concrete:
 - 1. Prime deck as specified.
 - 2. Apply two plies of asphalt saturated felt mopped down to deck.
- C. Precast Concrete Unit Decks Without Concrete Topping:
 - 1. Prime deck as specified.
 - 2. Apply two plies of asphalt saturated felt.
 - 3. Mop to deck, keeping bitumen 100 mm (four inches) away from joints of precast units. Bridge joints with felt. Mop between plies as specified.
- D. Steel Deck:
 - 1. Material and method of application of roofing systems used on metal decks shall meet the requirements of FM Approvals for Class I-A Insulated Steel Roof Deck.
 - 2. Attach substrate board and subsequent components to meet the requirements of FM Approval's "RoofNav" listing for specified system meeting Fire/Windstorm Classification indicated in Division 07 roofing section.
 - 3. Locate the long dimension edge joints to have solid bearing on top of decking ribs; do not cantilever over rib openings or flutes.

3.5 RIGID INSULATION INSTALLATION

- A. Insulation Installation, General:
 - 1. Install roof insulation in accordance with roofing system manufacturer's written instructions.
 - 2. Install roof insulation in accordance with requirements of FM Approval's Listing for specified roofing system.
 - 3. Base Sheet: Where required by roofing system, install one lapped base sheet specified in Division 07 roofing section by mechanically fastening to roofing substrate prior to installation of insulation.
 - 4. Cant Strips: Install //preformed insulation cant strips// //wood cant strips specified in Division 06 Section ROUGH CARPENTRY// at junctures of roofing system with vertical construction.
 - 5. Use same insulation as existing for roof repair and alterations unless specified otherwise.
- B. Insulation Thickness:

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ROOF AND DECK INSULATION

1. Thickness of roof insulation shown on drawings is nominal. Actual thickness shall provide the average thermal resistance "R" value of not less than that specified in Performance Requirements Article.
2. Insulation on Metal Decks: Provide minimum thickness of insulation for metal decks recommended by the insulation manufacturer to span rib opening (flute size) of metal deck used. Support edges of insulation on metal deck ribs.
3. When thickness of insulation to be used is more or less than that shown on the drawings, make adjustments in the alignment and location of roof drains, flashing, gravel stops, fascias and similar items at no additional cost to the Government.
4. Where tapered insulation is used, the thickness of the insulation at high points and roof edges shall be as shown on the drawings; the thickness at the low point (drains) shall be not less than 38 mm (1-1/2 inches).
5. Use not less than two layers of insulation when insulation is 68 mm (2.7 inch) or more in thickness unless specified otherwise. Stagger joints minimum 150 mm (6 inches).
- C. Lay insulating units with close joints, in regular courses and with cross joints broken. When laid in more than one layer, break joints of succeeding layers of roof insulation with those in preceding layer.
- D. Lay units with long dimension perpendicular to the rolled (longitudinal) direction of the roofing felt.
- E. Seal all cut edges at penetrations and at edges against blocking with bitumen or roof cement.
- F. Cut to fit tight against blocking or penetrations.
- G. Cover all insulation installed on the same day; comply with temporary protection requirements of Division 07 roofing section.
- H. Installation Method:
 1. Adhered Insulation:
 - a. Prime substrate as required.
 - b. Set each layer of insulation firmly in solid mopping of hot asphalt.
 - c. Set each layer of insulation firmly in ribbons of bead-applied insulation adhesive.
 - d. Set each layer of insulation firmly in uniform application of full-spread insulation adhesive.
 2. Mechanically Fastened Insulation:
 - a. Fasten insulation in accordance with FM Approval's "RoofNav" requirement in Division 07 roofing section.
 - b. Fasten insulation to resist uplift pressures specified in Division 07 roofing section.
 3. Mechanically Fastened and Adhered Insulation:
 - a. Fasten first layer of insulation according to "Mechanically Fastened Insulation" requirements.
 - b. Fasten each subsequent layer of insulation according to "Adhered Insulation" requirements.

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ROOF AND DECK INSULATION

4. Cover Board: Install cover boards over insulation with long joints in continuous straight lines with staggered end joints. Offset cover board joints from insulation joints minimum 150 mm (6 inches). Fasten cover boards according to "Mechanically Fastened Insulation" requirements.

END OF SECTION

SECTION 07 24 00

Exterior Insulation and Finish System

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Stairs with concrete treads.
- B. Stairs with grating treads.
- C. Prefabricated stairs.
- D. Structural steel stair framing and supports.
- E. Handrails and guards.
- F. Prefabricated stair treads and nosings.

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Includes substrate preparation and materials and application of the exterior insulation and finish system.

1.2 RELATED SECTIONS

- A. Section 03 3000 - Cast-In-Place Concrete: Substrate for exterior insulation and finish system.
- B. Section 04 2000 - Unit Masonry: Substrate for exterior insulation and finish system. Strike joints flush where exterior insulation and finish system and Finisher are to be applied. Finisher applied to surfaces of concrete unit masonry.
- C. Section 06 1000 - Rough Carpentry: Wood blocking for support of the exterior insulation and finish system.
- D. Section 06 1600 - Sheathing: Exterior insulation and finish system applied over structural sheathing. Refer to Wall Type Schedule in Drawings.
- E. Section 07 1000 - Waterproofing and Damp proofing: Application of fluid-applied weather barrier prior to application of the exterior insulation and finish system. Refer to Wall Type Schedule in Drawings.
- F. Section 07 6000 - Flashing and Sheet Metal: Metal flashings installed in conjunction with the application of the exterior insulation and finish system.
- G. Section 07 9200 - Sealants: Sealing of joints in exterior insulation and finish system.
- H. Section 08 4100 - Aluminum Entrance Doors and Storefront Framing: Coordination of aluminum framing erection with the application of the exterior insulation and finish system. Protection of the aluminum finish and glazing during application of the exterior insulation and finish system.
- I. Section 08 4250 - Automatic Entrance Doors: Coordination of automatic entrance door installations with the application of the exterior insulation and finish system. Protection of the aluminum finish and glazing during application of the exterior insulation and finish system.
- J. Section 08 5200 - Aluminum Windows: Coordination of aluminum window installations with the application of the exterior insulation and finish system. Protection of the aluminum finish and glazing during application of the exterior insulation and finish system.

1.3 QUALITY ASSURANCE

- A. Before shipment of any materials all items shall be inspected to determine that materials and workmanship conform to the requirements of these Specifications.
- B. All finish materials must be ordered and shipped at the same time to insure sequential batches.
- C. All finishes must be installed in sequential batches.
- D. Applicator Certification: All bids are to be accompanied by a current copy of Certified Application Certificate.
- E. Applicator Qualifications: Provide names and locations of at least five (5) successfully completed projects where scope of work and magnitude is similar to and comparable to this project.
 - 1. Contractor: Shall be knowledgeable in the proper installation of the Dryvit Insulation Plus System and shall be experienced and competent in the installation of exterior insulation and finish systems. Additionally, the contractor shall possess a current insulation Plus trained* contractor certificate, issued by Dryvit.
 - 2. Provide copy of current and in good standing EIFS liability insurance.

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Exterior Insulation and Finish System

3. Applicator shall Provide evidence of "EIFSsmart" certification as provided by the Association of Walls and Ceilings (AWCI).
- F. Insulation Board Manufacturer: Shall be listed by Dryvit Systems, Inc., shall be capable of producing the Expanded Polystyrene (EPS) in accordance with the current Dryvit Specification for Insulation Board, DSI3I, and shall subscribe to the Dryvit Third Party Certification and Quality Assurance Program.
- G. Field-Constructed Mock-Up: Prior to installation of exterior insulation and finish systems with Drainages, erect mockups for each form of wall construction, including a window configuration with proper wall penetration preparation and associated flashings per code, EIFS termination detailing at grade, transition to dissimilar cladding I trim, floor line expansion joint and transitions at soffit I coping I roof conditions, typical joints and/or rustication type joints, etc., and finish required to verify selections made under sample submittals. Build mock-ups to comply with the following requirements, using materials indicated for final work:
 1. Locate mock-ups on site in location and of size indicated or, if not indicated, as directed by the Architect.
 2. Obtain the Architect's acceptance of mock-up's visual qualities before start of final work.
- H. Regulatory Requirements:
 1. The EPS shall be separated from the interior of the building by a minimum 15-minute thermal barrier.
 2. The use and maximum thickness of EPS shall be in accordance with the applicable building code(s).
 3. The insulation Plus MD System shall be recognized for the intended use by the applicable building code(s).
- I. Qualifications
 1. System Manufacturer: Shall be Dryvit Systems, Inc. All materials shall be manufactured or sold by Dryvit and shall be purchased from Dryvit or its authorized distributors.
 - a. Materials shall be manufactured at a facility covered by a current ISO 9001:2008 and ISO 14000:2004 certification. Certification of the facility shall be done by a registrar accredited by the American National Standards Institute, Registrar Accreditation Board (ANSI-RAB).
 2. Contractor shall be knowledgeable in the proper installation of the Dryvit insulation Plus MD System and shall be experienced and competent in the installation of Exterior Insulation and Finish Systems. Additionally, the contractor shall possess a current insulation Plus MD System Trained Contractor Certificate* issued by Dryvit Systems, Inc.

1.4 SYSTEM DESCRIPTION

- A. General: The Dryvit Outsulation Plus MD System is an Exterior Insulation and Finish System (EIFS), Class PB, consisting of a water-resistive barrier coating (air/water-resistive barrier), an adhesive, expanded polystyrene insulation board, base coat, reinforcing mesh(es) and finish.
- B. Methods of installation:
 1. Field Applied: The Outsulation Plus MD System is applied to the substrate system in place.
 2. Panelized: The Outsulation Plus MD System is shop-applied to the prefabricated wall panels.
- C. Design Requirements:
 1. Acceptable substrate as detailed in Drawings and specified herein.
 2. Deflection of the substrate systems shall not exceed 1/240 times the span.
 3. The substrate shall be flat within 1/4 in in a 4 ft radius.
 4. The slope of inclined surfaces shall not be less than 6:12, and the length shall not exceed 12 inches.
 5. All areas requiring an impact resistance classification higher than "standard", as defined by ASTM E 2486 (formerly EIMA Standard 101.86), shall be as detailed in the Drawings
 6. Expansion Joints:

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Exterior Insulation and Finish System

- a. Design and location of expansion joints in the Outsulation Plus MD System shall be as detailed in the Drawings. Expansion joints shall be placed at the following locations:
 - I. Where expansion joints occur in the substrate system.
 - II. Where building expansion joints occur.
 - III. At floor lines in wood frame construction.
 - IV. At floor lines of non-wood framed buildings where significant movement is expected.
 - V. Where the Outsulation Plus MD System abuts dissimilar materials.
 - VI. Where the substrate type changes.
 - VII. Where prefabricated panels abut one another.
 - VIII. In continuous elevations at intervals not exceeding 75ft.
 - IX. Where significant structural movement occurs, such as changes in roofline, building shape or structural system.
7. Terminations:
 - a. Prior to applying the Dryvit Outsulation Plus MD System, wall openings shall be treated with Dryvit Aqua Flash System or Flashing Tape. Refer to Dryvit Outsulation Plus MD Installation Details (DS110).
 - b. The insulation Plus MD System shall be held back from adjoining materials around openings and penetrations such as windows, doors, and mechanical equipment a minimum of 19mm (3/4in) for sealant application.
 - c. The system shall be terminated a minimum of 8 inches above finished grade.
 - d. Sealant: As specified under Section 07 9200.
8. Flashing: Shall be provided at all roof-wall intersections, windows, doors, chimneys, decks, balconies and other areas as necessary to prevent water from entering behind the Outsulation Plus MD System.

1.5 SUBMITTALS

- A. Product Data: Submit the manufacturer's product data sheets describing products, which will be used on this project.
- B. Samples: Submit two (2) samples of the insulation Plus MD System for each finish, texture and color to be used on the project. The same tools and techniques proposed for the actual installation shall be used. Samples shall be of sufficient size to accurately represent each color and texture being utilized on the project.
- C. Test Reports: When requested, the contractor shall submit to the owner/architect copies of selected test reports verifying the performance of the Outsulation Plus MD System.
- D. Substitutions: Substitute manufacturers/products must meet the requirement of the specified product as a minimum. The minimum requirements of the substitute product are:
 1. Performance.
 2. Durability.
 3. Structural, tensile bond (ASTM C 297/E2134) and transverse wind load (ASTM E 330).
 4. Impact resistance (ASTM E 2486).

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All Dryvit materials shall be delivered to the job site in the original, unopened packages with labels intact.
- B. Upon arrival, materials shall be inspected for physical damage, freezing or overheating. Questionable materials shall not be used.
 1. Materials shall be stored at the jobsite in a cool, dry location, out of direct sunlight, protected from weather and other sources of damage. Storage temperature(s) for materials shall be as recommended by the system manufacturer.
- C. Protect all products from inclement weather and direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements

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1. Application of wet materials shall not take place during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
 2. At the time of application, the minimum air and wall surface temperatures shall be as required by the system manufacturer for the substrate involved and the material being applied.
- B. Existing Conditions: Provide electric power, clean water and a clean work area at the location where the exterior insulation and finish system is to be applied.

1.8 SEQUENCING AND SCHEDULING

- A. Installation of the Outsulation Plus MD System shall be coordinated with other construction trades.
- B. Sufficient manpower and equipment shall be employed to ensure a continuous operation, free of cold joints, scaffold lines, texture variations, etc.

1.9 WARRANTY

- A. Dryvit Systems, Inc. shall provide a written warranty against manufacturing defects for a period of ten (10) years from the Date of Substantial Completion, provided that the system was installed in accordance with manufacturer's requirements and that the surface integrity of the system has been maintained. Materials shall have been purchased from a Dryvit authorized distributor. The warranty shall cover:
 1. Loss of bond.
 2. Peeling, flaking, chipping, fade and water resistance.
 3. The system will effectively drain any incidental water which may enter the cavity between the insulation board and the Dryvit water-resistive barrier coating which is applied directly over the sheathing.
- B. Workmanship shall be warranted for a period of one (1) year from the Date of Substantial Completion.

1.10 MAINTENANCE

- A. Maintenance and repair shall follow the procedures noted in the Dryvit Outsulation Plus MD System Application Instructions, DS2 I 8.
- B. All Dryvit products are designed to require minimal maintenance. However, as with all building products, depending on location, some cleaning may be required. See Dryvit publication OS152 on Cleaning and Recoating.
- C. Sealants and Flashings shall be inspected on a regular basis and repairs made as necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. All components of the Outsulation Plus MD System shall be supplied or obtained from Dryvit or its authorized distributors. Substitutions or additions of materials other than specified will void the warranty.
- B. Refer to Paragraph 1.05 D and Section 01600 for manufacturer substitution requirements.

2.2 MATERIALS

- A. Portland Cement: Shall be Type I or II, meeting ASTM C 150, white or gray in color, fresh and free of lumps.
- B. Water: Shall be clean and free of foreign matter.

2.3 COMPONENTS

- A. Air/Water-Resistive Barrier Components:
 1. Dryvit Backstop® NT: A flexible, polymer-based non cementitious water-resistive coating and air barrier available in texture and smooth.

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2. Dryvit Grid Tape™: An open weave fiberglass mesh tape with pressure sensitive adhesive available in rolls 4 inches wide by 100yards Jong.
3. Dryvit Backstop DMS: A sprayable single step water-resistive membrane/air barrier and adhesive.
- B. Flashing Materials: Used to protect substrate edges at terminations.
 1. Liquid Applied: An extremely flexible water-based polymer material, ready for use.
 - a. Shall be Aqua Flash and Aqua Flash Mesh
 2. Sheet Type:
 - a. Shall be Flashing Tape and Surface Conditioner
 - I. Dryvit Flashing Tape™: A high density polyethylene film backed with a rubberized asphalt adhesive available in rolls 4 inch, 6 inch, 9 inch wide by 75 ft Jong.
 - II. Dryvit Flashing Tape Surface Conditioner™: A water-based surface conditioner and adhesion promoter for the Dryvit Flashing Tape.
- C. Dryvit AP Adhesive™: A moisture cure, urethane-based adhesive used to adhere the Dryvit Drainage Strip and Drainage Track.
- D. Drainage Track: UV treated PVC "J" channel perforated with weep holes, complying with ASTM D 1784 and ASTM C1063. Drainage track usage is limited to the base of the system at finished grade level. All other horizontal terminations shall utilize the Dryvit Drainage Strip as shown in Outsulation Plus MD Installation Details, DS110. Shall be one of the following:
 1. Starter Trac STWP -without drip edge by Plastic Components, Inc.
 2. Starter Trac STDE -with drip edge by Plastic Components, Inc.
 3. Universal Starter Track by Wind-lock Corporation
 4. Sloped Starter Strip with Drip by Vinyl Corp.
- E. Dryvit Drainage Strip™: A corrugated plastic sheet material, which provides drainage.
- F. Adhesives: Used to adhere the EPS to the air/water-resistive barrier, shall be compatible with the water-resistive barrier and the EPS.
 1. Cementitious: A liquid polymer-based material, which is field mixed with Portland cement.
 - a. Shall be Primus, Genesis or Genesis® FM.
 2. Ready mixed: A dry blend cementitious, copolymer-based product, field mixed with water.
 - a. Shall be Primus® DM, Genesis® OM, Genesis® OMS, Rapidry OM 35-50 or Rapidry DM 50-75
- G. Insulation Board: Expanded Polystyrene meeting Dryvit Specification for Insulation Board,DS131.
 1. Thickness of insulation board shall be minimum 1 inch.
 2. The insulation board shall be manufactured by a board supplier listed by Dryvit Systems, Inc.
- H. Base Coat: Shall be compatible with the EPS insulation board and reinforcing mesh(es).
 1. Cementitious: A liquid polymer-based material, which is field mixed with Portland cement.
 - a. Shall be Primus, Genesis or Genesis FM
 2. Non cementitious: A factory-mixed, fully formulated, water-based product.
 - a. Shall be NCB
 3. Ready mixed: A dry blend cementitious, copolymer-based product, field mixed with water.
 - a. Shall be Primus OM, Genesis DM, Genesis DMS, Rapidry DM 35-50orRapidry DM 50-75.
- I. Reinforcing Mesh: A balanced, open weave, glass fiber fabric treated for compatibility with other system materials.

NOTE: Reinforcing meshes are classified by impact resistance and specified by weight and tensile strength.

 1. Shall be Standard, Standard Plus, Intermediate, Panzer 15, Panzer 20, Detail and Corner Mesh
 2. Shall be colored blue for product identification bearing the Dryvit logo.
- J. Finishes: Shall be the type, color and texture as called for in the Drawings.
 1. Provide Standard DPR (Dirt Pickup Resistance): Water-based, acrylic coating with integral color and texture and formulated with DPR chemistry. Finish texture(s) shall be as indicated on the Drawings.
- K. Coatings, Primers and Sealers: As required for the particular system application and substrate(s) involved.

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Exterior Insulation and Finish System

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of the Outsulation Plus MD System, the contractor shall verify that the substrate:
 - 1. Is compatible with the system to be applied.
 - 2. Is flat within 1 /4 inches in a 4 ft radius.
 - 3. Is sound, dry, connections are tight; has no surface voids, projections, or other conditions that may interfere with the Outsulation Plus MD System installation or performance.
- B. Prior to installation of the Outsulation Plus MD System, verify that all needed flashings and other waterproofing details have been completed, if such completion is required prior to the Outsulation Plus MD application. Additionally, verify that:
 - 1. Metal/aluminum roof flashing has been installed in accordance with Asphalt Roofing Manufacturers Association (ARMA) Standards.
 - 2. Openings are flashed in accordance with the Outsulation Plus MD System Installation Details, DS110, or as otherwise necessary to prevent water penetration.
 - 3. Contiguous items have been properly flashed.
 - 4. Windows, Doors, etc. are installed and flashed per manufacturers' requirements.
- C. Prior to the installation of the Outsulation Plus MD System, correct all discrepancies that would be detrimental to the application and performance of the finish system.

3.2 PREPARATION

- A. The Outsulation Plus MD materials shall be protected by permanent or temporary means from inclement weather and other sources of damage prior to, during, and following application until completely dry.
- B. Protect adjoining work and property during Outsulation Plus MD installation.
- C. The substrate shall be prepared as to be free of foreign materials, such as oil, dust, dirt, form-release agents, efflorescence, paint, wax, water repellants, moisture, frost, and any other condition that may inhibit adhesion.

3.3 INSTALLATION

- A. The system shall be installed in accordance with the most current Dryvit Outsulation Plus MD System Application Instructions.
- B. The overall minimum base coat thickness shall be sufficient to fully embed the mesh. As a minimum, apply the base coat in two (2) passes.
- C. Sealant shall not be applied directly to textured finishes or base coat surfaces. Dryvit Outsulation Plus MD System surfaces in contact with sealant shall be coated with Demandit or Color Prime.
- D. High impact meshes shall be installed to a height of 6'-0" above grade at ground level building perimeter, which include high traffic areas and other areas exposed to or susceptible to impact damage.

3.4 FIELD QUALITY CONTROL

- A. Be responsible for the proper application of the Outsulation Plus MD materials.
- B. If required, the contractor shall certify in writing the quality of work performed relative to the substrate system, details, installation procedures, workmanship and as to the specific products used.

3.5 CLEANING

- A. All excess Outsulation Plus MD System materials shall be removed from the job site by the contractor in accordance with contract provisions and as required by applicable law.
- B. All surrounding areas, where the Dryvit Outsulation Plus MD System has been applied, shall be left free of debris and foreign substances resulting from the contractor's work.

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3.6 PROTECTION

- A. The Outsulation Plus MD System shall be protected from inclement weather and other sources of damage until dry and permanent protection in the form of flashings, sealants, etc. are installed.

END OF SECTION

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Under-Slab Vapor Barrier

PART 1 – GENERAL

1.1 SUMMARY

- A. Products Supplied Under This Section
 - 1. Vapor Barrier, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.
- B. RELATED SECTIONS
 - 1. Section 03300 Cast-in-place Structural Concrete
 - 2. Section 07260 Under-Slab Vapor Retarder

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM E 1745-97 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
 - 2. ASTM E 154-88 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
 - 3. ASTM E 96-95 Standard Test Methods for Water Vapor Transmission of Materials
 - 4. ASTM E 1643-98 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- B. American Concrete Institute (ACI)
 - 1. ACI 302.1R-96 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick

1.3 SUBMITTALS

- A. Quality Control / Assurance
 - 1. Independent laboratory test results showing compliance with ASTM & ACI Standards.
 - 2. Manufacturer's samples, literature
 - 3. Manufacturer's installation instructions for placement, seaming and pipe boot installation

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Vapor Barrier
 - 1. Vapor Barrier must have the following qualities
 - a. Permeance of 0.012 (WVTR of 0.006 gr/ft²/hr) or less as tested by ASTM E 96
 - b. ASTM E 1745 Class A (Plastics)
 - 2. Vapor Barrier Products
 - a. **Stego Wrap** (10 mil) Vapor Barrier by **STEGO INDUSTRIES LLC**, San Juan Capistrano, CA (877) 464-7834 www.stegoindustries.com
 - b. W.R. Meadows Premoulded Membrane with Plasmatic Core.
 - c. Zero-Perm by Alumiseal.

2.2 ACCESSORIES

- A. Seam Tape
 - 1. Tape must have the following qualities:
 - a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower
 - 2. Seam Tape

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Under-Slab Vapor Barrier

- a. Stego Tape by **STEGO INDUSTRIES LLC**, San Juan Capistrano, CA (877) 464-7834 www.stegoindustries.com
- B. Vapor Proofing Mastic
 - 1. Mastic must have the following qualities:
 - a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower
 - 2. Mastic
 - a. Stego Mastic by **STEGO INDUSTRIES LLC**, San Juan Capistrano, CA (877) 464-7834 www.stegoindustries.com
- C. Pipe Boots
 - 1. Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Ensure that subsoil is approved by architect or geotechnical firm
 - 1. Level and tamp or roll aggregate, sand or tamped earth base.

3.2 INSTALLATION

- A. Install Vapor Barrier/Retarder:
 - 1. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643-98.
 - 2. See Architectural Wall Section Reference for Heavy 10 Mill Thick Plastic Vapor Barrier.
 - a. Unroll Vapor Barrier/Retarder with the longest dimension parallel with the direction of the pour.
 - b. Lap Vapor Barrier/Retarder over footings and seal to foundation walls.
 - c. Overlap joints 6 inches and seal with manufacturer's tape.
 - d. Seal all penetrations (including pipes) per manufacturer's instructions.
 - e. No penetration of the Vapor Barrier/Retarder is allowed except for reinforcing steel and permanent utilities.
 - f. Repair damaged areas by cutting patches of Vapor Barrier/Retarder, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION

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Firestopping

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Includes materials and installation of the firestopping. Refer to attached firestopping drawing for typical areas of installation. This Drawing is not to be considered as inclusive of all areas of installation.
- B. Code Requirements: The intent and extent of firestopping work is described in governing Local and State Building Codes and Amendments thereto. Comply with all requirements of therein, except where more restrictive are described herein.
- C. Firestopping is required to prevent the passage of flame and products of combustion through concealed spaces and openings including, but not limited to, the following:
 - 1. Openings above fire-rated walls or partitions indicated to extend to underside of structure above ceilings.
 - 2. Openings in concealed furred spaces behind finished wall surfaces.
 - 3. Openings around pipes, conduits, ducts, and other construction passing through wall, floor and roof construction and fire-rated assemblies.
 - 4. Openings in locations that would permit the free travel of flame and products of combustion through fire-rated assemblies.
 - 5. Openings related to mechanical and electrical panels and systems, and all other construction that penetrates or in any other way interrupts fire-rated wall, floor and roof assemblies.
- D. Refer to the U.L. Approved System Schedules (Paragraph 2.0 I) for additional requirements.

1.2 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
 - 1. ASTM International:
 - a. ASTM C411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - b. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - c. ASTM C661 Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
 - d. ASTM C920 Standard Specification for Elastomeric Joint Sealants.
 - e. ASTM C 1299 Standard Guide for Use in Selection of Liquid-Applied Sealants.
 - f. ASTM C1338 Standard Test Method for Fungi Resistance of Insulation Materials and Facings.
 - g. ASTM D149 Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
 - h. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
 - i. ASTM D3045 Standard Practice for Heat Aging of Plastics Without Load.
 - j. ASTM D5510 Standard Practice for Heat Aging of Oxidatively Degradable Plastics.
 - k. ASTM D6620 Standard Practice for Asbestos Detection Limit Based on Counts.
 - l. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - m. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - n. ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
 - o. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - p. ASTM E 1966 Standard Test Method for Fire-Resistive Joint Systems.
 - q. ASTM E2174 Standard Practice for On-Site Inspection of Firestop Systems.

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- r. ASTM E2307 Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using the Intermediate Scale, Multi-Story Test Apparatus.
- s. ASTM E2336 Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- t. ASTM E2393 Standard Practice for On-Site Inspection of installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- u. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- 2. Underwriters Laboratories, Inc.(UL):
 - a. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - b. UL910 Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air.
 - c. UL 1479 Fire Tests of Through-Penetration Firestops.
 - d. UL 1978 (Sections 12 & 13) Grease Ducts.
 - e. UL 2079 Standard for Tests for Fire Resistance of Building Joint Systems.
- 3. National Fire Protection Association (NFPA):
 - a. NFPA 70 National Electric Code.
 - b. NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - c. NFPA 101 Life Safety Code.
 - d. NFPA 5000 Building Construction and Safety Code.
- 4. International Association of Plumbing and Mechanical Officials(IAPMO):
 - a. Uniform Mechanical Code(UMC).
 - b. Uniform Plumbing Code(UPC).
- 5. International Code Council(ICC):
 - a. International Building Code(IBC).
 - b. International Fire Code(IFC).
 - c. International Mechanical Code(IMC).

1.3 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Provide products which have been tested in accordance with ASTM E 119 (or UL263, ANSI A2.1 or NFPA 251) for fire resistance and rated by UL or other industry-recognized agency for required resistances.
- B. Surface-Burning Ratings: Provide products which have been tested and listed by UL for required surface burning characteristics (flame spread, fuel contributed, smoke developed) in accordance with ASTM E 84.
 - 1. General Rating: Except as otherwise indicated, provide complete installations with maximum flame spread of 25.
- C. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- D. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity, trained and authorized by the manufacturer to install the specified products as follows:
- E. Regulatory Requirements and Approvals: Specify applicable requirements of regulatory agencies.
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA 101 Life Safety Code.
 - b. NFPA 70 National Electric Code.
 - c. NFPA 5000 Building and Construction Code.
- F. International Association of Plumbing and Mechanical Officials(IAPMO):
 - 1. Uniform Mechanical Code(UMC).
 - 2. Uniform Plumbing Code(UPC).
- G. International Code Council (ICC):
 - 1. International Building Code.

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2. International Mechanical Code.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications and installation instructions for each type of material and application method required. Submit data in accordance with Section 01340.
- B. Certified Test: For each material, submit certified test reports on performances including (as applicable) heat Resisting and burning characteristics, densities, compressive strengths, and thermal insulating values.

1.5 SEQUENCING AND COORDINATION

- A. Integrate the scheduling/coordination of work of this section with other units of work so that this work will not be damaged, will be installed prior to installation of enclosing or concealing work, and will be installed as soon as practicable.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturer: 3M Fire Protection Products, Building and Commercial Services Division.
- B. Proprietary Products/Systems: Firestop materials, including the following:
 1. 3M Fire Barrier CP25WB+ Caulk:
 - a. Material Description: intumescent latex/water based caulk.
 - b. Formulation: No-sag, non-halogen formula. Fast drying. Paintable.
 - c. Fire Resistance Capability: Provide up to 4 hour fire resistance rating.
 2. 3M FireDam 150+Acrylic Latex Caulk:
 - a. Material Description: Single part, water based, acrylic latex sealant.
 - b. Formulation: High flowrate, no-sag formula. One-part system. Low shrinkage. Paintable.
 - c. Fire Resistance Capability: Provide up to 3-hour fire resistance rating.
 3. 3M FireDam Spray200:
 - a. Material Description: Water based, capable of drying to tough elastomeric coating. Paintable.
 - b. Compression/Extension Recovery: +/- 25% of original joint width.
 4. 3M Fire Barrier [1000 N/S] [1003 S/L] Silicone Sealant:
 - a. Material Description: [Non-slump formula (1000) for floor and wall openings] [Self-leveling formula (1003) for floor openings].
 - b. Hardness (ASTM C661): [1000 N/S: 20 - 25] [1003 S/L: 10 - 15].
 - c. Service Temperature (ASTM C299): -60 - 300 degrees F (-51 - 149 degrees C).
 5. 3M Fire Barrier [2000] [2003] Silicone Sealant:
 - a. Material Description: [Non slump (2000) for top-of-wall/head-of-wall joints] [Self-leveling (2003)].
 - b. Service Flexibility: Accommodate vibration from normal building movement.
 - c. Pipe Size Capability: Maximum pipe size of 24 inches (610 mm).
 - d. Compression/Extension Recovery: +/- 31% of original joint width.
 6. 3M Fire Barrier 2000+ Silicone Sealant:
 - a. Material Description: Remain elastic, weather resistant in use.
 - b. Fire Resistance Capability: Provide up to 4-hour fire resistance rating.
 - c. Compression/Extension Recovery: +/- 15% of original joint width.
 7. 3M Fire Barrier 2001 Silicone RTV Foam:
 - a. Material Description: Two-part, liquid-silicone elastomer, foams in place when mixed.
 - b. Cure Time: Cure in 1 - 5 minutes to form an elastic compression seal.
 - c. Electrical Characteristics: No ampacity derating of cables.
 8. 3M Fire Barrier 3000 WT Silicone Sealant:
 - a. Material Description: Premium, ready-to-use, single component, neutral cure, non-slumping, intumescent silicone sealant.

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- b. Formulation: High flowrate, no-sag formula. One-part system.
 - c. Fire Resistance Capability: Provide up to 3-hourfireresistance rating.
9. 3M Ultra Plastic Pipe Device:
 - a. Material Description: Intumescent and endothermic material.
 - b. Configuration: One-piece metal collar, with locking latch and bendable tabs to secure; equipped also for conventional anchoring.
 - c. Fire Resistance Capability: Provide up to 3-hourfireresistance rating. J
10. 3M Ultra RC Pack:
 - a. Material Description: Intumescent and endothermic material.
 - b. Configuration: One-piece metal collar assembly encasing Ultra GS intumescent material
 - c. Fire Resistance Capability: Provide up to 2 hour fire resistance rating
11. 3M Jnteram Ultra GS:
 - a. Material Description: Graphite based, large lying organic, flexible. intumescent and endothermic mat. used with 3MFire Barrier RC-I Restricting Collar.
 - b. Size: 40 foot (12m) roll.
 - c. Free Expansion:25times.
 - d. Surface Burning Characteristics (ASTM E84, UL723): Flame spread index0, smoke development index5.
12. 3M FireBarrier FS-195+Wrap/Strip:
 - a. Material Description: One-part, organic/inorganic intumescent elastomeric strip with foil on one side Capable of being cut to fit irregular shapes. Re-enterable.
 - b. Size:24 inch (610 mm) strips, [1 inch (25.4 mm)] [2inches (51 mm)] wide.
13. 3M Fire Barrier RC-I Restricting Collar:
 - a. Material Description: 28 gauge steel.
 - b. Compatibility: Works in conjunction with3MFS-195+ Wrap/Strip or3M Jnteram Ultra GS. Required for firestopping plastic pipes larger than 4 inches (102 mm) in diameter
 - c. Size:25 foot (7.6 m) roll.
14. 3MFireBarrier Moldable Putty+:
 - a. Material Description: One-part, 100%solidsintumescent firestop, capable of remaining pliable, flexible and easily re-enterable.
 - b. Formulation: Non-halogen, nontoxic synthetic elastomer formula.
 - c. Type: [Sticks][Pads].
15. 1 5. 3M FireBarrier CS-195+ Composite Sheet:
 - a. Material Description: Organic/inorganic intumescent elastomeric sheet, bonded on one side to a layer of 28 gauge galvanized steel. Other side reinforced with steel-wire mesh and covered with aluminum foil. Re-enterable.
 - b. Fire Resistance Capability: Up to 4 hours.
16. 3M FireBarrier Mortar:
 - a. Material Description: Lightweight cementitious firestop, capable of adhesion bonds to concrete, metals, wood, plastic and cable jacketing. Re-enterable.
 - b. Formulation: Contains no asbestos.
 - c. Mix Ratio: Variable mix ratio, capable of permitting self-leveling and no-sag application consistencies.
17. 3M FireBarrier IC 15WB+Sealant:
 - a. Material Description: intumescent latex based caulk.
 - b. Formulation: No-sag, non-halogen formula. Fast drying. Paintable.
 - c. Fire Resistance Capability: Provide up to 2-hourfireresistance rating.
18. 3M FireBarrier Pillow:
 - a. Material Description: Self-contained, highly intumescent firestop product.
 - b. Fire Resistance Capability: Provide up to 3 hours fire resistance rating with no wire mesh.
19. 3M FireBarrier self-locking Pillow:
 - a. Material Description: Self-contained, highly intumescent firestop product with interlocking strips to hold pillows together.

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- b. Fire Resistance Capability: Provide up to 3 hours fire resistance rating with no wire mesh.
- 20. 3M Fire Barrier Pass Through Devices:
 - a. Material Description: Intumescent firestop sleeve.
 - b. Configuration: One-piece metal sleeve, with intumescent firestop component.
 - c. Fire Resistance Capability: Provide up to 3 hours fire resistance rating for plastic and metal pipes.
- 21. 3M Fire Barrier 136 Sealant:
 - a. Material Description: One component, non-combustible sealant.
 - b. Formulation: High flowrate, Non sag formulation, one-part system.
 - c. Fire Resistance Capability: Meets applicable fire blocking building code requirements
- 22. 3M Fire Barrier Cast-in-Place Devices:
 - a. Material Description: Cast-in-place devices to be used before a concrete pour. Easy height adjustment with pull tabs, straight edge design for close placement to walls and other devices.
 - b. Fire Resistance Capability: Provide up to 3 hours fire resistance rating for plastic and metal pipes.
 - c. Assembly: Adapters for fluted metal deck, height adapters for pours greater than 8 inches (203 mm), tub box assembly.
- 23. 3M Fire Barrier Cast-in-Place Devices:
 - a. Material Description: Cast-in-place devices to be used before a concrete pour. Easy height adjustment with pull tabs, straight edge design for close placement to walls and other devices.
 - b. Fire Resistance Capability: Provide up to 3 hours fire resistance rating for plastic and metal pipes.
 - c. Assembly: Adapters for fluted metal deck, height adapters for pours greater than 8 inches (203 mm), tub box assembly.
- 24. 3M Interam E-5 Series Mat:
 - a. Material Description: Combination of organic and inorganic materials. Outdoor durable, with [Stainless steel] [Aluminum] backing.
 - b. Type: Endothermic through chemical absorption of heat energy to protect structural steel, cable trays and circuits in conduits.
 - c. Fire Resistance Capability: Provide up to 3 hours of electrical circuit protection.
- 25. 3M Interim T-49 Tape:
 - i. Material Description: 3 mil (0.076 mm) aluminum foil with acrylic adhesive, designed to perform in high temperatures. Designed to seal cut edges of 3M Interam Mats and 3M FireMaster Duct Wrap to complete the total encapsulation.
- 26. 3M Fire Barrier Duct Wrap 615+:
 - a. Material: Inorganic blanket encapsulated with a scrim-reinforced foil.
 - b. Type and Size: Roll, [2 inches x 24 inches x 25 feet] [2 inches x 48 inches x 25 feet].
 - c. Fire Resistance Capability: Provide up to a 3 hour rating.
 - d. Combustibility (ASTM E 136): Noncombustible.

2.2 ACCESSORIES

- A. For each application provide manufacturer's standard board-anchorage system complying with related UL Design, and as indicated.
- B. Provide accessory products and materials as follows:
 - 1. Aluminum Foil Tape: Type and Size: Acceptable to wrap material manufacturer.
 - 2. Filament Tape: Width: Minimum 3/4 inch (19.1 mm).
 - 3. Banding Material and Banding Clips:
 - a. Material: Carbon steel or stainless steel.
 - b. Width: Minimum 1/2 inch (12.7 mm).
 - c. Thickness: Minimum 0.015 inch (0.38 mm).

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4. Insulation Pins:
 - a. Material: Copper-coated steel.
 - b. Size: Minimum 12 gauge.
5. Speed Clips:
 - a. Material: Galvanized steel.
 - b. Type and Size: Minimum 1/2 inches (38mm) square or 1 1/2 inches (38 mm) diameter round or equivalent sized insulated cup-headpins.
6. Access Door Hardware:
 - a. Type: Threaded rods with 1/4 inch (6.4 mm) wingnuts and 1/4 inch (6.4mm) washers.
 - b. Material: Galvanized steel.
 - c. Diameter: 1/4 inch (6.4mm).
 - d. Length: 4 1/2 inches - 5 inches (114 - 127mm).
7. Access Door Hardware:
 - a. Type: Hollow tubing to fit threaded rods.
 - b. Material: Steel.
 - c. Length: 4 inches (102 mm).
8. Miscellaneous Anchorage Hardware: Type, Size and Material: Acceptable to firestop manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Examine substrates and conditions under which work is to be performed, and correct all unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Architect.
- B. Ensure that surfaces of all openings and penetrating items are clean, dry, frost-free and free of dust, oil, grease, release compounds, incompatible primers, loose scale or other deleterious conditions.
- C. Review required firestopping with governing authority (building official). Before proceeding with installation, obtain approval of thicknesses and installation methods, including extension of typical details for coverage of nontypical locations.

3.2 INSTALLATION

- A. General
 1. Comply with manufacturer's instructions for particular conditions of installation in each case. Consult with manufacturer's technical representative for conditions not covered by printed instructions.
 2. Provide firestopping material and number of layers as required to provide indicated ratings (hours of fire endurance protection). Where not otherwise indicated, comply with UL Designs as required by governing regulations. In multiple-layer work, offset joints by 6".
 3. Anchor firestopping to substrate with manufacturer's recommended anchorage system and in compliance with UL Designs. Space anchors and anchor supports (if any) as indicated by applicable.
 - a. Selection of Anchorage system in Contractor's option where not otherwise indicated; comply with applicable UL Designs.
 4. Install firestopping without gaps and voids. Do not use damaged materials. Remove and replace mis fitted work.
 5. install fire resistance sealant to seal around penetrations through fire rated assemblies.

3.3 COORDINATION AND PROTECTION

- A. Coordinate installation of firestopping with other work to minimize cutting into or removal of installed
- B. Firestopping by other trades. As trades successively complete installations which have been damaged or removed. Maintain complete coverage of full thickness in locations to be protected.

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Firestopping

- C. Protection: Advise Contractor of protection requirements for work, which will ensure that his work will be without damage or deterioration at time of Substantial Completion of project. Provide protection from harmful exposures. Repair or replace work which has been damaged prior to that date.

3.4 FIELD QUALITY CONTROL

- A. Site Tests: Owner may engage a qualified independent testing agency to inspect installation of fire protection systems and to prepare test reports.
 - 1. In the event work is found to be non-compliant, immediately remove non-compliant work.
 - 2. Repair or replace work so as to bring it into compliance with the specified requirements.
- B. Inspection: Proceed with enclosing firestop systems only after inspection by the independent testing agency and approval by authorities having jurisdiction.
- C. Identification: Identify firestopping and fire protection systems with pressure sensitive, self-adhesive vinyl labels applied to both sides of the assembly, readily visible, depicting the following information:
 - 1. The words: "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Installing contractor's name, address and phone number.
 - 3. System designation of applicable testing and inspection agency.
 - 4. Date of installation.
 - 5. Firestop system manufacturer's name.

3.05 CLEANING

- A. Clean off all excess fill materials adjacent to openings as work progresses by methods and with cleaning materials recommended and approved by firestop systems manufacturer and that do not damage materials in the openings in which they occur.

END OF SECTION

Fluid-Applied Weather Barriers**FLUID-APPLIED WEATHER BARRIERS**

DuPont™ Tyvek® Fluid Applied WB System

PART 1 - GENERAL**1.1 SECTION INCLUDES**

(Specifier Note: "Weather barrier system" has been used throughout the document. A weather barrier is a weather resistant membrane for vertical building envelope protection that will maintain air/moisture resistance while maintaining moisture-vapor permeability and is interchangeable with the term fluid-applied air-barrier system. The system consists of the following components.)

- A. Fluid-applied, vapor permeable weather barrier membrane. *(DuPont™ Tyvek® Fluid Applied WB System.)*
- B. Joint Treatment:
 - 1. Joint Tape.
 - 2. Joint Compound. *(DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound, trowel grade)*
- C. Flashing:
 - 1. Vapor Permeable Fluid-Applied Elastomeric Flashing. *(DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound or DuPont™ Tyvek® Fluid Applied Flashing – Brush Grade, as manufactured by DuPont™)*
 - 2. Flexible Flashing. *(DuPont™ FlexWrap™NF)*
 - 3. Sheet Flashing. *(DuPont™ StraightFlash™)*
- D. Sealant. *(DuPont™ Sealant for Tyvek® Fluid Applied Systems)*
- E. Primers for flexible flashing and sheet flashing.

1.2 REFERENCES

- A. ASTM International
 - 1. ASTM C 1250 – Standard Test Method for Nonvolatile Content of Cold Liquid-Applied Elastomeric Waterproofing Membranes.
 - 2. ASTM D 412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - 3. ASTM D 2240 – Standard Test Method for Rubber Property – Durometer Hardness.
 - 4. ASTM D 4541 – Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers.
 - 5. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. ASTM E 96 - Test Method for Water Vapor Transmission of Materials
 - 7. ASTM E 283 – Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen.
 - 8. ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylight, Doors and Curtain Walls by Uniform Static Air Pressure Differences.
 - 9. ASTM E 779 – Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
 - 10. ASTM E 783 – Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors.
 - 11. ASTM E 1105 – Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
 - 12. ASTM E 1186 – Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
 - 13. ASTM E 1677 - Specification for Air Retarder Material or System for Framed Building Walls.
 - 14. ASTM E 2178 – Standard Test Method for Air Permeance of Building Materials
 - 15. ASTM E 2357 – Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
 - 16. ASTM G155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.
 - 17. ASTM C 1305 - Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane.

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- B. AATCC – American Association of Textile Chemists & Colorists
 - 1. Test Method 127 Water Resistance: Hydrostatic Pressure Test.
- C. TAPPI
 - 1. Test Method T-460; Air Resistance of Paper (Gurley Hill Method).

1.3 SUBMITTALS

(Specifier Note: When project is being submitted for USGBC LEED™ certification, contact DuPont™ Tyvek® Product Representative for assistance in determining how the use of weather barriers can assist in obtaining credits. ADD submittal requirements as required.)

- A. Refer to Section [01 33 00 Submittal Procedures] [insert section number and title].
- B. Product Data: Submit manufacturer's current technical literature for each component.
- C. Quality Assurance Submittals:
 - 1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
 - 2. Manufacturer Instructions: Provide manufacturer's written installation instructions.

(Specifier Note: Weather barrier field service reports are recommended for all projects and may be required by manufacturers on projects where warranties are specified. Verify requirements with manufacturer. DELETE requirement if not project specific.)

- 3. Manufacturer's Field Service Reports: Provide site reports from authorized field service representative, indicating observation of weather barrier system installation.

(Specifier Note: When DuPont™ Weatherization Products 10 Year Limited Product Warranty is not specified, DELETE closeout warranty submittal requirement.)

- D. Closeout Submittals:
 - 1. Refer to Section [01 78 00 Closeout Submittals] [insert section number and title].
 - 2. Weather Barrier Warranty: Manufacturer's executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer shall have experience with installation of commercial fluid-applied weather barrier assemblies under similar conditions.
 - 2. Installer shall be trained and certified for installation by manufacturer.
- B. Installation shall be in accordance with manufacturer's installation guidelines and recommendations.
- C. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.
- D. Mock-up:

(Specifier Note: Mock-ups are recommended for all projects and may be required by manufacturers on projects where special warranties are specified. Verify requirements with manufacturer. DELETE or EDIT mock-up requirements for specific project.)

- 1. Install mock-up using approved weather barrier system including membrane, flashing, joint and detailing compound and related weather barrier accessories according to weather barrier manufacturer's current printed instructions and recommendations.
 - a. Mock-up size: [10 feet by 10 feet] [insert size].
 - b. Mock-up Substrate: Match wall assembly construction, including window opening.
 - c. Mock-up may [not] remain as part of the work.

(Specifier Note: Visual inspection by manufacturer's designated representative is recommended for all projects and may be required by WB manufacturer on projects where a warranty is specified. Verify requirements with manufacturer prior to completion of specification. DELETE or EDIT inspection requirements for specific project.)

- 2. Contact manufacturer's designated representative prior to weather barrier system installation, to perform required mock-up visual inspection and analysis as required for warranty.

- E. Pre-installation Meeting
 - 1. Refer to Section [01 31 19 Project Meetings] [insert section number and title].

(Specifier Note: A pre-installation meeting is recommended for all projects where warranties are specified. Verify requirements with manufacturer prior to completion of specification. DELETE or EDIT pre-installation requirements for specific project.)

Fluid-Applied Weather Barriers

2. Hold a pre-installation conference, two weeks prior to start of weather barrier installation. Attendees shall include Contractor, Architect, certified installer, Owner's Representative, and weather barrier manufacturer's designated field representative.
3. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier system materials and components, installer's training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section [01 60 00 Product Requirements] [insert section number and title].
- B. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store weather barrier materials as recommended by manufacturer.

1.6 SCHEDULING

(SPECIFIER NOTE: **THE PREFERRED ORDER OF INSTALLATION FOR WEATHER BARRIER IS PRIOR TO THE INSTALLATION OF WINDOWS AND DOORS.**)

- A. Review requirements for sequencing of installation of weather barrier system with installation of windows, doors, louvers and flashings to provide a weather-tight barrier system.
- B. Schedule installation of exterior cladding within nine months of weather barrier system installation.

1.7 WARRANTY

- A. Refer to Section [01 78 36 Warranties] [insert section number and title].

(**Specifier Note:** Manufacturer warranty program - The DuPont™ Tyvek® Fluid Applied WB offers a 10 Year Limited Product Warranty Program that is project specific and requires pre-installation meetings and jobsite observations by the manufacturer. Include warranty language only when manufacturer's limited product warranty program is to be used. To receive coverage under the DuPont™ Tyvek® Fluid Applied WB Product 10 Year Limited Product Warranty Program, it is required that the following conditions are met; the use of manufacturer's recommended installation methods, a DuPont™ Certified Installer, required mock-up and pre-construction meetings and observation visits during installation along with required submittal and post installation documentation process. Please refer to: www.weatherization.TYVEK.com for complete details on the DuPont™ Tyvek® Fluid Applied WB 10 Year Limited product warranty program.)

- B. Limited Warranty
 1. Manufacturer's warranty for weather barrier for a period of ten (10) years from date of Purchase.
 2. Pre-installation meeting and jobsite observations by weather barrier manufacturer for warranty are required.
 3. Warranty Areas: [Describe specific areas of work protected and areas of work excluded as required by project conditions].

PART 2 - PRODUCTS

(SPECIFIER NOTE: **PRODUCT INFORMATION LISTED IS PROPRIETARY TO DUPONT BUILDING INNOVATIONS – DUPONT™ TYVEK® FLUID APPLIED WB PRODUCTS. IF ADDITIONAL PRODUCTS ARE REQUIRED FOR COMPETITIVE PROCUREMENT, CONTACT DUPONT BUILDING INNOVATIONS FOR ASSISTANCE.**)

2.1 WEATHER BARRIER

- A. Manufacturer: DuPont Building Innovations; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1.800.44TYVEK (8-9835); <http://weatherization.tyvek.com>
 1. Description: A single-component, low VOC, 25 mil thick synthetic polymer fluid-applied product with superior elasticity and flexibility providing resistance to air flow, bulk water and wind driven rain yet allows moisture vapor to escape.
 2. Basis of Design: DuPont™ Tyvek® Fluid Applied WB System; including DuPont™ Tyvek® Fluid Applied WB, DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound, DuPont™ Tyvek® Fluid Applied Flashing – Brush Grade and DuPont™ Sealant for Tyvek® Fluid Applied Systems.

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(SPECIFIER NOTE: **ADDITIONAL SELF-ADHERED FLASHING PRODUCTS FROM DUPONT™ FLASHING SYSTEMS MAY BE ADDED AS NEEDED FOR MASONRY OR STUD-FRAME SILL-PAN OR OTHER USES AS REQUIRED.**

B. Performance Characteristics:

1. Air Penetration Resistance (Material):
 - a. 0.0002 cfm/ft² at 75 Pa, when tested in accordance with ASTM E 2178.
 - b. Air infiltration greater than 10,000 seconds per 100cc, when tested in accordance with TAPPI Test Method T-460.
2. Air Penetration Resistance (System / Assembly):
 - a. ≤ 0.01 cfm/ft² at 75 Pa, when tested in accordance with ASTM E 2357.
 - b. ≤ 0.01 cfm/ft² at 75 Pa, Type I Air Barrier, when tested in accordance with ASTM E 1677.
3. Water Vapor Transmission: 25 perms, when tested in accordance with ASTM E 96, Method B at 25 mils DFT (Dry Film Thickness).
4. Water Penetration Resistance: Greater than 1000 cm when tested in accordance with AATCC Test Method 127. No leakage at 15 psf when tested in accordance with ASTM E 331.
5. Tensile Strength: Minimum 169 lbs/in², when tested in accordance with ASTM D 412.
6. Estimated Elongation: 420% in accordance with ASTM D 412.
7. Hardness: Passes at a Shore A hardness of 71, when tested in accordance with ASTM D 2240.
8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84. Flame Spread: 25, Smoke Developed: 25.
9. UV Resistance: 9 months
10. Volatile Organic Content (VOC): Less than 2% (25-30 g/L) when measured in accordance with ASTM C 1250.
11. Adhesion Strength (Concrete): Greater than 33 psi when measured in accordance with ASTM D 4541.
12. Low Temperature Crack Bridging: Pass, when tested in accordance with ASTM C 1305.

2.2 ACCESSORIES

A. Joint Treatment:

1. Joint Tape:
 - a. Product: Self-adhered fiberglass mesh tape as recommended by weather barrier manufacturer.
2. Joint Compound: Fluid-applied, vapor permeable, elastomeric flashing material; trowel applied.
 - a. Product: DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound

B. Flashing:

(**Specifier Note:** Flashing is dependent upon construction conditions. DELETE products that are unnecessary and inappropriate for specific project. Vapor permeable elastomeric flashing is used around openings in walls and joints between different building materials.)

1. Vapor permeable fluid-applied elastomeric flashing:

(**Specifier Note:** *DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound is the preferred product for use around openings in commercial construction.*)

- a. Product: [DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound] or [DuPont™ Tyvek® Fluid Applied Flashing – Brush Grade, as manufactured by DuPont™].

AND/OR

2. Flexible flashing with butyl adhesive layer.

(**Specifier Note:** *DuPont™ FlexWrap™ NF and DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound products are acceptable for use around openings in commercial construction.*)

- a. Product: DuPont™ FlexWrap™ NF.

(**Specifier Note:** Sheet Flashing is used at transitions between wall material, building corners, and over gaps in sheathing up to 1 inch wide.)

3. Sheet flashing with butyl adhesive layer.

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- a. Product: DuPont™ StraightFlash™.
- C. Sealant: Elastomeric; non-vapor permeable sealant; compatible with weather barrier.
 - 1. Product: DuPont™ Sealant for Tyvek® Fluid Applied Systems.
- D. Primers for flexible flashing and sheet flashing:
 - 1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.

(Specifier Note: *Products listed below are only recommendations for inclusion when required and should be EDITED for specific project.*)

- 2. Products:
 - a. 3M High Strength 90
 - b. Denso Butyl Spray
 - c. SIA 655
 - d. Permagrip 105
 - e. ITW TACC Sta' Put SPH

(Specifier Note: *SIA product meets California VOC requirements.*)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.2 PREPARATION

- A. Complete surface preparation, priming, flashing and detailing of openings, cracks, and material transitions prior to beginning installation of fluid-applied weather barrier system.
- B. Surfaces shall be clean and free of frost, oil, grease, mold and efflorescence prior to application of fluid-applied weather barrier system.

3.3 INSTALLATION - DETAILING

(Specifier Note: *Either option for preparation of corners is acceptable to manufacturer, select one and delete the other.*)

- A. Corners: [Apply fluid-applied joint compound, 25 mil thick, to outside and inside corners. Joint compound shall extend 2 inches from corner for full height of corner] or [Apply primer to outside and inside corners, extend 2 inches on each side of corner. Center sheet flashing over corner and press firmly in place per manufacturer's recommendations].
- B. Joint treatment:

(Specifier Note: *Verify that sheathing on project is an acceptable material to apply weather barrier. Acceptable substrates are gypsum, OSB or plywood sheathing, masonry or concrete.*)

- 1. Sheathing:
 - a. Joints shall be prepared per manufacturer's approved joint treatment details.
 - b. Apply joint tape as recommended by fluid-applied weather barrier manufacturer.
 - 1) No joint treatment required for joints up to 1/16 inch.
 - 2) Joints 1/16 to 1/4 inch: Fluid-applied joint compound applied to form a 1 inch width on each side of sheathing joint; smooth joint compound across sheathing joint. Thickness shall be 15 to 25 mils.
 - 3) Joints 1/16 to 1/2 inch: Apply joint tape to bridge both sides of joint equally. Apply fluid-applied joint compound and trowel smooth embedding joint compound uniformly into joint tape to form a 1 inch width on each side of sheathing joint at a consistent thickness of 15 to 25 mils.
 - 4) Joints 1/2 to 1 inch: Apply sheet flashing primer above and below sheathing joint. Center sheet flashing over sheathing joint and press firmly in place per manufacturer's recommendations.
- 2. Non-movement joints in masonry and transitions to columns and beams:
 - a. Joints 1/4 inch wide or less: Apply fluid-applied joint compound a minimum of 2 inches wide by 60 mils thick to each side of joint or crack.

(Specifier Note: *Either option for preparation of joints is acceptable to manufacturer, select one and delete the other.*)

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- b. Joints 1/4 to 1/2 inch: [Apply joint tape to joint, then apply joint compound to joint 2 inches wide by 60 mils thick.] or [Apply primer 2 inches on each side of joint. Center sheet flashing over joint and press firmly in place per manufacturer's recommendations.]
- C. Apply fluid-applied joint compound to cladding anchors prior to installation of weather barrier membrane per manufacturer's instructions.
- D. Apply fluid-applied joint compound around penetrations in exterior walls forming a fillet bead minimum 1/2 inch onto each surface.

(Specifier Note: Opening preparation and flashing installation is dependent upon the construction of the opening and construction of the window. DELETE execution requirements that are not appropriate for specific project. COORDINATE proper design and detailing at windows, doors and other openings or intersections in accordance with window manufacturer guidelines, industry standards and best flashing and waterproofing practices.)

(Specifier Note: Vapor permeable fluid-applied elastomeric flashing is the preferred application around openings in walls)

- E. Installation – Vapor permeable fluid-applied elastomeric flashing at openings:
 - 1. At jambs and head of rough opening: Apply 25 mil thickness of fluid-applied flashing to full depth of opening and 2 inches onto outside face of opening.
 - 2. At sills: Apply primer to substrates as recommended by manufacturer. Cut sheet flashing to fit directly between jambs of opening. Install sheet flashing to full width of sill opening and down onto outside face of opening a minimum of 2 inches. Cover sheet flashing with 25 mil thickness of vapor permeable fluid-applied elastomeric flashing per fluid-applied weather barrier manufacturer's instructions.

OR

- F. Installation – Self-adhered flexible and sheet flashing at openings:
 - 1. Prime substrates as recommended by self-adhered sheet membrane flashing manufacturer. Cut flexible flashing a minimum of 12 inches longer than length of sill rough opening.
 - 2. Cover horizontal sill by aligning flexible flashing so that 2 inches will extend onto the face of the wall. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure sheet membrane tightly into corners by working in along the sill before adhering up the jambs.
 - 3. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place.
 - 4. Apply 9-inch wide strips of sheet flashing at jambs. Align sheet flashing so that 2 inches will extend onto the face of the wall. Start sheet flashing at head of opening and lap sheet membrane at sill.
 - 5. Install flexible flashing at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
 - 6. Coordinate flashing with fluid-applied weather barrier and window installation.
- G. Allow Fluid-Applied Flashing, Joint Compound and Sealant to cure for minimum 24 hours before coating with Fluid-applied Weather Barrier.

3.4 INSTALLATION - FLUID-APPLIED WEATHER BARRIER

- A. Install fluid-applied weather barrier prior to installation of windows, doors, and louvers.
- B. Mask and protect any adjacent finished surfaces from fluid-applied weather barrier material.
- C. Install fluid-applied weather barrier over exterior face of required exterior wall substrates in accordance with weather barrier manufacturer recommendations and instructions.

(Specifier Note: Power-rolling is the preferred method of application of weather barrier. When using spray applied application, weather barrier must be backrolled.)

- D. Install fluid-applied weather barrier by [power-rolling method] [or] [spray and backrolling method] to achieve 25 mils providing a consistent and uniform thickness.
- E. Repair any voids, holidays, or non-uniform installations or damage by other trades to proper mil thickness prior to installation of final cladding assemblies.

3.5 FIELD QUALITY CONTROL

(Specifier Note: Field observation by a manufacturer designated representative is recommended for all projects and may be required by manufacturers on projects where warranties are specified. Verify requirements with manufacturer. DELETE or EDIT field quality control requirements for specific project.)

- A. Notify weather barrier manufacturer's designated representative to obtain [required] periodic observations of weather barrier system installation.

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- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections as required in Contract Documents.
 - C. Inspections: Weather barrier materials, accessories, and installation are subject to inspection for compliance with performance requirements.
- (Specifier Note: EDIT as required for the specific project)**
- D. Tests: As determined by Owner's testing agency from among the following tests:
 - 1. Quantitative Air-Leakage Testing: Weather barrier assemblies will be tested for air infiltration according to ASTM E 783.
 - 2. Quantitative Air-Leakage Testing: Whole building air leakage will be tested in accordance with ASTM E 779, ASTM E 1827 or equivalent.
 - 3. Qualitative Air-Leakage Testing: Weather barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186.
 - 4. Qualitative Water-Leakage Testing: Weather barrier assemblies will be tested for water leakage according to ASTM E 1105.
 - E. Weather barriers assemblies will be considered defective upon failure of inspections and specific project testing required.
 - 1. Apply additional fluid-applied weather barrier material, in accordance with manufacturer's instructions, where inspection results indicate insufficient thickness, voids, skips, pinholes or other defects as recommended by weather barrier manufacturer.
 - 2. Remove and replace deficient weather barrier system components for retesting as specified above.
 - F. Repair damage to weather barriers caused by destructive testing; follow manufacturer's written instructions.

3.6 PROTECTION AND CLEANING

- A. Protect weather barrier from contact with incompatible materials and sealants not approved per weather barrier manufacturer's recommendation.
- B. Protect installed weather barrier system from damage during construction prior to cladding installation.
 - 1. If damaged or exposed to UV beyond nine (9) months, clean and prepare surfaces and install additional, full-thickness, fluid-applied weather barrier application in accordance with weather barrier manufacturer's instructions.
- C. Remove masking materials and adjacent protection after weather barrier installation.

END OF SECTION

DISCLAIMER:

DuPont Building Innovations Guide Specifications have been written as an aid to the professionally qualified Specifier and Design Professional. The use of this Guideline Specification requires the sole professional judgment and expertise of the qualified Specifier and Design Professional to adapt the information to the specific needs for the Building Owner and the Project, to coordinate with their Construction Document Process, and to meet all the applicable building codes, regulations and laws. DUPONT EXPRESSLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE OF THIS PRODUCT FOR THE PROJECT.

SECTION 07 4150

Preformed Aluminum Soffit Panels, Solid and Vented

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. This section covers the pre-finished, pre-fabricated Factory Manufactured Aluminum or Steel Soffit System. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings are part of this section
- B. Related Work Specified Elsewhere
 - 1. Roof Deck structural steel, flat roof systems, preformed metal standing seam roofing, perimeter edge systems, included in this section roof hatches, firestopping not

1.2 QUALITY ASSURANCE

- A. Petersen Aluminum Corp products establish a minimum of quality required.
 - Petersen Aluminum Corp, Elk Grove Village, IL, 800-323-1960
 - Petersen Aluminum Corp, Annapolis Junction, MD, 800-344-1400
 - Petersen Aluminum Corp, Tyler, TX, 800-441-8661
 - Petersen Aluminum Corp, Acworth, GA, 800-272-4482
- B. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.
- C. Sheet Metal Industry Standard: Comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Architectural Sheet Metal Manual.
- D. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.

1.3 SUBSTITUTIONS

- A. The material, products and equipment specified in this section establish a standard for required function, dimension, appearance and quality to be met by any proposed substitution.

1.4 SYSTEM DESCRIPTION

- A. Material to comply with:
 - 1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate - .032 & .040 Aluminum

1.5 SOFFIT SYSTEM PERFORMANCE TESTING

- A. Soffit System shall be designed to meet Standard Building Code wind load requirements.
- B. Soffit System shall be designed to meet applicable Local Building Code and the Soffit System shall have been tested by the Manufacturer per ASTM E-330 and have the applicable Load Tables published from this Air Bag testing for negative loads.

1.6 WARRANTIES

- A. Finish warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace soffit panels that show evidence of deterioration of factory-applied finish within specified warranty period.
 - 1. Exposed Panels Finish – deterioration includes the following:
 - a. Color fading more than 5 hunter units when tested according to
 - b. ACSHaTIMkinDg2in24e4xcress of a No. 8 rating when tested according to ASTM D 4214
 - c. Cracking, checking, peeling or failure of a paint to adhere to a bare metal.
 - 2. Warranty Period: 30 Years from the date of substantial completion

1.7 SUBMITTALS

- A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation.
- B. Provide finish samples of all colors specified.

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- C. LEED Submittals
 - 1. Product data for Credit MR 4.1 and credit MR 4.2: Indicating the percentages by weight of postconsumer and preconsumer recycled content for products having recycled content

1.7 DELIVERY, STORAGE AND HANDLING

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

1.8 PROJECT CONDITIONS

- A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication

PART 2 – PRODUCTS

2.1 PANEL DESIGN

- A. Soffit panels shall be Reveal Panel, in 12" widths with 1" height. Flush type panels can be specified panels only) in the specified cion losor l(isd) .o r with venting strips (aluminum
- B. Panels to be produced smooth.
- C. Forming: Use continuous end rolling method. No end laps on panels. No portable roll forming machines will be permitted on this project, no installer-owned or installer-rented machines will be permitted. It is the intent of the Architect to provide Factory-Manufactured panel systems only for this project.

2.2 ACCEPTABLE MANUFACTURERS

- A. This project is specified around the roofing product of Petersen Aluminum Corporation, Flush Soffit Panel.
- B. Contact: Josh Jacobi – 903-581-6229
Email: jjacobi@petersenmail.com
- C. Other acceptable manufacturers, if they comply with specification:
 - 1. IMETCO, Tucker, GA, Soffit Panel only
 - 2. ATAS Aluminum, Allentown, PA, "Wind-Lock" Panel only

2.3 MATERIALS AND FINISHES

- A. Preformed metal panels shall be fabricated .032" thick 3105-H14 aluminum, .040" thick 3105-H14 aluminum. Panels shall be Herr-Voss corrective leveled for flat appearance.
 - 1. Color shall be PAC-CLAD Kynar 500 stocked_____
- B. Finishes: Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over 0.25 to 0.31 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil. Finish shall conform to tests for adhesion, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.
- C. Field protection must be provided by the Contractor at the job site so material is not exposed to weather and moisture.
- D. If any strippable film coating is applied to any pre-finished panels or materials for protection during shipping, strippable film shall be removed prior to installation.

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- E. Forming: use continuous and rolling method. No end laps on panels. No “portable roll forming” machines will be permitted on this project; no installer-owned or installer-rented machines shall be permitted. It is the intent of the Architect to provide Factory-Manufactured soffit systems only for this project.
- F. for this project.
- G. Trim: Trim shall be fabricated of the same material and finish to match the profiled sheeting and press broken in lengths of 10 – 12 feet. Trim shall be formed only by the manufacturer or their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
- H. Accessories/Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates. Accessories and
- I. their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the wall panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces, except at designed points of roof panel fixity
- J. Zees: Where required by design of primary structural framing system, zees shall be used to span between beams and/or other joists. Thermally responsive base and top clips shall be fastened to the zees on 12” centers.
- K. Insulation: See Section 07 2100: Building Insulation.

2.4 SEALANTS

- A. Provide two-part polysulfide class B non-sag type for vertical and horizontal joints or
- B. One-part polysulfide not containing pitch or phenolic extenders or
- C. Exterior grade silicone sealant recommended by roofing manufacturer or
- D. One-part non-sag, gun grade exterior type polyurethane recommended by the roofing manufacturer.

2.5 FABRICATION

- A. Comply with dimensions, profile limitations, gauges and fabrication details shown and if not shown, provide manufacturer’s standard product fabrication.
- B. Fabricate components of the system in factory, ready for field assembly.
- C. Fabricate components and assemble units to comply with fire performance requirements specified.
- D. Apply specified finishes in conformance with manufacturer’s standard, and according to manufacturer’s instructions.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine alignment of structural steel and related supports, primary and secondary roof framing, solid roof sheathing, prior to installation.
- B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FASTENERS

- A. Secure units to supports
- B. Place fasteners as indicated in manufacturer’s standards.

3.3 INSTALLATION

- A. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years’ successful experience with similar applications.

SECTION 07 4150

Preformed Aluminum Soffit Panels, Solid and Vented

- B. Install soffit panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight, complete and architecturally pleasing installation.
- C. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.
- D. Panels attached to any TREATED LUMBER MUST HAVE AN APPROPRIATE VAPOR BARRIER INSTALLED OVER THE TREATED LUMBER PRIOR TO INSTALLING ANY SOFIT PANELS OR RELATED FLASHINGS. DO NOT ALLOW ANY METAL PRODUCTS TO COME INTO DIRECT CONTACT WITH TREATED LUMBER

3.4 DAMAGED MATERIAL

- A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

END OF SECTION

SECTION 07 54 23

Thermoplastic Polyolefin Roofing (TPO)

PART 1 -

PART 2 - GENERAL

2.1 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic Polyolefin (TPO) sheet roofing adhered to concrete roof deck.
 - 2. Manufacturer is Johns Manville Roofing System.
 - 3. JM TPO - 60 MIL Thermoplastic Polyolefin Membrane.

2.2 RELATED REQUIREMENTS

- A. Non-Flooring Adhesives and Sealants VOC Limits: Section 01 81 13.
- B. Roof Insulation: Section 07 22 00, ROOF AND DECK INSULATION.

2.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):
 - 1. FX-1-01(R2006) - Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.
- C. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
 - 1. 7-10 - Minimum Design Loads for Buildings and Other Structures.
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
 - 1. 90.1-13 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- E. ASTM International (ASTM):
 - 1. C67-14 - Sampling and Testing Brick and Structural Clay Tile.
 - 2. C140/C140M-15 - Sampling and Testing Concrete Masonry Units and Related Units.
 - 3. C1549-09(2014) - Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
 - 4. D1876-08(2015)e1 - Peel Resistance of Adhesives (T-Peel Test).
 - 5. D4263-83(2012) - Indicating Moisture in Concrete by the Plastic Sheet Method.
 - 6. D4434/D4434M-15 - Poly(Vinyl Chloride) Sheet Roofing.
 - 7. D6878/D6878M-13 - Thermoplastic Polyolefin Based Sheet Roofing.
 - 8. E408-13 - Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
 - 9. E1918-06(2015) - Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
 - 10. E1980-11 - Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- F. Cool Roof Rating Council (CRRC):
 - 1. 1-15 - Product Rating Program.
- G. National Roofing Contractors Association (NRCA):
 - 1. Manual-15 - The NRCA Roofing Manual: Membrane Roofing Systems.
- H. UL LLC (UL):
 - 1. 580-06 - Tests for Uplift Resistance of Roof Assemblies.
 - 2. 1897-15 - Uplift Tests for Roof Covering Systems.
- I. U.S. Department of Commerce National Institute of Standards and Technology (NIST):
 - 1. DOC PS 1-09 - Structural Plywood.
 - 2. DOC PS 2-04 - Performance Standard for Wood-Based Structural-Use Panels.
- J. U.S. Environmental Protection Agency (EPA):
 - 1. Energy Star - ENERGY STAR Program Requirements for Roof Products Version 3.0. (Effective July 1, 2017)

2.4 STORAGE AND HANDLING

- A. Comply with NRCA Manual storage and handling requirements.
- B. Store products indoors in dry, weathertight facility.
- C. Store adhesives according to manufacturer's instructions.
- D. Protect products from damage during handling and construction operations.

SECTION 07 54 23

Thermoplastic Polyolefin Roofing (TPO)

- E. Products stored on the roof deck must not cause permanent deck deflection.

2.5 FIELD CONDITIONS

- A. Environment: Reinforced Concrete Roof Deck at 56 ft above the Ground Floor.
 - 1. Product Temperature: Minimum 4 degrees C (40 degrees F) for minimum 48 hours before installation.
 - 2. Weather Limitations: Install roofing only during dry current and forecasted weather conditions.

PART 3 - PRODUCTS

3.1 SYSTEM DESCRIPTION

- A. Roofing System JM TPO - 60 MIL Thermoplastic Polyolefin Membrane adhered to roof deck; Manufactured by Johns Manville Roofing Systems.

3.2 SYSTEM PERFORMANCE

- A. Design roofing system complying with specified performance:
 - 1. Load Resistance: ASCE/SEI 7; Design criteria as indicated on Drawings.
 - a. Uplift Pressures: Refer to Structural Engineer. The following Loads are Unknown at the time of writing this Specification Section.
 - 1) Corner Uplift Pressure: // _____ // kPa/sq. m (// _____ // psf).
 - 2) Perimeter Uplift Pressure: // _____ // kPa/sq. m (// _____ // psf).
 - 3) Field-of-Roof Uplift Pressure: // _____ // kPa/sq. m (// _____ // psf).
 - 2. Energy Performance:
 - a. EPA Energy Star Listed for low-slope roof products.
 - b. ASTM E1980; Minimum 78 Solar Reflectance Index (SRI).
 - c. CRRRC-1; Minimum 0.70 initial solar reflectance and minimum 0.75 emissivity.
 - d. Three-Year Aged Performance: Minimum 0.55 solar reflectance tested in according to ASTM C1549 or ASTM E1918, and minimum 0.75 thermal emittance tested in according to ASTM C1371 or ASTM E408.
 - 1) Where tested aged values are not available:
 - a) Calculate compliance adjusting initial solar reflectance according to ASHRAE 90.1.
 - b) Provide roofing system with minimum 64 three-year aged Solar Reflectance Index calculated according to ASTM E1980 with 12 W/sq. m/degree K (2.1 BTU/h/sq. ft.) convection coefficient.

3.3 PRODUCTS - GENERAL

- A. Provide roof system components from one manufacturer.
- B. Sustainable Construction Requirements:
 - 1. Solar Reflectance Index: 78 minimum.
 - 2. Biobased Content: Where applicable, provide products designated by USDA and meeting or exceeding USDA recommendations for bio-based content, and products meeting Rapidly Renewable Materials and certified sustainable wood content definitions; refer to www.biopreferred.gov.
 - 3. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
 - a. Non-flooring adhesives and sealants.

3.4 TPO ROOFING MEMBRANE

- 1. TPO Sheet: ASTM D6878/D6878M, internally fabric or scrim reinforced, 1.5 mm, JM TP(60 mil) TPO Thermoplastic Membrane, with fabric backing .
- 2. Manufacturer: Johns Manville Roofing Systems.

3.5 MEMBRANE ACCESSORY MATERIALS

- A. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as TPO sheet membrane.

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Thermoplastic Polyolefin Roofing (TPO)

- B. Factory Formed Flashings: Inside and outside corners, pipe boots, and other special flashing shapes to minimize field fabrication.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Metal Termination Bars: Manufacturer's standard, stainless-steel or aluminum, 25 mm wide by 3 mm thick (1 inch wide by 1/8 inch thick) factory drilled for fasteners.
- E. Fasteners: Manufacturer's standard coated steel with metal or plastic plates, to suit application.
- F. Primers, Sealers, T-Joint Covers, Lap Sealants, and Termination Reglets: As specified by roof membrane manufacturer.
- G. Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane.

3.6 WALKWAY PADS

- A. Manufacturer's standard, slip-resistant rolls, minimum 900 mm (3 feet) wide by 5 mm (3/4 inch) thick Rubber.

3.7 ACCESSORIES

- A. Temporary Protection Materials:
 - 1. Expanded Polystyrene (EPS) Insulation: ASTM C578.
 - 2. Plywood: NIST DOC PS 1, Grade CD Exposure 1.
 - 3. Oriented Strand Board (OSB): NIST DOC PS 2, Exposure 1.

PART 4 - EXECUTION

4.1 EXAMINATION

- A. Examine and verify substrate suitability with roofing Installer and roofing inspector present.
 - 1. Verify roof penetrations are complete, secured against movement, and firestopped.
 - 2. Verify roof deck is adequately secured to resist wind uplift.
 - 3. Verify roof deck is clean, dry, and in-plane ready to receive roofing system.
- B. Correct unsatisfactory conditions before beginning roofing work.

4.2 PREPARATION

- A. Complete roof deck construction before beginning roofing work:
 - 1. Curbs, blocking, edge strips, nailers, cants, and other components to which insulation, roofing, and base flashing is attached in place ready to receive insulation and roofing.
 - 2. Coordinate roofing membrane installation with flashing work and roof insulation work so insulation and flashing are installed concurrently to permit continuous roofing operations.
 - 3. Complete installation of flashing, insulation, and roofing in same day except for the area where temporary protection is required when work is stopped for inclement weather or end of work day.
- B. Dry out surfaces // including roof deck flutes, // that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates, only.
- C. Broom clean roof decks. Remove dust, dirt and debris.
- D. Remove projections capable of damaging roofing materials.
- E. Concrete Decks, except Insulating Concrete:
 - 1. Test concrete decks for moisture according to ASTM D4263 before installing roofing materials.
 - 2. Prime concrete decks. Keep primer back 100 mm (4 inches) from precast concrete deck joints.
 - 3. Allow primer to dry before application of bitumen.
- F. Insulating Concrete Decks:
 - 1. Allow to dry out minimum five days after installation before installing roofing materials.
 - 2. Allow additional drying time when precipitation occurs before installing roofing materials.
- G. Poured Gypsum Decks: Dry out poured gypsum according to manufacturer's instructions before installing roofing materials.
- H. Existing Membrane Roofs and Repair Areas:
 - 1. Comply with requirements in Section 07 01 50.19 PREPARATION FOR REROOFING.

Thermoplastic Polyolefin Roofing (TPO)**4.3 TEMPORARY PROTECTION**

- A. Install temporary protection consisting of a temporary seal and water cut-offs at the end of each day's work and when work is halted for an indefinite period or work is stopped when precipitation is imminent.
- B. Install temporary cap flashing over top of base flashings where permanent flashings are not in place to protect against water intrusion into roofing system. Securely anchor in place to prevent blow off and damage by construction activities.
- C. Temporarily seal exposed insulation surfaces within roofing membrane.
 - 1. Apply temporary seal and water cut off by extending roofing membrane beyond insulation and securely embedding edge of the roofing membrane in 6 mm (1/4 inch) thick by 50 mm (2 inches) wide strip of temporary closure sealant. Weight roofing membrane edge with sandbags, to prevent displacement; space sandbags maximum 2400 mm (8 feet) on center.
 - 2. Direct water away from work. Provide drainage, preventing water accumulation.
 - 3. Check daily to ensure temporary seal remains watertight. Reseal open areas and weight down.
- D. Before the work resumes, cut off and discard portions of roof membrane in contact with temporary seal.
 - 1. Cut minimum 150 mm (6 inches) back from sealed edges and surfaces.
- E. Remove sandbags and store for reuse.
- F. Install according to manufacturer's recommended instructions.
- G. Comply with UL 580 or UL 1897 for uplift resistance.
- H. Do not allow membrane and flashing to contact surfaces contaminated with asphalt, coal tar, oil, grease, or other substances incompatible with TPO.

4.4 ROOFING INSTALLATION

- A. Install the membrane so the sheets run perpendicular to the long dimension of the insulation boards.
- B. Begin installation at the low point of the roof and work towards the high point. Lap membrane shingled in water flow direction.
- C. Position the membrane free of buckles and wrinkles.
- D. Roll membrane out; inspect for defects as membrane is unrolled. Remove defective areas:
 - 1. Lap edges and ends of sheets 50 mm (2 inches) or more as recommended by the manufacturer.
 - 2. Heat weld laps. Apply pressure as required. Seam strength of laps as required by ASTM D4434/D4434M.
 - 3. Check seams to ensure continuous adhesion and correct defects.
 - 4. Finish seam edges with beveled bead of lap sealant.
 - 5. Finish seams same day as membrane is installed.
 - 6. Anchor membrane perimeter to roof deck or parapet wall as indicated on drawings.
 - 7. Repair areas of welded seams where samples have been taken or marginal welds, bond voids, or skips occurs.
 - 8. Repair fishmouths and wrinkles by cutting to lay flat and installing patch over cut area extending 100 mm (4 inches) beyond cut.
- E. Membrane Perimeter Anchorage:
 - 1. Install batten at perimeter of each roof area, curb flashing, expansion joints and similar penetrations on top of roof membrane as indicated on drawings.
 - 2. Mechanically Fastening:
 - a. Space fasteners maximum 300 mm (12 inches) on center, starting 25 mm (1 inch) from ends.
 - b. When battens are cut, round edges and corners before installing.
 - c. After mechanically fastening strip cover and seal strip with a 150 mm (6 inch) wide roof membrane strip; heat weld to roof membrane and seal edges.
 - d. At // gravel stops // fascia-cants // turn roofing membrane down over front edge of the blocking, cant, or nailer. Secure roofing membrane to vertical portion of nailer; or, if required by the membrane manufacturer, with fasteners spaced maximum 150 mm (6 inches) on centers.
 - e. At parapet walls intersecting building walls and curbs, secure roofing membrane to structural deck with fasteners 150 mm (6 inches) on centers or as shown in NRCA manual.
- F. Adhered System:

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Thermoplastic Polyolefin Roofing (TPO)

1. Apply bonding adhesive in quantities required by roof membrane manufacturer.
2. Fold sheet back on itself, clean and coat the bottom side of the membrane and the top of substrate with adhesive. Do not coat the lap joint area.
3. After adhesive has set according to adhesive manufacturer's instruction, roll roofing membrane into adhesive minimizing voids and wrinkles.
4. Repeat for other half of sheet.

4.5 FLASHING INSTALLATION

- A. Install flashings same day as roofing membrane is installed. When flashing cannot be completely installed in one day, complete installation until flashing is watertight and provide temporary covers or seals.
- B. Flashing Roof Drains:
 1. Install roof drain flashing as recommended by roofing membrane manufacturer.
 - a. Coordinate to set the metal drain flashing in asphalt roof cement, holding cement back from the edge of the metal flange.
 - b. Do not allow the roof cement to come in contact with TPO roofing membrane.
 - c. Adhere roofing membrane to metal flashing with bonding adhesive.
 2. Turn down the metal drain flashing and roofing membrane into drain body. Install clamping ring and strainer.
- C. Installing Base Flashing and Pipe Flashing:
 1. Install flashing sheet to pipes, wall or curbs to minimum 200 mm (8 inches) above roof surfaces and extending roofing manufacturer's standard lap dimension onto roofing membranes.
 - a. Adhere flashing with bonding adhesive.
 - b. Form inside and outside corners of flashing sheet according to NRCA manual. Form pipe flashing according to NRCA manual.
 - c. Lap ends roofing manufacturer's standard dimension.
 - d. Heat weld flashing membranes together and flashing membranes to roofing membranes. Finish exposed edges with lap sealant.
 - e. Install flashing membranes according to NRCA manual.
 2. Anchor top of flashing to walls and curbs with fasteners spaced maximum 150 mm (6 inches) on center. Use surface mounted fastening strip with sealant on ducts. Use pipe clamps on pipes or other round penetrations.
 3. Apply sealant to top edge of flashing.
- D. Installing Building Expansion Joints:
 1. Install base flashing on curbs as specified.
 2. Coordinate installation with roof expansion joint system.
 3. Install flexible tubing 1-1/2 times the width of joint centered over joint. Cover tubing with flashing sheet adhered to base flashing and lapping base flashing roofing manufacturer's standard dimension. Finish edges of laps with sealant.
- E. Repairs to Membrane and Flashings:
 1. Remove sections of roofing membrane or flashing that are creased, wrinkled, or fishmouthed.
 2. Cover removed areas, cuts and damaged areas with a patch extending 100 mm (4 inches) beyond damaged, cut, or removed area. Heat weld to roofing membrane or flashing sheet. Finish edge of lap with lap sealant.

4.6 WALKWAY PAD INSTALLATION

- A. Heat weld walkway sheet to roofing membrane at edges. Weld area 50 mm (2 inches) wide by the entire length of the walkway sheet.
- B. Finish edges of laps with lap sealant.

4.7 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
 1. Fastener Pull Out Tests: ANSI/SPRI FX-1; one test for every 230 sq. m (2,500 sq. ft.) of deck. Perform tests for each combination of fastener type and roof deck type before installing roof insulation.
 - a. Test at locations selected by Contracting Officer's Representative.
 - b. Do not proceed with roofing work when pull out resistance is less than manufacturer's required resistance.

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Thermoplastic Polyolefin Roofing (TPO)

- c. Test Results:
 - 1) Repeat tests using different fastener type or use additional fasteners achieve pull out resistance required to meet specified wind uplift performance.
 - 2) Patch cementitious deck to repair areas of fastener tests holes.
 - 2. Examine and probe roofing membrane and flashing seams in presence of Contracting Officer's Representative and Manufacturer's field representative.
 - 3. Probe seams to detect marginal bonds, voids, skips, and fishmouths.
 - 4. Cut 100 mm (4 inch) wide by 300 mm (12 inch) long samples through seams where directed by Contracting Officer's Representative.
 - 5. Cut one sample for every 450 m (1500 feet) of seams.
 - 6. Cut samples perpendicular to seams.
 - 7. Failure of samples to pass ASTM D1876 test will be cause for rejection of work.
 - 8. Repair areas where samples are taken and where marginal bond, voids, and skips occur.
 - 9. Repair fishmouths and wrinkles by cutting to lay flat. Install patch over cut area extending 100 mm (4 inches) beyond cut.
 - B. Manufacturer Services:
 - 1. Inspect initial installation, installation in progress, and completed work.
 - 2. Issue supplemental installation instructions necessitated by field conditions.
 - 3. Prepare and submit inspection reports.
 - 4. Certify completed installation complies with manufacturer's instructions and warranty requirements.
- 4.8 CLEANING**
- A. Remove excess adhesive before adhesive sets.
 - B. Clean exposed roofing surfaces. Remove contaminants and stains // to comply with specified solar reflectance performance //.
- 4.9 PROTECTION**
- A. Protect roofing system from traffic and construction operations.
 - 1. Protect roofing system when used for subsequent work platform, materials storage, or staging.
 - 2. Distribute scaffolding loads to exert maximum 50 percent roofing system materials compressive strength.
 - B. Loose lay temporary insulation board overlaid with plywood or OSB.
 - 1. Weight boards to secure against wind uplift.
 - C. Remove protective materials immediately before acceptance.
 - D. Repair damage.

END OF SECTION

SECTION 07 62 00

Sheet Metal Flashing and Trim

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flashings and counter flashings, and fabricated sheet metal items.
- B. Precast concrete splash pads.

1.2 STORAGE AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Galvanized Steel Sheet: ASTM A361/A361M, Grade A, 24 gauge, G90 zinc coating. Kynar paint to match other building components.

2.2 ACCESSORIES

- A. Fasteners: Galvanized steel; exposed fasteners same material and finish as flashing metal.

2.3 COMPONENTS

- A. Connectors: Furnish required connector pieces for components.
- B. Splash Pads: Precast concrete type, 8 inches x 16 inches x 4 inches thick.

2.4 FABRICATION

- A. Form components true to shape, accurate in size, square, and free from distortion or defects. Form pieces in longest practical lengths.
- B. Fabricate cleats and starter strips of same material as sheet, minimum one inch wide, interlockable with sheet.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- D. Fabricate flashings to allow toe to extend 6 inches over roof panels. Return and brake edges.
- E. Fabricate corners in one piece, 6 inch long legs; seam for rigidity, seal with sealant.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Verify roof openings, curbs, pipes, sleeves, or vents through roof are solidly set, and nailing strips located.
- B. Secure flashings in place using fasteners.
- C. Apply plastic cement compound between metal work and felt flashings.
- D. Fit components tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Set splash pads under downspouts.
- F. Seal joints watertight.

END OF SECTION

SECTION 07 62 10

Flashing and Counterflashing/ Galvanized Steel

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install flashing, counterflashing, and hold-down clips as described in Contract Documents and not specified to be of other material.

1.2 REFERENCES

- A. American Society For Testing And Materials:
 - 1. ASTM A 653-01, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.'

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sheet Metal:
 - 1. Galvanized iron or steel meeting requirements of ASTM A 653, G 90.
 - a. 22 ga 0.792 mm for hold-down clips.
 - b. 24 ga 0.635 mm for all other.
 - 2. Finish:
 - a. Metal exposed to view shall have face coating of polyvinylidene Fluoride (PVF₂) Resin-base finish (Kynar 500 or Hylar 5000) containing 70 percent minimum PVF₂ in resin portion of formula. Thermo-cured two coat system consisting of corrosion inhibiting epoxy primer and top coat factory applied over properly pre-treated metal. Reverse side coating shall be thermo-cured system consisting of corrosion inhibiting epoxy primer applied over properly pre-treated metal.
 - b. Color as selected by Architect from Manufacturer's standard colors.
 - 3. Acceptable Manufacturers:
 - a. Copper Sales Inc, Minneapolis, MN (800) 426-7737 or (612) 576-9595. www.unaclad.com
 - b. Englert Inc, Perth Amboy, NJ (800) 610-1975 or (732) 826-8614. www.englertinc.com
 - c. Fabral, Jackson, GA (800) 884-4484. www.fabral.com
 - d. Integrismetals, Minneapolis, MN (800) 328-7800 or (763) 717-9000. www.integrismetals.com
 - e. Metal Sales Manufacturing Corp, Sellersburg, IN (800) 999-7777 or (812) 246-1866. www.mtlsales.com
 - f. Petersen Aluminum Corp, Elk Grove, IL (800) 323-1960 or (847) 228-7150. www.pacclad.com
 - g. Reynolds Metals Company, Richmond, VA (800) 841-7774 or (804) 281-2636. www.rmc.com
 - h. Equal as approved by Architect before installation. See Section 01600.
- B. Screws, Bolts, Nails, And Accessory Fasteners: Of strength and type consistent with function.

2.2 FABRICATION

- A. Form accurately to details.
- B. Profiles, bends, and intersections shall be even and true to line.
- C. Fold exposed edges 1/2 inch 13 mm to provide stiffness.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install with small, watertight seams.
- B. Slope to provide positive drainage.

SECTION 07 62 10

Flashing and Counterflashing/ Galvanized Steel

- C. Provide sufficient hold down clips to insure true alignment and security against wind.
- D. Provide 4 inch 100 mm minimum overlap.
- E. Allow sufficient tolerance for expansion and contraction.
- F. Insulate work to prevent electrolytic action.

3.2 CLEANING

- A. Leave metals clean and free of defects, stains, and damaged finish.

END OF SECTION

SECTION 07 81 00

Applied Fireproofing

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies spray-applied mineral fiber and cementitious coverings to provide fire resistance to interior structural steel members shown.

1.2 RELATED WORK:

- A. Section 05 1200 – Structural Steel Framing
- B. Section 05 3100 – Steel Decking

1.3 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Installer qualifications.
- C. Testing laboratory accreditations.
- D. Manufacturer's Literature and Data:
 - 1. Manufacturer's complete and detailed application instructions and specifications.
 - 2. Manufacturer's repair and patching instructions.
- E. Certificates:
 - 1. Certificate from testing laboratory attesting fireproofing material and application method meet the specified fire ratings.
 - a. List thickness and density of material required to meet fire ratings.
 - b. Accompanied by complete test report and test record.
 - 2. Manufacturer's certificate indicating sprayed-on fireproofing material supplied under the Contract is same within manufacturing tolerance as fireproofing material tested.
- G. Miscellaneous:
 - 1. Manufacturer's written approval of surfaces to receive sprayed-on fireproofing.
 - 2. Manufacturer's written approval of completed installation.
 - 3. Manufacturer's written approval of the applicators of fireproofing material.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver to job-site in sealed containers marked and labeled to show manufacturer's name and brand and UL certification markings of compliance with the specified requirements.
- B. Remove damaged or opened containers from the site.
- C. Store the materials off the ground, under cover, away from damp surfaces.
- D. Keep dry until ready for use.
- E. Remove materials that have been exposed to water before installation from the site.

1.4 FIELD CONDITIONS:

- A. Temperature: Do not apply fireproofing when substrate or ambient temperature is below 4 degrees C (40 degrees F) unless temporary protection and heat are provided to maintain temperature at or above stated value during application and for 24 hours before and after application.
- B. Humidity: Maintain relative humidity levels within limits recommended by fireproofing manufacturer.
- C. Ventilation: Provide ventilation to properly dry the fireproofing after application. Provide a minimum of four (4) air exchanges per hour by forced air circulation. When permitted by Contracting Officer Representative (COR), Engineer, and Architect, ventilate by natural circulation.

SECTION 07 81 00

Applied Fireproofing

1.5 QUALITY ASSURANCE:

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. Submit manufacturer's certification that each installer is trained and qualified to install the specified fireproofing. Submit evidence that each installer has a minimum of three (3) years' experience and a minimum of four (4) installations using the specified fireproofing.
- B. Testing Laboratory Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority. Submit a copy of the Certificate of Accreditation and Scope of Accreditation.
- C. Test for fire endurance in accordance with ASTM E119, for fire rating specified, in a nationally recognized laboratory.
- D. Manufacturer's inspection and approval of surfaces to receive fireproofing.
- E. Manufacturer's approval of fireproofing applications.
- F. Manufacturer's approval of completed installation.
- G. Manufacturer's representative is to observe and advise at the commencement of application, and is required to visit the site as required thereafter for the purpose of ascertaining proper application.
- H. Pre-Application Test Area.
 - 1. Apply a test area consisting of a typical overhead fireproofing installation, including not less than 4.5 m (15 feet) of beam and deck.
 - a. Apply to one (1) column.
 - b. Apply for the hourly ratings required in the construction documents.
 - 2. Install in location selected by the Engineer or Architect, for approval by the representative of the fireproofing material manufacturer and the Engineer or Architect.
 - 3. Perform Bond test for cohesive and adhesive strength in accordance with ASTM E736 for each applied fireproofing design used.
 - 4. Perform density test in accordance with ASTM E736 for each applied fireproofing design used.
 - 5. Do not proceed in other areas until installation of test area has been completed and approved.
 - 6. Keep approved installation area open for observation as criteria for sprayed-on fireproofing.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. ASTM International (ASTM):
 - C841-03(R2013) Installation of Interior Lathing and Furring
 - C847-14 Metal Lath
 - D2240-05(R2010) Test Method for Rubber Property – Durometer Hardness
 - E84-14 Surface Burning Characteristics of Building Materials
 - E119-12a Fire Tests of Building Construction and Materials
 - E605-93(R2011) Thickness and Density of Sprayed Fire-Resistive Materials
Applied to Structural Members
 - E736-00(R2011) Cohesion/Adhesion of Sprayed Fire-Resistive Materials
Applied to Structural Members
 - E759-92(R2011) The Effect of Deflection on Sprayed Fire-Resistive Material
Applied to Structural Members

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- E760-92(R2011) Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
- E761-92(R2011) Compressive Strength of Fire-Resistive Material Applied to Structural Members
- E859-93(R2011) Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members
- E937-93(R2011) Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members
- E1042-02(R2014) Acoustically, Absorptive Materials Applied by Trowel or Spray.
- G21-13..... Determining Resistance of Synthetic Polymeric Materials to Fungi
- C. Underwriters Laboratories, Inc. (UL):
Fire Resistance Directory...Latest Edition including Supplements
- D. Warnock Hersey (WH):
Certification Listings.....Latest Edition
- E. Factory Mutual System (FM):
Approval GuideLatest Edition including Supplements
- F. Environmental Protection Agency (EPA):
40 CFR 59(2014) National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 SPRAYED-ON FIREPROOFING:

- A. ASTM E1042, Class (a), Category A.
1. Type I, factory mixed cementitious materials with approved aggregate.
 2. Type II, factory mixed mineral fiber with integral inorganic binders minimum 240 kg per cubic meter (15 lb. per cubic feet) density per ASTM E605 test unless specified otherwise. Use in areas that are completely encased.
- B. Materials containing asbestos are not permitted.
- C. Fireproofing characteristics when applied in the thickness and density required to achieve the fire-rating specified.

	Characteristic	Test	Results
1.	Deflection	ASTM E759	No cracking, spalling, or delamination when backing to which it is applied has a deflection up to 1/120 in 3 m (10 ft.)
2.	Corrosion-Resistance	ASTM E937	No promotion of corrosion of steel.
3.	Bond Impact	ASTM E760	No cracking, spalling, or delamination.
4.	Cohesion/Adhesion (Bond Strength)	ASTM E736	Minimum cohesive/adhesive strength of 9.57 kPa (200 lbf per sq. ft.) for protected areas. 19.15 kPa (400 lbf per sq. ft.) for exposed areas.
5.	Air Erosion	ASTM E859	Maximum gain weight of the collecting filter 0.27 gm per sq. meter (0.025 gm per sq. ft.).

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6.	Compressive Strength	ASTM E761	Minimum compressive strength 48 kPa (1000 psf).
7.	Surface Burning Characteristics with adhesive and sealer to be used	ASTM E84	Flame spread 25 or less smoke developed 50 or less
8.	Fungi Resistance	ASTM G21	Resistance to mold growth when inoculated with aspergillus niger (28 days for general application)

2.2 ADHESIVE:

- A. Bonding adhesive for Type II (fibrous) materials as recommended and supplied by the fireproofing material manufacturer.
- B. Adhesive may be an integral part of the material or applied separately to surface receiving fireproofing material.

2.3 SEALER:

- A. Sealer for Type II (fibrous) material as recommended and supplied by the fireproofing material manufacturer.
- B. Surface burning characteristics as specified for fireproofing material.
- C. Fungus resistant.
- D. Sealer may be an integral part of the material or applied separately to the exposed surface. When applied separately use contrasting color pigmented sealer, white preferred.
- E. VOC content: Product to comply with VOC content limits of authorities having jurisdiction and the following VOC limits when calculated according to 40 CFR 59, (EPA Method 24):
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.

2.4 WATER:

- A. Clean, fresh, and free from organic and mineral impurities.
- B. pH of 6.9 to 7.1.

2.5 MECHANICAL BOND MATERIAL:

- A. Expanded Metal Lath: ASTM C847, minimum weight of 0.92 kg per square meter (1.7 pounds per square yard) or as required, according to fire-resistance designs indicated and fire proofing manufacturer's written instructions.
- B. Fasteners: ASTM C841.
- C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
- D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachments.

Applied Fireproofing

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify surfaces to receive fireproofing are clean and free of dust, soot, oil, grease, water soluble materials or any foreign substance which would prevent adhesion of the fireproofing material.
- B. Verify hangers, inserts and clips are installed before the application of fireproofing material.
- C. Verify ductwork, piping, and other obstructing material and equipment is not installed that will interfere with fireproofing installation.
- D. Verify concrete work on steel decking and concrete encased steel is completed.
- E. When applied in conjunction with roof structures or roof decks, verify that roofing, installation of rooftop HVAC equipment, and other related work are complete.
- F. Verify temperature and enclosure conditions required by fire-proofing material manufacturer.
- G. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond. Submit test report.

3.2 APPLICATION:

- A. Do not start application until written approval has been obtained from manufacturer of fireproofing materials that surfaces have been inspected by the manufacturer or his representative, and are suitable to receive sprayed-on fireproofing.
- B. Coordinate application of fireproofing material with other trades.
- C. Cover other work and exterior openings subject to damage from fallout or overspray of fireproofing materials during application.
- D. Application of Metal Lath:
 - 1. Apply to beam and columns having painted surfaces which fail ASTM E736 Bond Test requirements in pre-application test area.
 - 2. Apply to beam flanges 305 mm (12-inches) or more in width.
 - 3. Apply to column flanges 406 mm (16-inches) or more in width.
 - 4. Apply to beam or column web 406 mm (16-inches) or more in depth.
 - 5. Tack weld or mechanically fasten on maximum of 305 mm (12-inch) center.
 - 6. Lap and tie lath member in accordance with ASTM C841.
- E. Mix and apply in accordance with manufacturer's instructions.
 - 1. Mechanically control material and water ratios.
 - 2. Apply adhesive and sealer, when not an integral part of the materials, in accordance with the manufacturer's instructions.
 - 3. Apply to density and thickness indicated in UL Fire Resistance Directory, FM Approval Guide, or WH Certification Listings unless specified otherwise. Test in accordance with ASTM E119.
- 4. Minimum ASTM E605 applied dry density per cubic meter (cubic foot) for the underside of the walk on deck (interstitial) hung purlin or beam and steel deck, columns in interstitial spaces and mechanical equipment rooms to be as follows:
 - a. Type II - 240 kg per cubic meter (15 lb. per cubic ft.).
 - b. Provide materials with higher density of 640 kg per cubic metric (40 lb. per cubic feet) in mechanical rooms and parking garages.//
- F. Complete application is to be completed in one area. Inspection and approval by COR is required before removal of application equipment and proceeding with further work.

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Applied Fireproofing

3.3 FIELD TESTS:

- A. The applied fireproofing to be tested by a COR approved independent testing laboratory and paid for by the Contractor. Submit test reports documenting results of tests on the applied material in the project.
- B. COR will select area to be tested in specific bays on each floor using a geometric grid pattern. Apply test sample every 929 square meters (10,000 square feet) of floor area or two (2) for each floor, whichever produces the greatest number of test areas.
- C. Test for thickness and density in accordance with ASTM E605. Areas showing thickness less than that required as a result of fire endurance test are not acceptable.
- D. Areas showing less than required fireproofing characteristics are not suitable for the following field tests.
 - 1. Test for cohesion/adhesion: ASTM E736.
 - 2. Test for bond impact strength: ASTM E760.

3.4 PATCHING AND REPAIRING:

- A. Inspect after mechanical, electrical and other trades have completed work in contact with fireproofing material, but before sprayed material is covered by subsequent construction.
- B. Perform corrective measures in accordance with fireproofing material manufacturer's recommendations.
 - 1. Respray areas requiring additional fireproofing material to provide the required thickness, and replace dislodged or removed material.
 - 2. Spray material for patching by machine directly on point to be patched, or into a container and then hand apply.
 - 3. Do not hand mix material.
- C. Repair:
 - 1. Respray test and rejected areas.
 - 2. Patch fireproofing material which is removed or disturbed after approval.
- D. Perform final inspection of sprayed areas after patching and repair.

3.6 SCHEDULE:

- A. Apply fireproofing material in interior structural steel members and on underside of interior steel floor, and steel roof decks, except on following surfaces:
 - 1. Structural steel and underside of steel decks in elevator or dumbwaiter machine rooms.
 - 2. Steel members in elevator hoist ways.
 - 3. Areas used as air handling plenums.
 - 4. Steel to be encased in concrete or designated to receive other type of fireproofing.

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Fire Rating Schedule			
Type	Element	Hourly Rating	UL Design Reference
II	Columns supporting one floor	1 HR	UL X527
II	Columns supporting more than one floor	1 HR	UL X527
//__//	Columns supporting roof	//__//	//__//
//__//	Floor decks	//__//	//__//
II	Floor supports	1 HR	UL D902
//__//	Roof decks	//__//	//__//
//__//	Roof supports	//__//	//__//

END OF SECTION

SECTION 07 92 00

Joint Sealers

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sealants and joint backing.

1.2 SUBMITTALS

- A. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

PART 2 PRODUCTS

2.1 SEALANTS

- A. Type 1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25,; single or multi-component.
 - 1. Standard colors matching finished surfaces.
 - 2. Manufacturer: Bostik or approved equal.
 - 3. Applications:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
- B. Type 2 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.
 - 1. Standard colors matching finished surfaces.
 - 2. Manufacturer: Bostik or approved equal.
 - 3. Applications:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Interior joints for which no other type of sealant is indicated.
- C. Type 3 – Georgia Pacific 'Prosoco' Fluid Applied Flashing to seal Exterior Sheathing Joints, Inside And Outside Corners Penetrations, Rough Openings, and Material Transitions.
 - 1. Primer to seal raw gypsum edges before applying fluid applied flashing.
 - 2. Foam Backer Rods and Accessory Materials. Backer Rods will be used when open joints are greater than 1/4" wide.
 - 3. See Section 07250 – Gypsum Board Weather-Resistant Barrier and Air Barrier System.

2.2 ACCESSORIES

- A. Primer: Non-staining type, as recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056, sponge or expanded rubber ; oversized 30 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Verify that substrate surfaces and joint openings are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.
- C. Remove loose materials and foreign matter which might impair adhesion of sealant.

SECTION 07 92 00

Joint Sealers

- D. Clean and prime joints in accordance with manufacturer's instructions.
- E. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

3.2 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.

END OF SECTION

SECTION 09 27 13

GLASS-FIBER-REINFORCED GYPSUM FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass fiber reinforced gypsum fabrications as indicated on the drawings.

1.2 RELATED SECTIONS

- A. Section 03490 - Glass Fiber Reinforced Concrete.
- B. Section 04720 - Cast Stone.
- C. Section 05500 - Metal Fabrications: Supplementary supports for large items.
- D. Section 06100 - Rough Carpentry: Supplementary supports for large items.
- E. Section 06610 - Glass Fiber Reinforced Plastic Fabrications.
- F. Section 09900 - Paints and Coatings: Field painting and sealing prior to painting.

1.3 REFERENCES

- A. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board; 1999.
- B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 1997.
- C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics; 1999.
- D. ASTM D 785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials; 1998.
- E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 1999.
- F. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 1999.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including dimensions, finishes, storage and handling requirements and recommendations, and installation recommendations.
- C. Shop Drawings: For custom items, provide drawings showing dimensions, layout, joints, details, and interface with adjacent work; include field measured dimensions of the spaces where items are to be installed, if critical to proper installation.
- D. Samples: For each custom finish specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transport, lift, and handle units with care, avoiding excessive stress and preventing damage; use appropriate equipment.
- B. Store products in manufacturer's unopened packaging until ready for installation, in a clean dry area protected from weather, moisture and damage; store units upright and not stacked unless permitted by manufacturer.

SECTION 09 27 13

GLASS-FIBER-REINFORCED GYPSUM FABRICATIONS

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Stromberg Architectural Products Inc; PO Box 8036, I-30 West, 4400 Oneal, Greenville, TX 75404. ASD. Tel: (903) 454-0904. Fax: (903) 454-3642. Email: sales@strombergarchitectural.com. www.strombergarchitectural.com.
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MATERIALS

- A. Glass Fiber Reinforced Gypsum Fabrications: High density gypsum reinforced with continuous filament glass fiber mat and structural reinforcing as required.
 - 1. Glass Content: 5 to 6 percent by weight.
 - 2. Density: 103 to 112 pcf (1650 to 1795 kg/cu m).
 - 3. Shell Thickness: 1/8 to 3/16 inch (3 to 5 mm), nominal.
 - 4. Flame Spread Index: 0, when tested in accordance with ASTM E 84.
 - 5. Flexural Strength: 3200 to 4000 psi (22 to 27.5 MPa), when tested in accordance with ASTM D 790.
 - 6. Modulus of Elasticity: 2.1 to 2.2 x 10⁵ psi (1450 to 1515 MPa), when tested in accordance with ASTM D 790.
 - 7. Tensile Strength: 1200 to 1400 psi (8.3 to 9.6 MPa)), when tested in accordance with ASTM D 638.
 - 8. Impact Strength: 8.0 to 8.8 ft lb/sq in (13 to 14.4 J/sq mm), when tested in accordance with ASTM D 256.
 - 9. Hardness: M 72,), when tested in accordance with ASTM D 785, Rockwell.
 - 10. Variation from Dimensions Indicated on Drawings: Plus and minus 1/8 inch (3 mm), maximum.
 - 11. Variation from Plane Along Edge or Surface: Plus and minus 1/16 inch per linear foot (1.5 mm in 300 mm), maximum.
 - 12. Outside Corner Radius: 1/16 inch to 1/8 inch (1.5 to 3 mm).
 - 13. Draft Angle: 3 degrees, minimum, on returns, setbacks, reveals, and grooves.
 - 14. Items Too Large or Heavy to be Adhesively Installed: Provide concealed anchorage points for plaster type wire anchors.
- B. Joint Cement: Liquid Nail, or equivalent.
- C. Joint Tape and Compound: Types recommended for gypsum wallboard work.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

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GLASS-FIBER-REINFORCED GYPSUM FABRICATIONS

- C. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect and wait for instructions before beginning installation.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Install supplementary temporary and permanent supports as required for proper installation.

3.3 INSTALLATION

- A. Install in accordance with applicable code and manufacturer's recommendations, plumb and true to line; shim where necessary.
- B. Coordinate work with related gypsum wallboard work.
- C. Join pieces with cemented butt joints except at control and expansion joints.
- D. Provide control joints at not more than 35 feet (10.5 m) on center if not indicated on drawings.
- E. Provide expansion joints where moving joints in substrate occur.
- F. Finish joints the same as specified for adjacent gypsum board work in Section 09260.
- G. Finish joints and surfaces as required for Level 5 in ASTM C 840.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal support systems.
 - 2. Acoustic insulation.
 - 3. Gypsum wallboard.
 - 4. Water-resistant gypsum backing board.
 - 5. Drywall finishing.
- B. Related Sections:
 - 1. Cold-formed metal framing: Division 5.
 - 2. Rough carpentry: Division 6.
 - 3. Painting: Elsewhere in Division 9.

1.2 REFERENCES

- A. ANSI A136.1 -- American National Standard for Organic Adhesives for Installation of Ceramic Tile.
- B. ASTM A 641 -- Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- C. ASTM C 36 -- Standard Specification for Gypsum Wallboard.
- D. ASTM C 475 -- Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- E. ASTM C 630 -- Standard Specification for Water-Resistant Gypsum Backing Board.
- F. ASTM C 645 -- Standard Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
- G. ASTM C 665 -- Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- H. ASTM C 754 -- Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum.
- I. ASTM C 840 -- Standard Specification for Application and Finishing of Gypsum Board.
- J. ASTM C 919 -- Standard Practice for Use of Sealants in Acoustical Applications.
- K. ASTM C 1002 -- Standard Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
- L. ASTM E 90 -- Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- M. ASTM E 119 -- Standard Test Methods for Fire Tests of Building Construction and Materials.
- N. Fire Resistance Directory; Underwriters Laboratories Inc. (UL).
- O. Gypsum Construction Handbook; USG Corporation.

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GYPSUM BOARD

1.3 SYSTEM DESCRIPTION

- A. Sound-Rated Construction: Provide construction built in accordance with manufacturer's assemblies which have been laboratory-tested per ASTM E 90 for designated STC ratings.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for systems required, including installation instructions and data sufficient to show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Provide installation by a company specializing in work similar to that required on this project and with not less than 5 years of documented experience.
- B. Regulatory Requirements: At locations indicated on drawings, provide fire-rated assemblies tested in accordance with ASTM E 119 and acceptable to authorities for ratings required. Provided assemblies as listed in the following:
 - 1. Underwriters Laboratories Inc.'s (UL) "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original and unopened packages, containers, or bundles, with brand names and manufacturer's labels intact and legible.
- B. Store materials in dry location, fully protected from weather and direct exposure to sunlight.
- C. Stack gypsum board products flat and level, properly supported to prevent sagging or damage to ends and edges.
- D. Store corner bead and other metal and plastic accessories to prevent bending, sagging, distortion, or other mechanical damage.

1.7 PROJECT CONDITIONS

- A. Temperature: Maintain temperature in areas of installation between 50 and 70 degrees F for at least 24 hours before installation begins and for not less than 48 hours after joint finishing has been completed.
- B. Ventilation: Provide controlled ventilation during joint finishing operations, to eliminate excessive moisture. Avoid drafts during hot, dry weather to prevent excessively fast drying of joint compound.

PART 2 – PRODUCTS

2.1 FRAMING MATERIALS

- A. General: Select size and gage of framing members and establish spacing to comply with requirements of ASTM C 754 unless otherwise specifically indicated.
 - 1. Maximum deflection: L/240, Typical; minimum gauge – 25 ga, 20 ga. As required.
- B. Studs and Tracks: ASTM C 645, steel with protective coating.
 - 1. Nominal depth: 3-5/8 inches.
- C. Hanger Wire: ASTM A 641, soft, Class 1 galvanized.

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GYPSUM BOARD

1. Ceiling hangers: Minimum 8 gage wire.
2. Furring channel ties: Minimum 18 gage wire.
- D. Furring Members: ASTM C 645, steel with protective coating.
 1. Hat-shaped except as otherwise indicated.
- E. Resilient Channels: United States Gypsum RC-1 Resilient Channel, 25 Gauge.
- F. Furring Fasteners/Connectors: Manufacturer's recommended system for specific application indicated, complying with ASTM C 754.
- G. Manufacturers: Products of the following manufacturers, provided they comply with requirements of the contract documents, will be among those considered acceptable:
 1. Dietrich Industries, Inc.
 2. Gold Bond Building Products, a National Gypsum Division.
 3. USG Corporation.

2.2 GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 36; maximum lengths available.
 1. ½" Standard type, except as otherwise indicated.
 2. 5/8" Fire-resistant type (Type X or equivalent), where required for fire-resistant rated assemblies.
 3. Edges: Tapered.
- B. Moisture-Resistant Gypsum Backing Board: ASTM C 630; maximum lengths available.
 1. ½" Standard type, except as otherwise indicated.
 2. 5/8" Fire-resistant type (Type X or equivalent), where required for fire-resistant rated assemblies.
 3. Edges: Tapered, for taped joint treatment.
- C. Back-up for ceramic tile: Georgia Pacific Denshield Tile Baker Board.
- D. Gypsum Board ceiling in Guest room baths and at exterior soffits: U. L. rated Type 'X', 5/8" exterior grade soffit board.
- E. Gypsum Board Sheathing for manufactured stone back-up: 5/8" Densglass Gold, 2" fiberglass joint tape.
- F. Gypsum Board Sheathing at back of Roof Parapets: 5/8" Dens deck Prime Fireguard Type X roof board as manufactured by Georgia Pacific.
- G. Provide Densglass Ultra Shaftliner for shaft wall construction.
- H. Manufacturers: Products of the following manufacturers, provided they comply with requirements of the contract documents, will be among those considered acceptable:
 1. Georgia-Pacific Corporation.
 2. Gold Bond Building Products, a National Gypsum Division.
 3. USG Corporation.

2.3 TRIM AND ACCESSORIES

- A. General: Except as otherwise specifically indicated, provide trim and accessories by manufacturer of gypsum board materials, made of galvanized steel or zinc alloy and configured for concealment in joint compound.

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GYPSUM BOARD

1. Include corner beads, edge trim, and other trim units necessary for project conditions. Provide accessories as required in order to achieve details indicated, whether or not specific accessories are shown on the drawings.
- B. Control Joints: At locations indicated, provide manufacturer's standard one-piece control joints of extruded vinyl, zinc alloy, or other non-corrosive metal.

2.4 JOINT TREATMENT

- A. General: Provide products by manufacturer of gypsum boards. Comply with ASTM C 475 and with manufacturer's recommendations for specific project conditions.
- B. Joint Tape: Manufacturer's standard paper type.
- C. Joint Tape: If recommended by manufacturer, provide open-weave fiberglass tape for joint treatment of water-resistant gypsum backing board.
- D. Joint Compound: Vinyl-based ready-mixed type for interior use, and as follows:
 1. All-purpose type, for both embedding tape and as topping.
- E. Joint Compound: At joints and fasteners in water-resistant gypsum backing board intended for tile surfacing, provide compound specifically recommended or permitted by manufacturer of gypsum board.

2.5 MISCELLANEOUS MATERIALS

- A. General: Provide miscellaneous materials as produced or recommended by manufacturer of gypsum products.
- B. Sound Attenuation Blankets: ASTM C 665, Type I; unfaced semi rigid mineral fiber mat; thickness as required for wall construction and STC rating indicated.
- C. Screws: ASTM C 1002; self-drilling type; lengths as recommended by gypsum board manufacturer for project conditions.
- D. Acoustical Sealants: ASTM C 919; nondrying, no hardening, no skinning type for concealed locations; non oxidizing, skinning type for exposed locations.
- E. Sealing: At water-resistant gypsum backing board, provide Type I organic adhesive per ANSI A136.1.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Inspection: Verify that project conditions and substrates are appropriate to begin installation of work of this section.

3.2 INSTALLATION OF METAL FRAMING

- A. General: Comply with provisions of ASTM C 754 except where exceeded by other requirements.
- B. Soffits:
 1. Secure hangers to structure or to anchorage devices so that full strength of hanger can be achieved.

SECTION 09 29 00

GYPSUM BOARD

2. Secure furring members by means of screws, clips, or wire ties, as appropriate to substrate. Space furring members as follows:
 - a. 16 inches on center.
 3. Level soffits to a tolerance of 1/8 inch in 12 feet, or to a higher tolerance if required by specific project conditions.
 4. Reinforce openings and interruptions in horizontal framing system with additional furring channels. Ensure that entire suspension system is laterally braced.
- C. Steel Studs:
1. General: Install tracks and studs in accordance with manufacturer's recommendations and as follows:
 - a. Stud spacing: 16 inches on center, except as otherwise shown.
 2. Door openings: Comply with recommendations of USG Corporation's "Gypsum Construction Handbook"; reinforce openings as required for size and weight of doors, using a minimum of two side-by-side studs on each side of opening.
 - a. At openings in fire-rated partitions, comply with requirements of governing authorities for framing.
 3. Partition heights: Extend studs full height, to underside of floor or roof construction above.
 4. Partial height partitions: Extend studs to height indicated, bracing as required to assure stability.
 5. Blocking and bracing: Install blocking and bracing as recommended by manufacturer for adequate support of wall-mounted items installed as work of other sections.
- D. Wall Furring:
1. General: Install wall furring members in accordance with manufacturer's recommendations.
 - a. Spacing: 16 inches on center, except as otherwise shown.
 2. On solid walls, install furring members vertically.

3.3 INSTALLATION OF GYPSUM BOARD

- A. General: Comply with ASTM C 840 and GA-216 except where exceeded by other requirements.
1. Wherever possible, install gypsum board to minimize butt end joints.
 2. Apply ceiling boards prior to installation of wallboards. Arrange to minimize butt end joints near center of ceiling area.
 3. Install wallboards in a manner which will minimize butt end joints in center of wall area. Stagger vertical joints on opposite sides of walls.
 4. Butt all joints loosely, with maximum of 1/16 inch between boards.
 5. Place wrapped edges adjacent to one another; do not place cut edges or butt ends adjacent to wrapped edges.
 6. Support all edges and ends of each board on framing or by solid substrate, except that long edges at right angles to framing members in non-fire-rated construction may be left unsupported.
- B. Control Joints: Form control joints by means of 1/4-inch space between adjacent gypsum boards, with each edge supported on separate framing member, ready to receive trim accessory, and located as shown on the drawings and as follows:
1. Not more than 30 feet apart on walls which are not intersected by other walls for 50 feet or more.
- C. Sound-Rated Construction: Seal perimeter of construction with acoustical sealant, complying with ASTM C 919. Carefully seal around penetrations and at control joints and other openings.
1. At partitions shown or where required for STC ratings indicated, install sound attenuation blankets after gypsum board has been installed on one side.
- D. Installation on Metal Framing and Furring:

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GYPSUM BOARD

1. Single-layer application: Install gypsum board by means of screw attachment.
 - a. On walls and partitions, plan installation so that leading edge or end of gypsum board is attached to open end of stud flange first.
- E. Installation of Backing Board:
 1. Install moisture-resistant backing board at toilets, janitor closets, breakroom and kitchen, and within 4 feet of any exterior window, door, or opening.
 2. Install moisture-resistant gypsum backing board in accordance with manufacturer's recommendations for installation, including minimum clearances and sealing of penetrations and edges. Do not install water-resistant backing board on ceilings or over vapor retarders.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

- A. General: Comply with manufacturer's recommendations for installation of trim items. Except for items intended by manufacturer to be left exposed or semi exposed, install trim units for concealment in joint finishing compound. Wherever possible, fasten metal trim items to substrate with same fasteners used to install gypsum board products.
- B. Corner Bead: Install metal corner bead at all external corners unless details clearly indicate its omission at specific locations.
- C. Edge Trim: Install edge trim at locations indicated and wherever edge of gypsum board otherwise would be exposed.
- D. Control Joints: Install one-piece control joints at required locations. Do not remove tape until finishing operations are complete

3.5 INSTALLATION OF GYPSUM BOARD

- A. General: Comply with ASTM C 840 and GA-216 except where exceeded by other requirements.
 1. Do not mix joint compounds except as specifically recommended by manufacturer.
- B. Finish gypsum board in each area to the level of finish indicated below:
 1. Typical: All Walls, unless noted otherwise.
 - a. Level 5: Embed tape in two coats joint compound at all joints and interior angles. Provide three separate coats of compound at all joints, angles, fastener heads, and accessories. Apply a thin skim coat of joint compound or a special purpose coating to the entire gypsum board surface. Provide smooth surfaces free of tool marks and ridges.
 2. Ceilings, soffits, other horizontal surfaces.
 - a. Level 4: Embed tape in two coats joint compound at all joints and interior angles. Provide three separate coats of compound at all joints, angles, fastener heads, and accessories. Provide smooth surfaces free of tool marks and ridges.
 3. Areas receiving texture finish, or heavy grade wallcovering.
 - a. Level 3: Embed tape in joint compound at all joints and interior angles. Provide two separate coats of compound at all joints, angles, fastener heads, and accessories. Provide smooth surfaces free of tool marks and ridges.
 4. Fully Concealed Areas above ceilings, etc.
 - a. Level 1: Embed tape in joint compound at all joints and interior angles. Tool marks and ridges are acceptable.
- C. Joint Treatment: Tape and finish joints in accordance with manufacturer's instructions for compounds used, using proper hand tools designed for the purpose.
 1. Avoid raising nap of face paper when sanding; carefully sponge down any areas roughened by sanding process.

SECTION 09 29 00

GYPSUM BOARD

- D. Penetrations: Fill cutouts and openings around fixtures and penetrations with joint compound.

3.6 PARTITION CAULKING AT PERIMETER – ALL WALLS THAT RECEIVE ACOUSTICAL INSULATION

- A. Cut panels for loose fit around partition perimeter. Leave a joint of no more than 1/8" wide. Apply 1/4" round bead of acoustical sealant each side of runners including those used at partition intersections with dissimilar wall construction. Immediately install panels, squeezing sealant into firm contact with adjacent surfaces. Fasten panels as specified.
- B. Identify all rated partitions above ceilings spaces.

3.7 CLEANING

- A. Promptly remove any residual gypsum drywall materials from adjacent or adjoining surfaces, leaving spaces ready for subsequent finishing operations and decorating.

END OF SECTION

SECTION 09 30 13

CERAMIC TILING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Ceramic tile floor and base finish using the thin-set application method.
- B. Marble thresholds at door openings.
- C. REFER TO ID DRAWINGS FOR INSTALL LOCATIONS.

1.2 REFERENCES

- A. ANSI/TCA A108.4 – Installation of Ceramic Tile with Water Resistant Organic Adhesive.
- B. ANSI/TCA A108.5 – Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.
- C. ANSI/TCA A137.1 – Specifications for Ceramic Tile.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01 33 00 – Submittal Procedures.
- B. Submit product data under provisions of Section 01 33 00 – Submittal Procedures.
- C. Submit manufacturer's installation instructions under provisions of Section 01 33 00 – Submittal Procedures.

1.4 QUALITY ASSURANCE

- A. Conform to ANSI/ATC A137.1
- B. Conform to TCA Handbook for Ceramic Tile Installation. ANSI/TCA A108.4

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of products specified in this Section with minimum three years documented experience.
- B. Installer: Company specializing in applying the work of this Section with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01 66 00.
- B. Store and protect products under provisions of Section 01 66 00.
- C. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.7 ENVIRONMENT REQUIREMENTS

- A. Do not install adhesives in a closed, unventilated environment.

SECTION 09 30 13

CERAMIC TILING

- B. Maintain 50 degrees F (10 degrees C) during installation of mortar materials.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Refer to ID Drawings and Finish Manual Specs

2.2 PRODUCTS - GENERAL

- A. ANSI Standard for Ceramic Tile: comply with ANSI A137.1 “American National Standard Specifications for Ceramic Tile” for types 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: For tile, grout and other products requiring selection of colors, surface textures or other appearance characteristics, provide products to match characteristics indicated or, if not otherwise indicated, as selected by Architect from the Manufacturers standards.
 - 1. Provide tile trim and accessories which match color and finish of adjoining flat tile.

2.3 TILE PRODUCTS

- A. Refer to ID Drawings.

2.4 SETTING MATERIALS

- A. Latex-Portland Cement Mortar: Provide product complying with ANSI A118.4 and the following requirements for composition:
 - 1. Prepackaged dry mortar mix incorporating dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.
 - 2. Latex additive (water emulsion) of type described below, serving as a replacement for part or all of gauging water, added at job site to prepackaged dry mortar mix supplied or specified by latex manufacturer.
 - a. Latex Type: Manufacturer’s standard.
- B. Grouting Materials:
 - 1. Latex-Portland Cement Grout: Provide product complying with ANSI A118.6 for the following composition and of color indicated.
 - a. Prepackaged dry grout mix incorporating dry polymer additive in the form of a re-emulsifiable power to which only water is added at job site.
 - 2. Latex additive (water emulsion) serving as a replacement for part or all of gauging water, added at job site to prepackaged dry grout mix, with type of latex and dry grout mix complying with requirements indicated below:
 - a. Latex Type: Manufacturers standards,
 - b. Grout Type: Commercial portland cement grout specified or supplied by latex manufacturer.
 - (1.) Application: Use to grout joints in floor tile, unless otherwise indicated.
 - c. Grout Type: Dry-set grout specified or supplied by latex manufacturer. Use latex additive without a retarder with dry-set grout.
 - d. Application: Use to grout joints in glazed wall tile unless otherwise indicated.

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CERAMIC TILING

2.5 MISCELLANEOUS MATERIALS

- A. Marble Thresholds: Use manila STD white marble thresholds at all toilet room doors where floor finishes transition to ceramic tile. Marble thresholds should be designed to allow handicapped access.
- B. Tile Cleaner: Product specifically acceptable to manufacturer of tile and grout manufacturer for application indicated and as recommended by National Tile Promotion Federation, 112 North Alfred St., Alexandria, VA 22134 or Ceramic Tile Institute, 700 N. Virgil Ave., Los Angeles, CA 90029.

PART 3 – EXECUTION

3.1 FLOOR INSTALLATION METHODS

- A. Ceramic Mosaic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of subfloor construction, and grout types.
 - 1. Portland Cement Mortar: ANSI A108.1
 - a. Bond Coat: Portland Cement paste on plastic bed or the following thin-set mortar on cured bed, ANSI A108.5, at Contractors option.
 - 2. Latex-portland cement mortar.
 - a. Concrete subfloors, interior: TCA F112 (bonded)
 - b. Grout: Latex-portland cement

3.2 WALL TILE INSTALLATION METHODS

- A. Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types.
 - 1. Portland Cement Mortar: ANSI A108.1
 - 2. Masonry or Concrete, Interior: TCA W211 (bonded)
 - 3. Grout: Latex-portland cement.
 - 4. Latex-Portland Cement Mortar: ANSI A108.5

3.3 CLEANING AND PROTECTION

- A. Install types of tile designated Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. 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.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.
- C. Protection: 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.
- D. Prohibit foot and wheel traffic from using tile floors for at least 7 days after grouting is completed.
- E. Before final inspection, remove protective covering and rinse neutral cleaner from tile surfaces.

END OF SECTION

SECTION 09 68 00

CARPETING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Includes installation of Owner-furnished carpeting and carpet cushion. Installations will include direct glue-down and over carpet cushion.
- B. Provide installation of carpet base in areas scheduled, including the binding of the top edge of the carpet base.
- C. Provide and install carpet markers for floor cleanout locations.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete: Concrete slab as substrate for carpeting.
- B. Section 03 54 00 - Gypsum Concrete Underlayment: Gypsum concrete as substrate for carpeting.
- C. Section 06 20 00 - Finish Carpentry: Coordination of installation of wood base with carpet installations.
- D. Section 09 65 00 - Resilient Flooring: Coordination of resilient flooring and resilient base installations with the carpet installations.
- E. Section 09 90 00 - Painting: Coordination of painting with carpet installation.

1.3 QUALITY ASSURANCE

- A. The entire carpet installation is to be performed by personnel experienced in carpet installation and whose primary occupation is carpet installation. The practice of employing men trained in other trades or common laborers to install carpet will not be acceptable.
- B. The installation contractor shall be totally responsible for the accuracy of his measurements on total yardage requirements, individual floor yardage requirements, dye lot yardage requirements. No requests for carpet or installation extras will be considered due to measurement or take-off errors by the installation contractor.
- C. Prior to installation, the carpet manufacturer shall provide a letter to the Owner, signed by an officer of the firm, certifying all specifications of samples submitted for approval have been met or exceeded in the manufacture of the carpet.
- D. Finish Flooring Materials Application Over Gypsum Concrete Underlayment: Comply with Maxxon Corporation's "Procedures for Attaching Finished Floor Goods to Maxxon Underpayments" brochure for guidelines for installing finished floor goods.

1.4 SUBMITTALS

- A. The following shall be submitted to the Contractor from the Owner for coordination and bidding purposes.
 - 1. One 24"x18" quality/color sample of each coloration and carpet type shall be submitted. Sample must be labeled with manufacturers and suppliers' names. Samples submitted will be assumed to be the type, quality, color and weight to be installed.
 - 2. A copy of a printed installation manual written by the carpet manufacturer's technical services department shall be submitted.

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CARPETING

3. Copies of manufacturers maintenance data; refer to Section 01700. 4. After carpet order is placed, submit roll register lists. Such lists to remain on job site until after all carpet has been delivered and installed.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Care shall be taken in the handling of all carpet during transportation and at the job site. The manufacturer's label, original mill wrappings must be on all carpet when it arrives at the job site. Each roll shall have its register number properly attached. Store material under cover in a dry location and in a manner to prevent damage. For a period of seven days prior to installation and at all times after installation the temperature in all areas receiving carpet shall be maintained at a minimum of 68 degrees F.

1.6 JOB CONDITIONS

- A. Installer: Coordinate all his activities with the Work.
- B. Environmental: The carpet substrate temperature shall remain at 65°F for 24 hours before installation and 40 hours after the installation. Take the reading from a thermometer placed directly on the substrate.

1.7 GUARANTEE

- A. Installer shall be required to relay any carpet that does not provide an attractive, wrinkle-free appearance, and shall correct any condition due to faulty installation which may appear for a period of one year from the date of the complete installation.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Carpet and Carpet Cushion: Provided by Owner, Installed by Contractor. Refer to Interior Design Drawings for carpet selections and manufacturers.
- B. Tack Strips: Water-resistant plywood strips as required to match pad thickness and in compliance with CRI 104, Section 11.3. Provide commercial type with three (3) rows of pins. Strips shall be pre-nailed for anchoring into concrete.
- C. Carpet Adhesive for Gluing Carpet to Floor: Non-staining, low odor, solvent free, with no alcohol, glycol or ammonia, waterproof and strippable, and as recommended by the carpet manufacturer for the installations involved. Adhesive shall comply with OSHA Regulation 29 CFR 1910-1200. All containers shall contain safety data sheets and be available at the job site for inspection.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Floor surfaces to receive carpeting shall be inspected by the Carpet Contractor, and he shall promptly notify the General Contractor of any and all defects in the floor which affects this work in order that they may be corrected before start of this work.
- B. Proceeding with this work shall be deemed as acceptance by the Carpet Contractor of the pertinent floor areas, and he shall be held responsible thereafter for installation of this work.

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Includes furnishing and application of painting materials to surfaces, including:
 - 1. Surface preparation of surfaces to be painted.
 - 2. Touching up of prime coats and other preparation necessary prior to finish painting.
 - 3. Painting, staining and otherwise finishing of new surfaces as indicated/scheduled on the Drawings and specified in this and other Sections of this Project Manual.
- B. "Paint" as used herein means all coating systems materials including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.
- C. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors or materials /are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these colors from standard colors or finishes available.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete: Painting of exposed concrete surfaces as scheduled.
- B. Section 04 20 00 - Unit Masonry: Painting of exposed concrete unit masonry surfaces.
- C. Section 05 12 00 - Structural Steel Framing: finish painting of exposed steel members, where fireproofing material is not required.
- D. Section 05 50 00 - Metal Fabrications: Painting of exposed metal items.
- E. Section 06 20 00 - Finish Carpentry: Painting, staining and otherwise finishing of finish carpentry items not scheduled to receive factory applied finish.
- F. Section 07 92 00 – Joint Sealants: Coordination of sealant and caulking installation with application of paint.
- G. Section 08 11 00 - Metal Doors and Frames: Surface preparation and painting of all hollow metal work.
- H. Section 08 71 00 - Finish Hardware: Installation of hardware items after finish painting is complete.
- I. Section 09 29 00 - Gypsum Board: Surface preparation and painting of gypsum wallboard systems.
- J. Section 21 13 13 – Wet-Pipe Sprinkler System: Surface preparation and painting of exposed piping and sprinkler system apparatus.
- K. Division 22 - Plumbing: Surface preparation and painting of plumbing equipment and apparatus exposed to view and exposed to weather.
- L. Division 23 - Heating, Ventilating and Air Conditioning: Surface preparation and painting of mechanical equipment exposed to view and exposed to weather.

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- M. Division 26 - Electrical: Painting of electrical equipment exposed to view and exposed to the weather.

1.3 QUALITY ASSURANCE

- A. Acceptable Manufacturers - The following manufacturers are acceptable for use on this project subject to compliance with requirements:
 - 1. Sherwin Williams
 - 2. Benjamin Moore Company
 - 3. Porter Paint Company
 - 4. Pittsburgh
 - 5. Glidden
 - 6. As scheduled in Interior Design Drawings
- B. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.
- C. Coordination of Work: Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings systems for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.
- D. Sample Area: A sample area of block filler shall be applied on a designated interior wall of the project as well as a sample area of the "final appearance". Such sample walls must be reviewed and accepted by the Owner and the Architect prior to proceeding with any other paint application.
- E. Acceptable Surfaces: The paint contractor and General Contractor shall be solely responsible for determining that the wall is ready and suitable to be painted.
- F. Spray Equipment: Block filler and paint for masonry walls must be roller or brush applied. Spray equipment will not be permitted for this work.

1.4 SUBMITTALS

- A. Submit color chips and manufacturer's product data to the Architect for color selection and product review. Submittals shall include spread and coverage rate per coat.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver products and materials in original unbroken containers with legible labels intact bearing manufacturer's brand and name with application instructions printed thereon. Paint shall arrive on the job ready mixed, except for tinting of undercoats and possible thinning as recommended by manufacturer.

1.6 JOB CONDITIONS

- A. Inspection of Surfaces: The painting contractor shall be responsible for inspecting the work of others prior to the application of any paint or finishing material. If any surface to be finished cannot be put in proper condition for finishing by customary cleaning, sanding, and puttying operations, the painting contractor shall immediately notify the General Contractor in writing or assume responsibility for and rectify any unsatisfactory finish resulting.

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PAINTING

- B. Environmental Requirements: Comply with manufacture¹'s recommendations as to environmental conditions under which coatings and coating systems can be applied. Do not apply finish in areas where dust is being generated.
- C. Protection: All materials used on the job shall be stored in a single place designated by the Contractor. Such storage place shall be kept neat and clean. All damage to the storage area and its surroundings shall be repaired. Any soiled or used rags, waste and trash must be removed from the building every night, and every precaution taken to avoid the danger of fire.
- D. Protect surfaces and objects inside and outside the building, as well as the grounds, lawns, shrubbery, and adjacent properties against damage. The painting contractor shall hold himself responsible for damage to adjacent furnishings.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. All paint and primer applied in the field shall be the products of a single manufacturer. For the purpose of clarification, only the products of one manufacturer have been listed herein.
- B. Extra Stock: Supply an extra 2% of total quantity of each paint used with a minimum of three (3) gallons of each paint. **Furnish in manufacturer's unopened, labeled containers for Owner's use.**

2.2 PAINTING SCHEDULE

- A. Exterior Painting Schedule - Colors as selected by the Architect.
 - 1. Galvanized Metal, Including Weather Exposed HVAC and Electrical Equipment:
 - a. First coat: SW Galvite B50W3 Series, DFT mils: 2. Omit first coat on items where compatible factory primer has been applied.
 - b. Second and third coats: SW Industrial Enamel B54 Series, DFT mils: 2.5, each coat.
 - 2. Ferrous Metals, Including Weather Exposed HVAC and Electrical Equipment:
 - a. First coat: SW Kem Kromik Metal Primer B50 Series, OFT mils: 3. Omit first coat on items where compatible factory primer has been applied.
 - b. Second and third coats: SW Industrial Enamel B54 Series, DFT mils: 2.5, each coat.
 - 3. Copper/Aluminum, Including Weather Exposed HVAC and Electrical Equipment:
 - a. First coat: SW Zinc Chromate Primer B50YI Series, OFT mils: 3.
 - b. Second and Third coats: SW Industrial Enamel B54 Series, DFT mils: 2.5, each coat.
 - 4. Masonry/Concrete:
 - a. First coat: SW Heavy Duty Block Filler B42W46 Series, DFT mils: 10.
 - b. Second and Third coats: SW A-100 Gloss, Latex House Paint AS Series, DFT mils: 1.4, each coat.
 - 5. Wood Gates.
 - a. Two (2) coats Olympic Semi-Transparent Linseed Oil Stain.
 - 6. Exterior Masonry Walls at Dumpster - Epoxy Paint Finish:
 - a. First coat: Kem Cati-Coat HS Epoxy Filler/Sealer, B58-600 Series, OFT mils: 10 to 20.
 - b. Second and Third coats: Macropoxy 646, DFT mils: 5 to 10 each coat.
 - 7. Weather Exposed Ferrous Piping:
 - a. First coat: SW Kem Kromik Metal Primer B50W I Series, DFT mils: 3.
 - b. Second and Third coats: SW Silver-Brite Aluminum B59S 1 1 Series, DFT mils: 1 per coat.
 - 8. Painters Caulk - Acrylic/Silicone: White, Paintable caulking compound, ASTM C 834.
- B. Interior Painting Schedule - Colors and paint types as scheduled in the Interior Design Drawings. For surfaces not scheduled, use paint type specified herein.
 - 1. Galvanized Metal:

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PAINTING

- a. First coat: SW Galvite B50W3 Series, DFT mils: 2. Omit first coat on items where compatible factory primer has been applied.
- b. Second and third coats: SW Industrial Enamel B54 Series, DFT mils: 2, each coat.
2. Ferrous Metals - Semi-Gloss Enamel
 - a. First coat: SW Kem Kromik Metal Primer B50 Series, DFT mils: 3. Omit first coat on items where compatible factory primer has been applied.
 - b. Second and third coats: SW Industrial Enamel B54 Series, DFT mils: 2, each coat.
3. Ferrous Metals - Gloss Epoxy Finish
 - a. First coat - SW Water Based Catalyzed Epoxy Primer B70 Series, DFT mils: 5.0.
 - b. Second and Third coats - SW Water Based Catalyzed Epoxy B70 Series, DFT mils: 3.0 per coat.
4. Galvanized Steel - Gloss Epoxy Finish
 - a. Two (2) coats SW Water Based Catalyzed Epoxy B70 Series, DFT mils: 3.0 per coat.
5. Gypsum Drywall - Semi-Gloss Enamel Finish:
 - a. First coat - SW ProMar 200 Latex Wall Primer B28 Series, DFT mils: 1.5.
 - b. Second and Third coats - SW ProMar 200 Latex Semi-Gloss Enamel B31 Series, DFT mils: 1.5 each coat.
6. Gypsum Wallboard - Flat Finish:
 - a. First coat - SW ProMar 400 Latex Wall Primer, B28 Series, DFT mils: 1.1.
 - b. Second and Third coats - SW ProMar 200 Latex Flat Wall Paint, B30 Series, DFT mils: 1.4.
7. Gypsum Wallboard - Eg-Shel Enamel Finish:
 - a. First coat - SW ProMar 200 Latex Wall Primer B28W200 Series, DFT mils: 1.4.
 - b. Second and Third coats - SW ProMar 200 Latex Eg-Shel Enamel B20 Series, DFT mils: 1.5, each coat.
8. Gypsum Drywall - Gloss Epoxy Finish.
 - a. First coat - SW Pro-Mar 200 Latex Wall Primer B28 Series, DFT mils: 1.4.
 - b. Second and Third coats - SW Water Based Catalyzed Epoxy B70 Series, DFT mils: 3.0 per coat.
9. Gypsum Board to Receive Vinyl Wallcovering:
 - a. One coat Preprite High-Holdout Latex Primer, B28WY2000 Series.
10. Concrete, Concrete Planks and Concrete Block - Eg-Shel Enamel Finish:
 - a. First coat: SW Heavy Duty Block Filler B42W46 Series, DFT mils: 10.
 - b. Second and Third coats - SW ProMar 200 Latex Eg-Shel Enamel B20 Series, DFT mils: 1.5, each coat.
11. Concrete Block - Gloss Epoxy Finish:
 - a. First Coat - SW Heavy-Duty Block Filler B42W46 Series @ 10 mils DFT.
 - b. Second and Third coats - SW Water Based Catalyzed Epoxy B70 Series, DFT mils: 3.0 per coat.
12. Wood - Semi-Gloss Enamel Finish:
 - a. First coat - SW ProMar 200 Alkyd Enamel Undercoater B49W200 Series, DFT mils: 2.
 - b. Second and Third coats - SW ProMar 200 Alkyd Semi-Gloss Enamel B34 Series, DFT mils: 2, each coat.
13. Wood - Open Grain and Close Grain - Stained Finish:
 - a. First coat - Minwax Polycrylic Satin.
 - b. Second coat - Minwax Polycrylic Satin.
 - c. Third coat - Minwax Polycrylic Satin.
14. Guestroom Walls and Ceilings (Exclude Closets): - "Light Orange Peel" Textured Semi-Gloss Enamel Finish:
 - a. First coat - SW ProMar 200 Latex Wall Primer B28W200 Series.
 - b. Second and Third coats - SW ProMar 400 Latex Eg-Shel Enamel B20 Series.

SECTION 09 90 00

PAINTING

PART 3 – EXECUTION

3.1 COOPERATION WITH THE OTHER TRADES

- A. This work shall be scheduled and coordinated with other trades and shall not proceed until other work and job conditions are as required to achieve satisfactory results.

3.2 GENERAL REQUIREMENTS

- A. Before starting any work, surfaces to receive paint finishes shall be examined carefully for defects which cannot be corrected by the procedures specified herein and which might prevent satisfactory painting results. Work shall not proceed until such damages are corrected.
- B. Secure approval of color samples before applying any paint or finish. All priming coats and undercoats shall be tinted to the approximate shade of the final coat.
- C. Start of painting shall be construed as acceptance of the surfaces to receive paint or other finish.
- D. Maintain temperature in building at constant 65 °F, or above, during drying of masonry, and provide adequate ventilation for escape of moisture from building in order to prevent mildew, damage to other work and improper drying of paint. Once painting has commenced, provide constant temperature of 65°F, or above, and prevent wide variation in temperature which might result in condensation on freshly painted surfaces.
- E. Surfaces to receive work described in this section shall be smooth, even, sound, thoroughly clean and dry and free of defects which would adversely affect application of this work. Surfaces which do not meet the tolerances or quality requirements imposed within the specifications governing substrate construction, shall be repaired or replaced prior to initiating this work.
- F. All materials shall be mixed, thinned, modified, and applied only as specified by the manufacturer's direction on the container.
- G. Application shall be sufficiently heavy to achieve pleasingly uniform color and lucid effect; matching approved sample.
- H. All coats shall be thoroughly dry before applying succeeding coats.
- I. The number of coats specified are intended to provide full coverage. Satisfactory coverage subject to the approval of the Architect. Additional coat or coats will be required by the Architect if these coats do not give sufficient coverage. Final coat shall match approved sample panel.

3.3 PREPARATION OF SURFACES

- A. General:
 - 1. Surfaces shall be clean, dry and adequately protected from dampness.
 - 2. Surfaces shall be smooth, even and true to plane.
 - 3. Surface shall be free of any foreign material which will adversely affect adhesion or appearance of applied coating.
 - 4. Remove all loose, spalling paint from previously painted surfaces utilizing wire brushes, pressure washing or mechanical means, as required to provide a smooth and sound substrate for the application of new paint.
 - 5. Mildew shall be removed and neutralized by scrubbing affected areas thoroughly with a solution made by adding two ounces of Tri-Sodium Phosphate and eight ounces of Sodium Hypochlorite (Clorox) to one-gallon warm water. Use a scouring powder if necessary to remove mildew spores. Rinse with clear water and allow to dry before painting.

SECTION 09 90 00

PAINTING

6. Efflorescence on any area that is scheduled to be painted shall be treated as herein specified provided that the structural defects allowing the entrance of moisture are corrected before painting.
 7. Scrub off efflorescence with a commercial lime solution or one (1) part commercial muriatic acid to five (5) parts water, then rinse with clear water and allow surface to thoroughly dry before painting.
- B. Gypsum Wallboard:
1. Fill narrow, shallow cracks and small holes with spackling compound.
 2. Rake deep, wide cracks and deep holes.
 - a. Dampen with clear water.
 - b. Fill with thin layers of drywall joint cement.
 3. Allow to thoroughly dry.
 4. Sand smooth. Do not raise nap of paper on wallboard.
- C. Wood:
1. Clean soiled surfaces with alcohol wash.
 2. Except where rough exterior surface is specified, sand to smooth and even surface, then dust or vacuum.
 3. Apply shellac to all knots, pitch and resinous sapwood before priming coat is applied.
 4. Fill nail holes, cracks, open joints and other defects with wood filler or lead putty as required after priming coat has dried. Filler material must be compatible with finish being applied. Color to match finish color.
- D. Preparation of Ferrous Metal Surfaces:
1. Remove rust, mill scale and defective paint down to sound surface or bare metal, using scraper, sandpaper, or wire brush as necessary. Grind if necessary to remove shoulders at edge of sound paint to prevent flaws from photographing through finish coats.
 2. Remove dirt and grease with mineral spirits and wipe dry with clean cloths.
 3. Touch-up all bare metal and damaged shop coats with specified rust-inhibitive primer.
 4. Necessary touching up of shop primer shall be done on ferrous metal surfaces of all items installed adjacent to concrete and masonry prior to any openings between metal surface and adjacent surfaces being filled in or caulked.
- E. Preparation of Galvanized Metal Surfaces:
1. Remove dirt and grease with mineral spirits and wipe dry with clean cloths.
 2. All galvanized steel surfaces shall be pre-treated with proprietary acid-bound resinous or crystalline zinc phosphate preparations used according to the manufacturer's directions prior to painting.
- F. Preparation of Masonry and Concrete Surfaces:
1. Masonry surfaces must be free from dirt, loose or excess mortar and be thoroughly dry. Perform moisture test prior to application of paint over any masonry surface. Moisture content must be within range recommended by paint manufacturer for the application involved.
 2. Point all open mortar joints; fill all holes with mortar.
 3. Comply with requirements set forth in Section 03300 for patching and repairing of concrete surface irregularities prior to application of any paint materials.
- G. Preparation of Aluminum Surfaces: Remove dirt and grease with mineral spirits, and wipe dry with clean cloths. H. Preparation of Copper Surfaces:
1. Buff or polish surfaces to bright color.
 2. Remove dirt and grease from surface with a mild phosphoric acid. Wipe dry with clean cloths.
 3. Apply finish while surface is clean and bright.

SECTION 09 90 00

PAINTING

3.4 APPLICATION

A. General:

1. Protection of Adjacent Surfaces and Mixed Items:
 - a. The Contractor not only shall protect his work at all times, but shall also protect all adjacent work and materials by drop cloth, covering or other methods during progress of his work.
 - b. Remove and protect hardware, accessories, device plates, lighting fixtures, factory finished work, and similar items, or provide ample in-place protection. Upon completion of each space, carefully replace all removed items. This work shall be done only by skilled mechanics.
 - c. Remove electrical panel box covers and doors before painting wall. Paint separately and reinstall after paint is dry.
2. The undercoats of paint and enamel shall be of approximate shade of the final coat. All metal surfaces calling for enamel or varnished finish shall first have priming coat well sanded, and shall be sanded between coats with fine sandpaper or steel wool that will produce an even, smooth finish. Each coat shall be perfectly dry before applying succeeding coats.
3. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer. Test with moisture meter. Exterior surfaces shall not be painted in damp, frosty, or cold weather. Latex paints shall not be applied when surface or air temperature is below 50°F.
4. Surfaces shall be finished the same as nearest or adjoining surfaces unless otherwise shown.
5. Exposed access doors or panels, exposed electric panel board covers, exposed pipes, ducts and raceways shall be painted the same color as adjacent surfaces. All piping exposed in finished areas shall be painted as required for interior ferrous metal. Where galvanized pipe occurs, prime galvanized surface as specified.
6. Hardware and accessories, fixtures and similar items placed prior to painting shall be removed or protected during painting, replaced on completion of painting.
7. Remove silencers from metal door frames prior to painting. Afterwards, replace silencers.
8. The tops, bottoms and edges of all doors to be painted shall be finished to match the surface of the doors after the hardware has been attached. Any door found unpainted upon the completion of the painting work shall be taken down and painted.
9. All suction spots in concrete which are noticeable after application of the first coat shall be touched up before applying the second coat.
10. Any exposed metal such as chairs, nails or tie wires in reinforced concrete slabs shall be covered with a rust inhibitive material.
11. All weather exposed HVAC and electrical equipment shall be painted.

3.5 FIELD QUALITY CONTROL

- A. The first finished area or item of each color scheme required shall be reviewed by the Architect for color, texture, and workmanship.
- B. First acceptable area or items shall be used as project standard for each color scheme.

3.6 CLEANUP

- A. During progress of the work, keep areas free from any unnecessary accumulation of tools, equipment and surplus materials and debris.
- B. At completion of work, the painting contractor shall remove from the premises all surplus painting materials and all debris created by him; he shall remove all spatters and leave his part of the work in a clean and finished condition.

END OF SECTION

SECTION 09 97 23

CONCRETE AND MASONRY COATINGS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section specifies an applied sealer for horizontal cast-in-place concrete surfaces.
- B. Related Sections: Refer to the following specification sections for coordination.
 - 1. Section 03 30 00 - Cast-In-Place Concrete.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions.
- B. Mock-Up: Prepare a test area minimum 2 by 2 feet in size to verify suitability of the sealer and final appearance.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10 years experience producing concrete coatings.
- B. Installer: Licensed installers experienced and trained in the use of specified products.
- C. Suitability of Substrate: Concrete surface must be clean and dry with all stains, oil, grease, dust and dirt removed prior to application. A thorough pressure washing is highly recommended.
- D. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and applicable codes at the location of the project.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Protect from damage.
- B. Store in a safe place, out of direct sunlight. Keep containers tightly sealed. Do not allow product to freeze. Use within the manufacturer's recommended shelf life, approximately 12 months.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Concrete Sealer: High-performance, non-yellowing, clear acrylic-based sealer by Concrete Coatings Inc., 1105 North 1600 West, Layton, UT 84041, 800-443-2871, www.concretecoatingsinc.com. Provide the following:
 - 1. Sealer with Gloss Finish: CCI GemKote 100, with 100 g/L VOC.
 - 2. Sealer with Gloss Finish: CCI GemKote 350, with 350 g/L VOC.
 - 3. Sealer with Gloss Finish: CCI GemKote 400, with 400 g/L VOC.
 - 4. Sealer with Gloss Finish: CCI SuperSeal 2000, with 600 g/L VOC.
 - 5. Sealer with Matte Finish: CCI GemKote 100-M, with 100 g/L VOC.
 - 6. Sealer with Matte Finish: CCI GemKote 350-M, with 350 g/L VOC.
 - 7. Sealer with Matte Finish: CCI GemKote 400-M, with 400 g/L VOC.
 - 8. Sealer with Matte Finish: CCI SuperSeal 2000-M, with 600 g/L VOC.
 - 9. Performance: Concrete sealers shall meet or exceed the following:
 - a. Coverage: As recommended by manufacturer.
 - b. Moisture Retention, Test ASTM C 309: 0.21 kg/m² at 200 ft² per gallon and 0.32 kg/m² at 300 ft² per gallon.
 - c. Gasoline Resistance: Slight dulling after 15-minute exposure (ponding).

SECTION 09 97 23

CONCRETE AND MASONRY COATINGS

- d. Tg: 50 degrees C.
- e. Tukon Hardness: 30 minutes at 180 degrees F, 9.3; 30 minutes at 300 degrees F, 13.7.
- f. Pencil Hardness: 30 minutes at 180 degrees F, F; 30 minutes at 300 degrees F, H.
- g. Spray Conditions, Viscosity: 19 seconds, No. 2 Zhan cup.
- h. Abrasion Resistance: 160 mg lost, CS-17 wheel, 1000 g load, 1000 cycles.

PART 3 – EXECUTION

3.1 COOPERATION WITH THE OTHER TRADES

- A. Inspection: Prior to start of application, inspect existing conditions to ensure surfaces are suitable for installation including the following:
 - 1. Concrete has cured for a minimum of 28 days prior to the application of sealer.
 - 2. Surface is completely free of sealers, oils, dirt, paint, alkali, penetrating sealers and foreign materials that would prevent the sealer from penetrating the concrete surface.
 - 3. Concrete has been swept clean.
 - 4. Test area has been approved.

3.2 APPLICATION

- A. Concrete Sealer: Strictly comply with manufacturer's installation recommendations including the following:
 - 1. Apply after stain has dried at rate recommended by manufacturer.
 - 2. Clean surface as recommended by the manufacturer.
 - 3. All concrete flatwork designated as being sealed in the plans and specifications shall be sealed with 2-3 even coats of sealer, at the rate of approximately 150 to 200 square feet per gallon.

3.3 CLEANING AND PROTECTION

- A. Protection: Do not cover, but protect floor area from paint and other contaminants that could inhibit the sealer.

END OF SECTION

SECTION 10 26 13

CORNER GUARDS

PART 1 – GENERAL

1.1 CONDITIONS

- A. Requirements of the Conditions of the Contract apply to all work under this section.

1.2 DESCRIPTION

- A. Work covered by this section includes furnishing of and paying for all materials, labor, equipment, licenses taxes, and other items required for execution and completion of all work under this section.
- B. The work described in this section of the specifications includes, but is not limited to, the following:
 - 1. Surface Mounted Corner Guards for drywall construction.

1.3 RELATED WORK

- A. The following items of related work are specified and included in other sections of these specifications:
 - 1. Gypsum Board, Section 09 29 00.
 - 2. Sealants, Section 07 92 00.
 - 3. Painting, Section 09 90 00.

1.4 SUBMITTALS

- A. Submit complete shop drawings showing dimension's locations, types, sizes and finishes for the Architect's approval.
- B. Samples shall be submitted with shop drawings.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Wall Corner Guards shall be foam tape mounted utilizing continuous foam double faced tape. Colors shall be selected by Interior Designer.
 - 1. Guest rooms: Solid color, high impact polycarbonate, 1 ½" x 1 ½" x 1/16" x full height.
 - 2. Lobby and Public Areas: The C/S Group Acrovyn No. VA-200, 2" x 2" x full height.
 - 3. Laundry/housekeeping and back of house areas: Srailess steel, 3 ½" x 3 ½" x full height, 1/8" radius, 16 gauge, type 304 non-magnetic stainless steel, satin finish.
- B. Approved manufacturers:
 - 1. Construction Specialties, Inc., Muncy, Pennsylvania
 - 2. Balco, Inc., Wichita, Kansas
 - 3. Tri-Grad, Inc.
 - 4. Brown Manufacturing
 - 5. Tubular Specialties
 - 6. Wilkinson Co.

SECTION 10 26 13

CORNER GUARDS

PART 3 – EXECUTION

3.1 ERECTION

- A. The installation of corner guards shall be closely coordinated with the work of the wall construction and painting.
- B. Corner Guards shall be set straight, level and plumb as indicated and aligned with adjacent construction.

END OF SECTION

SECTION 10 26 16

WALL GUARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Wall guard system for wall protection and decoration

1.02 SECTION INCLUDES

Inpro Corporation;
580 W18766 Apollo
Muskego, WI 53150
Tele: (292) 679-9010
Web: (www.inprocorp.com)
Email: (lfrederick@inprocorp.com)

CD-01 CORNER GUARDS GUESTROOM

Source: **Inpro Corporation**
Product: Tape-On 90 Degrees
Color/Finish: Graystone 0151
Size/Dimension: ¾" x ¾" x full height

CD-02 CORNER GUARDS @ LOBBY AND PANTRY

Source: **Inpro Corporation**
Product: Surface Mounted Stainless Steel Corner Guard Size/Dimensions: 90 degrees x 1 ½" wing x Full Height of wall. Type 430 (standard grade) 16 gauge.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. National Building Code of Canada (NBC)
- C. National Fire Protection Association (NFPA)
- D. Society of Automotive Engineers (SAE)
- E. Underwriters Laboratory (UL)
- F. Underwriters Laboratory of Canada (ULC)
- G. Uniform Building Code (UBC)

1.04 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide wall guard systems that conform to the following requirements of regulatory agencies and the quality control of IPC Door and Wall Protection Systems, **InPro Corporation**.
 - 1. Fire Performance Characteristics: Provide UL Classified wall guards conforming with NFPA Class A fire rating. Surface burning characteristics, as determined by UL-723 (ASTM E-84), shall be flame spread of 10 and smoke development of 350 - 450.
 - 2. Self-Extinguishing: Provide wall guards with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test

WALL GUARDS

Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988.

3. Impact Strength: Provide rigid vinyl profile materials that have an Impact Strength of 30.2 flubs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
4. System Impact Resistance: Provide a wall guard system that resists an impact of 175.9 ft-lbs while producing no visual blemishes upon the vinyl cover surface and no deformations in the aluminum retainers, as tested in accordance with applicable provisions of ASTM F 476-84, paragraph 18, Impact Test.
5. Chemical and Stain Resistance: Provide wall guards that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
6. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
7. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.

1.05 SUBMITTALS

- A. Product Data: Manufacturer's printed product data for each type of wall guard specified.
- A. Detail Drawings: Mounting details with the appropriate fasteners for specific project substrates.
 - B. Samples: Verification samples of wall guard, 8" (203mm) long, in full size profiles of each type and color indicated.
- D. Manufacturer's Installation Instruction: Printed installation instructions for each wall guard.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened factory packaging to the jobsite
- B. Inspect materials at delivery to assure that specified products have been received.
- C. Store in original packaging in a climate controlled location away from direct sunlight.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements: Products must be installed in an interior climate controlled environment.

1.08 WARRANTY

- A. Standard IPC Limited Lifetime Warranty against material and manufacturing defects.

PART 2 - PRODUCTS**2.01 PROPRIETARY MANUFACTURER**

- A. Acceptable Manufacturer: IPC Door and Wall Protection

WALL GUARDS

Systems,
InPro Corporation
PO Box 406
Muskego, WI 53150
Telephone: 800-222-5556, Fax: 888-715-8407,
Internet address: <http://www.inprocorp.com>

B. Substitutions: Not permitted

C. Provide all wall guards and wall protection from a single source.

2.02 MANUFACTURED UNITS

A. Wall Guard Profile

1. 700 Wall Guard, 7-3/4" (197mm) height x 1" (25mm) depth, with continuous aluminum retainer.
2. 700W Wall Guard, 7-3/4" (197mm) height x 1" (25mm) depth, with continuous aluminum retainer. Wall guard has a full wrap woodgrain pattern. Black reveals for end caps and corners.
3. Options: Curved wall guard, specify radius. Minimum radius - 3 feet (.91m)

2.03 MATERIALS

- A. Vinyl: Snap on cover of .080" (2mm) thickness shall be extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth).
- B. Aluminum: Continuous aluminum retainer of .080" (2mm) thickness shall be fabricated from 6063-T5 aluminum, with a mill finish.

2.04 COMPONENTS

- A. End caps, outside corners, inside corners and brackets shall be made of injection molded thermoplastics.
- B. Molded reveals shall have a smooth finish and shall be black.
- C. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawings shall be provided.

2.05 FINISHES

- A. Vinyl Covers: Colors of the wall guard to be selected by the architect from the IPC finish selection. Surface shall have a pebblette texture.
- B. Molded Components: End caps, outside corners, inside corners and brackets shall be of a color matching the wall guards. Surface shall have a pebblette texture.

SECTION 10 26 16

WALL GUARDS

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions in which the wall guard systems will be installed.
- B. Complete all finishing operations, including painting, before beginning installation of wall guard system materials.
- C. Wall surface shall be dry and free from dirt, grease and loose paint.

3.02 PREPARATION

- A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.03 INSTALLATION

- A. General: Locate the wall guard as indicated on the approved detail drawing for the appropriate substrate and in compliance with the IPC installation instructions. Install level and plumb at the height indicated on the drawings.
- B. Installation of Tape-On 90 degree Wall Guards:
 - 1. Cut the aluminum retainer to the desired length, allowing 1-9/16" (40mm) for each end cap, 7/16" (11mm) for each outside corner and 1-9/16" (40mm) for each inside corner.
 - 2. Drill 1/4" (6mm) holes in the aluminum retainer, 4" (102mm) from each end and evenly in a "zigzag" pattern. (10 anchors per 12' (3.66m) length).
 - 3. Position and level the aluminum retainer on the wall, allowing for end caps and corners, and transfer mounting holes to the wall with a marker. Drill 1/4" (6mm) holes at each mark and position ALLIGATOR anchors into the holes on the wall.

Mount the retainer with #10 x 1-3/4" phillips pan head screws and tighten the screws to secure the retainer.

Slide reveals onto end caps and corners). Slide the end caps and corners onto the aluminum, leaving a 1/16" gap for adjustments, and secure with two 1-1/4" self-tapping screws per end cap or four per corner.
 - 4. Cut the vinyl cover to the distance between the end caps/corners. NOTE: Trim all factory edges square before installation. Position the vinyl cover on the aluminum retainer starting at one end and working to the other end by pushing the cover over the aluminum until it snaps into place.

3.04 CLEANING

- A. At completion of the installation, clean surfaces in accordance with the IPC clean-up and maintenance instructions.

END OF SECTION

SECTION 10 44 13

FIRE PROTECTION CABINETS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Fire Rated Fire Extinguisher Cabinets for the following:
 - a. Portable fire extinguishers.
 - b. Fire hose valves.
 - c. Fire hoses and racks.
- B. Related Requirements:
 - 1. Section 10 44 16 "Fire Extinguishers."
 - 2. Section 21 12 00 "Fire-Suppression Standpipes" for fire-hose connections

1.2 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of [fire extinguishers] [fire hoses, hose valves, and hose racks] indicated are accommodated.
- B. Size Variations: Obtain Architect's acceptance and approval of manufacturer's standard size units that may vary slightly from sizes indicated on Drawings.
- C. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.3 ACTION SUBMITTALS

- A. Comply with Division 01 requirements.
- B. Shop Drawings:
 - 1. General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of door and panel units.
- C. Product Data: Manufacturer's technical data for each type of access door and panel assembly, including setting drawings, templates, fire-resistive characteristics, finish requirements, and details of anchorage devices.
 - 1. Include complete schedule, types, locations, construction details, finishes, latching or locking provisions, and other pertinent data.
- D. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.

1.4 QUALITY ASSURANCE

- A. NFPA 10 requirements for portable fire extinguishers.
- B. 2010 ADA Standards for maximum cabinet projection of 4 inches and mounting heights.
- C. ASTM E814 for fire resistive cabinets in rated wall assemblies.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Division 01 requirements.

SECTION 10 44 13

FIRE PROTECTION CABINETS

- B. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.
- C. Store per manufacturer's instructions.
 - 1. Store in dry area out of direct sunlight.

1.6 WARRANTY

- A. Provide manufacturer's written warranty.
- B. Warrant materials and workmanship against defects after completion and final acceptance of Work.
 - 1. Repair defects, or replace with new materials, faulty materials or fabrication developed during the warranty period at no expense to Owner.
 - 2. Fire Extinguisher Cabinet: 5 years from date of Substantial Completion of Project.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Nystrom
9300 73rd Avenue N
Nystrom, MN 55428
Phone: (800) 547-2635
Fax: (800) 317-8770
www.Nystrom.com

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-rated fire protection cabinets: listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.3 FIRE PROTECTION CABINET

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Nystrom; Alpine™ Fire Extinguisher Cabinet.
 - 1. Description: Steel unit construction, continuous piano hinge with 180 degree opening. Weld joints and grind smooth.
 - 2. Cabinet Mounting: Recessed, 1/2 inch (12.7 mm), Trimless
 - 3. Components
 - a. Door and frame
 - (1.) 0.036 inch (0.9mm) cold rolled steel.
 - (a.) Color and Finish: White from manufacturer's catalog factory applied powder coat paint finish.
 - (2.) 6063-T5 anodized aluminum
 - (a.) Color and Finish: Satin finish, clear polyester coated.
 - b. Tub: 0.036 inch (0.9mm) cold rolled steel
 - (1.) Color Finish: White factory applied powder coat paint finish.
 - c. Door Type: Full glass with tempered safety glass.
 - d. Options:
 - (1.) Door Glazing Type: See manufacturer's catalog for colors.
 - (2.) Lettering: Vertical die cut, white.
 - (3.) Latching: 90 Degree turn handle.

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FIRE PROTECTION CABINETS

4. Cabinet Dimensions: Size to match extinguisher type.
 5. Fire Rating: Non-fire rated.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Nystrom; Palisade™ Fire Extinguisher Cabinet.
1. Description: Steel unit construction, plexiglass door, gravity pin hinge with set screws to open 135 degrees. Weld joints and grind smooth.
 2. Cabinet Mounting: Recessed, 1/2 inch (12.7mm), Trimless.
 3. Components
 - a. Door and frame:
 - (1.) 0.036 inch (0.9mm) cold rolled steel.
 - (a.) Color and Finish: White, factory applied powder coat paint finish.
 - (2.) 6063-T5 anodized aluminum.
 - (a.) Color and Finish: Satin finish, clear polyester coated.
 - b. Tub: 0.036 inch (0.9mm) cold rolled steel.
 - (1.) Color and Finish: White factory applied powder coat paint finish.
 - c. Door Type: 0.236 inch (6mm) plexiglass.
 - d. Latching: Magnetic Catch
 4. Cabinet Dimensions: Size to match extinguisher type.
 5. Fire Rating: Non-fire rated and non-combustible wall systems.
- C. Basis-of-Design Product: Subject to compliance with requirements, Summit™ Fire Extinguisher Cabinet. provide Nystrom:
1. Description: Steel unit construction, concealed frame, handle and hinges.
 2. Cabinet Mounting: [Protrusion, 5/8 inch (15.875mm)]
 3. Components:
 - a. Door and Frame:
 - (1.) 0.036 inch (0.9mm) cold rolled steel.
 - (a.) Color and Finish: White applied powder coat paint finish.
 - (2.) 6063-T5 anodized aluminum.
 - (a.) Color and Finish: White factory applied powder coat paint finish.
 - b. Door Type: Duo Vertical Panel.
 - c. Latching: [90 degree turn handle][Pull handle roller catch][Fire pull handle roller catch][Flush pull handle].
 4. Cabinet Dimensions: Size to match extinguisher type.
 5. Fire Rating: [Non-fire rated][Fire rated for 1 hour or 2 hour combustible and noncombustible wall systems]
- D. Basis-of-Design Product: Subject to compliance with requirements, provide Nystrom; Ridge™ Fire Extinguisher Cabinet.
1. Description: Steel unit construction, continuous piano hinge with 180 degrees opening, architectural convex, clear “bubble” window.
 2. Cabinet Mounting: [Recessed, 1/2 inch (12.7mm)][Semi-Recessed, 2 inches (50mm)][Semi-Recessed, 3 inches (76mm)][Surface][Trimless]
 3. Components:
 - a. Door and Frame:
 - (1.) 0.036 inch (0.9mm) cold rolled steel.
 - (a.) Color and Finish: [White][Red][Select from manufacturer’s catalog] factory applied powder coat paint finish.
 - (2.) 6063-T5 anodized aluminum.
 - (a.) Color and Finish: Satin finish, clear polyester coated.
 - (3.) 0.0652 inch (1.66mm) stainless steel.
 - (a.) Color and Finish: Type 304 Stainless Steel with #4 finish
 - b. Tub: 0.036 inch (0.9mm) cold rolled steel.
 - (1.) Color and Finish: White factory applied powder coat paint finish.

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FIRE PROTECTION CABINETS

- c. Door Type: [Convex Clear Full bubble with catch][Convex Clear Full bubble with scored acrylic insert and trip lever cylinder lock].
(1.) Optional bubble color: [Bronze tinted][Smoke tinted]
- d. Options:
 - (1.) Lettering: [None][Vertical die cut, white][Vertical die cut, black][Vertical die cut, red][Vertical ascending die cut, white][Vertical ascending die cut, black][Vertical ascending die cut, red][Vertical decal, white][Vertical decal, black][Vertical decal, red].
 - (2.) Latching: [Pull handle roller catch][Fire pull handle roller catch][Flush pull handle]
- 4. Cabinet Dimensions: Size to match extinguisher type.
- 5. Fire Rating: [Non-fire rated][Fire rated for 1 hour or 2 hour combustible and non-combustible wall systems]

2.4 PORTABLE HAND-CARRIED FIRE EXTINGUISHERS

- A. ABC Dry Chemical Portable Fire Extinguisher
 - 1. Multi-purpose Dry Chemical Type in Steel Container <Insert drawing designation>: UL Rated 4A:60B:C, 10 lb. (4.5kg) nominal capacity, with mono-ammonium phosphate based dry chemical in enameled steel container.
 - 2. Kitchen Class K Portable Fire Extinguisher
 - a. Wet Chemical Type 2A:1B:C: K, 2.5 gal. (9.5L) nominal capacity, with potassium acetate based chemical in stainless steel container; with pressure indicating gage.
 - 3. BC Dry Chemical Portable Fire Extinguisher
 - a. Regular Dry Chemical Type in Steel Container 60B:C, 10 lb. (2.5kg) nominal capacity, with sodium bicarbonate based dry chemical in enameled steel container.
 - 4. Carbon Dioxide Portable Fire Extinguisher
 - a. Carbon Dioxide Type UL Rated 10B:C, 10 lb. (4.5kg) nominal capacity, with carbon dioxide in [manufacturer's standard enameled metal][enameled steel][enameled aluminum] container.
 - 5. Halotron I Portable Fire Extinguisher
 - a. Clean Agent Type in Steel Container: UL Rated 1A:10B:C, 10 lb. (4.5kg) nominal capacity, with HFC blend agent and inert material in enameled steel container; with pressure indicating gage.
- B. Options: Mounting Brackets
- C. Anti-freeze Charge

2.5 ACCESSORIES

- A. Wall Mounting Bracket with Extinguisher: Sized for each extinguisher. Manufacturer's standard mounting bracket with strap to secure fire extinguisher to bracket.
- B. Lettering and warning labels.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings for cabinet are correctly sized and located.
- B. Verify blocking is in place for brackets.

3.2 PREPARATION

- A. Coordinate work relating to fire extinguisher cabinet installation including rough opening dimensions and locations of supports.

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FIRE PROTECTION CABINETS

3.3 INSTALLATION

- A. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
- B. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
- C. Fire-rated units: Include UL label, UL classified listing No. 7N43 ANSI/UL 1479.

END OF SECTION

SECTION 10 44 16

FIRE EXTINGUISHERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes portable, fire extinguishers.
- B. Related Sections:
 - 1. Division 10 Section "Fire Extinguisher Cabinets."
- C. Submittals
- D. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.
- E. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.
- F. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
- G. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.4 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 PORTABLE HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each indicated.

SECTION 10 44 16

FIRE EXTINGUISHERS

1. Basis-of-Design Product: Subject to compliance with requirements, provide J. L. Larson Industries, Inc.; Cosmic 10 lb. or comparable product by one of the following:
 - a. Amerex Corporation.
 - b. Kidde Residential and Commercial Division; Subsidiary of Kidde PLC.
 - c. Larsen's Manufacturing Company.
 - d. Potter Roemer LLC.
 - e. Pyro-Chem; Tyco Safety Products.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with mono-ammonium phosphate-based dry chemical in enameled steel container.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction. See Division 10 Section "Fire Extinguisher Cabinets."

END OF SECTION

SECTION 10 73 10

PROTECTIVE COVERS

PART 1 – GENERAL

.01 SECTION INCLUDES

- A. Design and installation of extruded aluminum walkway covers and canopies.

.02 RELATED WORK

- A. Concrete
- B. Sealants

1.03 REFERENCES

- A. The Aluminum Association- Aluminum Design Manual 2010
- American Welding Society- AWS D1.2/D1.2M: 2008

1.04 SUBMITTALS

- A. Manufacturers brochures, manuals and literature.
- B. Shop drawings of the complete canopy layout, includes sections and details specific to project and bearing the seal of a registered structural engineer.
- C. Samples of canopy finishes.

1.05 QUALITY ASSURANCE

- A. Canopy shall be designed to comply with local building codes.
- B. Canopy manufacturer shall have a minimum of 10 years' experience in designing and installing the specified system.
- C. The installation of the canopy shall be performed by the manufacturer to assure single source responsibility.

Part 2 – Products

2.01 MANUFACTURER

- AVAddek Walkway Covers & Canopies

2.02 MATERIALS

- A. All components shall be 6063; 6061 or 6005 alloy extruded aluminum.
- B. Components shall be sized to comply with live load and wind load requirements of the project and shall not be less than the dimensions shown on the plan.
- C. The thickness of the aluminum deck panels shall be at least .080" thick.
- D. All columns shall have radius corners.
- E. Beams are open at top to drain canopy system internally into columns.
- F. Flashing shall be .040" thick.
- G. All bolts and fasteners shall be stainless steel or finished to match adjacent components and sized by canopy engineer.

2.03 FINISHES

- A. The finish and color selection of each component shall be chosen from the manufacturer's standard color selections and shall include:
 - 1. Polyester Baked Enamel
 - 2. Fluoropolymer
 - 3. Anodized- Clear, Bronze & Champagne

Part 3 – Execution

3.1 FABRICATION

- A. All welding shall be in compliance with AWS 1.2. The certification of each welder shall be available to verify compliance.
- B. Canopy shall be designed to drain through beams to columns with water tight connections.

SECTION 10 73 10

PROTECTIVE COVERS

3.2 INSTALLATION

- A. Install the canopy in strict accordance with the manufacturer's recommendations.
- B. Erect canopy after concrete and masonry work in vicinity is completed and washed down.
- C. Install columns and beams straight and true.
- D. Install raincaps over draining sections of the deck.
- E. The general contractor shall finish the concrete around the columns to assure a uniform quality of workmanship and appearance with the adjacent surrounding concrete work.
- F. Fill downspout columns with grout to the discharge level to prevent standing water.
- G. Install flashing as required.
- H. Care shall be taken to prevent damage or scratching during installation.
- I. Thoroughly clean canopy after installation.

END OF SECTION

SECTION 10 75 00

FLAGPOLES

PART 1 – GENERAL

1.1 SECTIONS INCLUDES

- A. Materials, fabrications and installation for, clear anodized finish aluminum flagpoles, and all parts and fabrication shall be made in the United States.

1.2 RELATED SECTIONS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 26 56 00 – Exterior Lighting
- D. Section 31 23 16 - Excavating, Trenching and Backfilling.

1.3 REFERENCES

- A. The Aluminum Association (AA)
 - 1. DAF 45, Designation System for Aluminum Finishes.
- B. American Society for Testing and Materials International (ASTM)
 - 1. ASTM B241/B241M, Standard Specification for Aluminum and Aluminum - Alloy Seamless Pipe and Seamless Extruded Pipe.
- C. The Masters Painters Institute (MPI)
 - 1. Architectural Painting Specification Manual.

1.4 DESIGN REQUIREMENTS

- A. Flagpoles, bases and anchorage devices to resist minimum wind velocity of 145 km/h unflagged, 100 km/h flagged. The Architectural Series Flag Poles are an aluminum ground-set, external halyard flagpole, up to 35 ft, and shipped as one-piece, shingle sheave, revolving truck poles.
- B. Provide (1) 35 ft. exposed Clear Anodized Aluminum Finish Flag Pole; Series EC35, SKU: CPEC35S, MPN: EC35S, for the American Flag.
- C. Provide (1) 30 ft. exposed Clear Anodized Aluminum Finish Flag Pole; Series EC30, SKU: CPEC30S, MPN EC30S, for the TRU by Hilton Brand Flag.

Manufacturer: **EDER FLAG Manufacturing Company**; 1000 W. Rawson Avenue Oak Creek, WI 53154.

- D. Substitutions as per Section 01 35 00, are acceptable.

1.5 SUBMITTALS

- A. Submit manufacturer's technical data and installation instructions for each type of flagpole.
- B. Indicate dimensions, finishes, base jointing, grounding devices, anchoring and support systems, cleats, halyard boxes, trucks, finials, and base collar for flagpoles.

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FLAGPOLES

- C. Submit Shop Drawings of flagpoles and bases, showing general layout, jointing and complete anchoring and supporting systems.
- D. Submit sample of flagpole (3ft or 900 mm) long.

1.6 QUALITY ASSURANCE

- A. Provide each flagpole as complete unit produced by single manufacturer, including fittings, accessories, bases and anchorage devices.
- B. Manufacturer will provide a minimum 5 Year Warranty

1.7 DELIVERY AND STORAGE

- A. Deliver, store, handle and protect materials in accordance with Division 1.
- B. Spiral wrap each flagpole with heavy kraft paper, wood strip and steel band, or polyethylene wrap and pack in tubing for shipment.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Aluminum: Aluminum Association alloy AA 6063-T5 seamless extruded aluminum tubing.
- B. Isolation coating: alkali-resistant bituminous paint or epoxy resin solution.

2.2 FABRICATION

- A. Supply *(1-30ft or 9144mm)* and *(1-35ft or 10,668mm)* long flagpole as complete unit including base, mounting brackets, anchorage and fittings.
- B. Cone tapered flagpole:
 - 1. Seamless, uniform, straight line tapered section above cylindrical butt section.
 - 2. Taper: 25 mm of run.
 - 3. Provide internal splicing, self-aligning sleeve of same material as flagpole for snug fitting, watertight field joints.
- C. Do welding to appropriate CSA Standards by welders certified by Canadian Welding Bureau. Finish exposed welds flush and smooth.

2.3 ACCESSORIES

- A. Finial: 8" dia. Or 203 mm diameter ball of 14 gage minimum thick, spun aluminum ball, anodized to match flagpole finish.
- B. Truck assembly: cast aluminum, stainless steel ball bearings, non-fouling, revolving double truck assembly, finish to match flagpole.
- C. Cleats: (1-9" or 230 mm size), One per halyard, cast aluminum, finish to match flagpole.
- D. Halyard: External, One continuous halyard per flagpole; 10 mm (No. 12) polypropylene, braided white cotton.
- E. Swivel snaps: two per halyard; Bronze swivel snaps with neoprene or vinyl covers per halyard.

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FLAGPOLES

- F. Cleat box: one per cleat; cast aluminum, finish to match flagpole. Furnish hasp for padlock, hinged cover, and tamperproof screws. Include lockable cleat box.

2.4 FINISHES

- A. Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.
 - 1. Clear anodic finish: designation AA-M32, C22, A41; Alloy: 6063T6
- B. Appearance and properties of anodized finishes designated by the Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative.

2.5 FIELD FABRICTION

- A. Fabricate ground-set tapered foundation assembly for sleeve installation of flagpole as recommended by Flagpole manufacturer for wind loads as indicated.
- B. Provide (1) LED Electric, Flush Mounted with Concrete Pavement, Weather-proof, Up-Light for each Flag Pole. Refer to Section 26 5600 Exterior Lighting.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Shop apply isolation coating to metal surfaces of flagpole and base that will be encased in 3500 PSI Concrete.
- B. Install flagpoles, base assemblies and fittings to shop drawings and manufacturer's instructions.
- C. Provide lightning rods for grounding of each flagpole installation as indicated.

3.2 COMMISSIONING

- A. Check and adjust installed fittings for smooth operation of halyards, and instruct Owner on adjustment and maintenance procedures.

END OF SECTION

SECTION 14 91 33

LAUNDRY AND LINEN CHUTES

PART 1 – GENERAL

1.1 SUMMARY

- A. Applicable provisions of the General Conditions and of Division 1, General Requirements, govern all work in this Section.
- B. The work under this Section includes materials and installation of linen chute, complete with mounting hardware, doors and related accessories.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In-Place Concrete.
- B. Section 04 20 00 – Unit Masonry.
- C. Section 07 62 00 – Sheet Metal Flashing and Trim.
- D. Section 09 29 00 – Gypsum Board.

1.3 QUALITY ASSURANCE

- A. Install units, sprinklers, and related equipment according to NFPA, U.L. and applicable codes.

1.4 SUBMITTALS

- A. Prior to fabrication of chutes, submit copies of drawings and technical data to the Architect in accordance with Section 01 33 00. Shop drawings shall indicate factory fabricated items and field fabricated items, connections for sprinklers, support doors, chute access hatches, plumbing and flashing connections, required wiring connections and conduit runs for wiring, including any required door interlocks. Submittals must be reviewed and approved prior to fabrication.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Valiant Laundry Chute: The chute shall be made of 16 gage standard aluminized steel, galvanized steel or stainless steel. Side hinged, hand operated, self-closing, 22 gauge stainless steel intake door with steel angle frame assembly. U.L."B" label, 1 1/2 hr. 250° 30 min. temperature rise. Valiant Products, Inc. chutes are available in 36", 30", and 24" diameters. The standard chute size is 24" per NFPA recommendations. Valiant Products, Inc. chutes are constructed of 16 gage standard aluminized steel, galvanized steel or stainless steel.

2.2 PRODUCTS, GENERAL

- A. Door and Chute:
 - 1. Recommended Door and Chute Size: W = DOOR WIDTH & H = DOOR HEIGHT

CHUTE SIZE	DOOR SIZE~ W x H
24" Diameter Chute	18" x 18" Door
30" Diameter Chute	21" x 21" Door
36" Diameter Chute	24" x 24" Door

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LAUNDRY AND LINEN CHUTES

1. Provide stainless door trim with embossed letters "SOILED LINEN". Provide cylinder lock on each intake door.
 2. Discharge door shall be Type "H" hopper with 24" wide x 30" high, stainless steel, self-closing, positive latching, top hinged, hand operated door bearing 1-1/2 hour. Reinforce bottom with #13 gauge impact plate. Hopper shall be complete with 2" IPS drain flange for connection by plumber. Support hopper with 2" pipe pedestal.
- B. Vent: Provide full diameter vent through roof 4'-0" above roof with metal explosion cap and self-flashing roof flange for installation without curb.
- C. Provide Electric Interlocks - 120v, 60 HZ so that only one intake door can be opened at a time, with illuminated in-use light & push button field wiring by electrical contractor.
- D. Accessories:
1. Sprinklers: Provide 1/2" IPS 165 degree sprinkler head above top intake and additional 1/2" sprinklers at every second intake or as required by Code. Provide 3/4" IPS flushing spray head located in channel above top intake.
 2. Provide floor frames of 1-1/2" x 1-1/2" x 3/16" angles and 1-1/2" x 3/16" bar stock welded assembly.
- E. Fire stopping Material: For fire stopping at each penetration of floor deck, provide insulation in accordance with Section 07270. Provide 16-gauge zinc-coated steel sheet with flange under deck at each penetration for retainage of fire stopping material.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Sheet metal workers shall assemble the chute, align and anchor to floor so as to be independent of wall construction.
- B. Plumbers shall run water supplies to the flushing and sprinkler heads.
- C. Electricians shall run conduit and wiring to electrical equipment such as interlocks or smoke detectors.
- D. Install fire stopping prior to erection of chute enclosure walls.
- E. Install wall system around chute as shown. Erect walls after all other work is completed. Chute intake doorframes shall be set square and flush with the finish wall face as the walls are erected.
- F. Flash around roof penetration as required by Sections 07 60 00 and 07 62 00.

3.2 CLEANUP

- A. Upon completion of the erection and installation of the chute, remove from the site excess materials and debris.

END OF SECTION

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Fire-department connections.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Manual control stations.
 - 7. Control panels.
 - 8. Pressure gages.

1.3 DEFINITIONS

- A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 300 psig
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. High-Pressure Piping System Component: Listed for 300-psig working pressure.
- C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Available fire-hydrant flow test records shall indicate the following conditions:
 - a. Date
 - b. Time
 - c. Performed by
 - d. Location of Residual Fire Hydrant
 - e. Location of Flow Fire Hydrant
 - f. Static Pressure at Residual Fire Hydrant
 - g. Measured Flow at Flow Fire Hydrant
 - h. Residual Pressure at Residual Fire Hydrant
- D. 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:

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WET-PIPE SPRINKLER SYSTEMS

- a. Building Service Areas: Ordinary Hazard, Group 1.
- b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
- c. Stage Area: Ordinary Hazard, Group 2.
- d. General Storage Areas: Ordinary Hazard, Group 1.
- e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
- f. Classroom, Office and Public Areas: Light Hazard.
- g. Cafeteria Service Areas: Ordinary Hazard, Group 1.
3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
 - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
- E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated: Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
 2. Piping materials, including sprinkler specialty fittings.
 3. Pipe hangers and supports, including seismic restraints.
 4. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 6. Hose connections, including size, type, and finish.
 7. Alarm devices, including electrical data.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Fire-hydrant flow test report.
- F. 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."

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- G. Field quality-control reports.
- H. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to allow for mechanical installations
- C. Coordinate installation of required supporting devices and set sleeves in poured-in- place concrete and other structural components as they are constructed.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS**2.1 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Black - Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Thinwall Black Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- D. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.
- E. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe

WET-PIPE SPRINKLER SYSTEMS

- with threaded ends.
- F. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- G. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- H. Malleable- or Ductile-Iron Unions: UL 860.
- I. Cast-Iron Flanges: ASME 16.1, Class 125.
- J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- K. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- L. Grooved-Joint, Steel-Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 2. Pressure Rating: 175 psig (1200 kPa) minimum.
 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full- face gaskets.
 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring- type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general- duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493, solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
 1. Use solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer that has a VOC content of 650 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200kPa).
 3. Minimum Pressure Rating for High-Pressure Piping: 300 psig (2070 kPa).
- B. Bronze Butterfly Valves:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fivalco Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.

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2. Standard: UL 1091.
 3. Pressure Rating: 175 psig (1200 kPa).
 4. Body Material: Bronze.
 5. End Connections: Threaded.
- C. Iron Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. NIBCO INC.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 2. Standard: UL 1091.
 3. Pressure Rating: 175 psig (1200 kPa).
 4. Body Material: Cast or ductile iron.
 5. Style: Lug or wafer.
 6. End Connections: Grooved.
- D. Check Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Anvil International, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Globe Fire Sprinkler Corporation.
 - e. NIBCO INC.
 - f. Potter Roemer.
 - g. Reliable Automatic Sprinkler Co., Inc.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
 - j. Viking Corporation.
 - k. Watts Water Technologies, Inc.
 2. Standard: UL 312.
 3. Pressure Rating: 300 psig (2070 kPa).
 4. Type: Swing check.
 5. Body Material: Cast iron.
 6. End Connections: Flanged or grooved.
- E. Bronze OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
 2. Standard: UL 262.
 3. Pressure Rating: 175 psig (1200 kPa).
 4. Body Material: Bronze.
 5. End Connections: Threaded.
- F. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Clow Valve Company; a division of McWane, Inc.

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- b. Mueller Co.; Water Products Division.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 - e. United Brass Works, Inc.
 - f. Watts Water Technologies, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 300 psig (2070 kPa).
- 4. Body Material: Cast or ductile iron.
- 5. End Connections: Flanged or grooved.
- G. Indicating-Type Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - 2. Standard: UL 1091.
 - 3. Pressure Rating: 175 psig (1200 kPa) minimum.
 - 4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 - 5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 - 6. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch indicating device.
- H. Indicator Posts:
 - 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. Clow Valve Company; a division of McWane, Inc.
 - b. Mueller Co.; Water Products Division.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 - 2. Standard: UL 789.
 - 3. Type: Horizontal for wall mounting.
 - 4. Body Material: Cast iron with extension rod and locking device.
 - 5. Operation: Wrench.

2.5 TRIM AND DRAIN VALVES

- A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating: 175 psig (1200 kPa) minimum.
- B. Angle Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
- C. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers

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offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Anvil International, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Kitz Corporation.
- d. NIBCO INC.
- e. Tyco Fire & Building Products LP.
- f. Victaulic Company.
- g. Watts Water Technologies, Inc.

D. Globe Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

E. Plug Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Southern Manufacturing Group.

2.6 SPECIALTY VALVES

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
 - b. High-Pressure Piping Specialty Valves: 300 psig (2070 kPa).
- 3. Body Material: Cast or ductile iron.
- 4. Size: Same as connected piping.
- 5. End Connections: Flanged or grooved.

B. Alarm Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
- 2. Standard: UL 193.
- 3. Design: For horizontal or vertical installation.
- 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
- 5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
- 6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
- 2. Standard: UL 1726.
- 3. Pressure Rating: 175 psig (1200 kPa) minimum.

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4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS**A. Exposed-Type, Fire-Department Connection:**

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. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire Protection Products, Inc.
 - d. Tyco Fire & Building Products LP.
2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire- department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" or "AUTO SPKR".
12. Finish: Polished chrome plated.
13. Outlet Size: NPS 4 (DN 100).

B. Flush-Type, Fire-Department Connection:

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. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire- department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" or "AUTO SPKR".
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4 (DN 100).

C. Yard-Type, Fire-Department Connection:

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:

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- a. AFAC Inc.
- b. Elkhart Brass Mfg. Company, Inc.
- c. Fire-End & Croker Corporation.
- d. Fire Protection Products, Inc.
- e. GMR International Equipment Corporation.
- f. Guardian Fire Equipment, Inc.
- g. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Exposed, freestanding.
4. Pressure Rating: 300 psig (2070 kPa).
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire- department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: Two.
11. Sleeve: Brass.
12. Sleeve Height: 18 inches (460 mm).
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" or "AUTO SPKR".
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4 (DN 100).

2.8 SPRINKLER SPECIALTY PIPE FITTINGS**A. Branch Outlet Fittings:**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.

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6. Inlet and Outlet: Threaded.
- C. Branch Line Testers:
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. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
 2. Standard: UL 199.
 3. Pressure Rating: 175 psig (1200 kPa).
 4. Body Material: Brass.
 5. Size: Same as connected piping.
 6. Inlet: Threaded.
 7. Drain Outlet: Threaded and capped.
 8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: 175 psig (1200 kPa) minimum.
 4. Body Material: Cast- or ductile-iron housing with sight glass.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
 2. Standard: UL 1474.
 3. Pressure Rating: 250 psig (1725 kPa) minimum
 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 5. Size: Same as connected piping.
 6. Length: Adjustable.
 7. Inlet and Outlet: Threaded.
- F. Flexible, Sprinkler Hose Fittings:
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. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Victaulic
 2. Standard: UL 1474.
 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 4. Pressure Rating: 175 psig (1200 kPa) minimum
 5. Size: Same as connected piping, for sprinkler.

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- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Reliable Automatic Sprinkler Co., Inc.
 - 3. Tyco Fire & Building Products LP.
 - 4. Victaulic Company.
 - 5. Viking Corporation.
- B. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
 - 3. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
 - 4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig (1725 kPa) minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Early-Suppression, Fast-Response Applications: UL 1767.
 - 2. Nonresidential Applications: UL 199.
 - 3. Residential Applications: UL 1626.
 - 4. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
 - 1. Characteristics:
 - a. Nominal 1/2-inch (12.7-mm) Orifice: With Discharge Coefficient K between 5.3 and 5.8
 - b. Nominal 17/32-inch (13.5-mm) Orifice: With Discharge Coefficient K between 7.4 and 8.2.
- E. Sprinkler Finishes:
 - 1. Chrome plated.
 - 2. Bronze.
 - 3. Painted.
- F. Special Coatings:
 - 1. Wax.
 - 2. Lead.
 - 3. Corrosion-resistant paint.
- G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
- H. Sprinkler Guards:
 - 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. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - 2. Standard: UL 199.
 - 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
 - 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:

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- a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
- 2. Standard: UL 753.
- 3. Type: Mechanically operated, with Pelton wheel.
- 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
- 5. Size: 10-inch (250-mm) diameter.
- 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
- 7. Inlet: NPS 3/4 (DN 20).
- 8. Outlet: NPS 1 (DN 25) drain connection.
- C. Electrically Operated Alarm Bell:
 - 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. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 - 2. Standard: UL 464.
 - 3. Type: Vibrating, metal alarm bell.
 - 4. Size: 6-inch (150-mm) minimum diameter.
 - 5. Finish: Red-enamel factory finish, suitable for outdoor use.
- D. Water-Flow Indicators:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - c. Viking Corporation.
 - d. Watts Industries (Canada) Inc.
 - 2. Standard: UL 346.
 - 3. Water-Flow Detector: Electrically supervised.
 - 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory- set, field- adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 5. Type: Paddle operated.
 - 6. Pressure Rating: 250 psig (1725 kPa).
 - 7. Design Installation: Horizontal or vertical.
- E. Pressure Switches:
 - 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. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - c. Tyco Fire & Building Products LP.
 - d. United Electric Controls Co.
 - e. Viking Corporation.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised water-flow switch with retard feature.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design Operation: Rising pressure signals water flow.

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- F. Valve Supervisory Switches:
 - 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. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled valve is in other than fully open position.
- G. Indicator-Post Supervisory Switches:
 - 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. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.11 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.12 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AMETEK; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gauge Range: 0 to 250 psig (0 to 1725 kPa) minimum.
- E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dialface.
- F. Air System Piping Gauge: Include "AIR" or "AIR/WATER" label on dialface.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

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- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire- Suppression Piping" and for piping insulation in Section 210700 "Fire- Suppression Systems Insulation."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire- Suppression Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire- Suppression Piping."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

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1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- I. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- L. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- N. 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. Apply primer.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Specialty Valves:
 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Where flexible drops are approved, install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
- C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

WET-PIPE SPRINKLER SYSTEMS

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.11 PIPING SCHEDULE

- A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- B. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller shall be one of the following:
 - 1. Standard-weight or Schedule 40, black-steel pipe with threaded ends; uncoated, gray- iron threaded fittings; and threaded joints.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
 - 1. Standard-weight or Schedule 40, black-steel pipe with threaded ends; uncoated, gray- iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be one of the following:
 - 1. Standard-weight or Schedule 40, black-steel pipe with threaded ends; uncoated, gray- iron threaded fittings; and threaded joints.

3.12 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
 - 5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.
 - 6. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - 4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 22 05 19
METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.
 - 7. Sight flow indicators.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Terice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Window: Glass.
 - 8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 - 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

METERS AND GAGES FOR PLUMBING PIPING**2.2 THERMOWELLS****A. Thermowells:**

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.**2.3 PRESSURE GAGES****A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:**

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. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Terice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).

METERS AND GAGES FOR PLUMBING PIPING

- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Ring: Metal.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, the following:**
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

METERS AND GAGES FOR PLUMBING PIPING

- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Archon Industries, Inc.
 - 2. Dwyer Instruments, Inc.
 - 3. Emerson Process Management; Brooks Instrument.
 - 4. Ernst Co., John C., Inc.
 - 5. Ernst Flow Industries.
 - 6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
 - 7. OPW Engineered Systems; a Dover company.
 - 8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 125 psig.
- E. Minimum Temperature Rating: 200 deg F.
- F. End Connections for NPS 2 and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
- J. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

METERS AND GAGES FOR PLUMBING PIPING

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

METERS AND GAGES FOR PLUMBING PIPING**3.4 THERMOMETER SCHEDULE**

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Industrial-style, liquid-in-glass type.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be one of the following:
 - 1. Liquid-filled direct-mounted, metal case.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
 - 1. Liquid-filled, direct-mounted, metal case.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 200 psi.
- B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION

HANGERS & SUPPORTS - PLUMBING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
1. Metal pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Fiberglass pipe hangers.
 4. Metal framing systems.
 5. Fiberglass strut systems.
 6. Thermal-hanger shield inserts.
 7. Fastener systems.
 8. Pipe stands.
 9. Pipe positioning systems.
 10. Equipment supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Fiberglass strut systems.
 4. Pipe stands.
 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
 2. Design Calculations: Calculate requirements for designing trapeze hangers.

HANGERS & SUPPORTS - PLUMBING**1.6 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS**2.1 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 3. Standard: MFMA-4.
 4. Channels: Continuous slotted steel channel with inturned lips.
 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 7. Metallic Coating: Electroplated zinc.
 8. Paint Coating: Vinyl
 9. Plastic Coating: PVC.
- B. Non-MFMA Manufacturer Metal Framing Systems:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers

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offering products that may be incorporated into the Work include, but are not limited to,

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the following:

- a. Anvil International; a subsidiary of Mueller Water Products Inc.
- b. Empire Industries, Inc.
- c. ERICO International Corporation.
- d. Haydon Corporation; H-Strut Division.
- e. NIBCO INC.
- f. PHD Manufacturing, Inc.
- g. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: PVC.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100- psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa)] or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated, stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V- shaped cradle to support pipe, for roof installation without membrane penetration.

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- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-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 INSTALLATION**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

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- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. 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.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- Q. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and

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- 0.06 inch thick.
- d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate- insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 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. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are as specified.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in

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- direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
 - F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.
 - G. Use padded hangers for piping that is subject to scratching.
 - H. Use thermal-hanger shield inserts for insulated piping and tubing.
 - I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 - 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 - 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

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21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment 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 piperings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar- joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

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2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 5. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load- adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use [powder-actuated fasteners] [or] [mechanical-expansion anchors] instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT PART 1 -

GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT PART 1 -

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch (0.64-mm) or anodized aluminum, 0.032-inch (0.8-mm)] minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11- inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT PART 1 -

- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 degC).
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Stainless steel, 0.025-inch (0.64-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT PART 1 -

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT PART 1 -

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches (50 mm), round.
 - b. Hot Water: 2 inches (50 mm), round.
 - c. Low-Pressure Compressed Air: 2 inches (50 mm), round.
 - d. High-Pressure Compressed Air: 2 inches (50 mm), round.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

PLUMBING PIPING INSULATION**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 1. Domestic cold-water piping.
 2. Domestic hot-water piping.
 3. Domestic recirculating hot-water piping.
 4. Domestic chilled-water piping for drinking fountains.
 5. Sanitary waste piping exposed to freezing conditions.
 6. Storm-water piping exposed to freezing conditions.
 7. Roof drains and rainwater leaders.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 1. Performed Pipe Insulation Materials: 12 inches long by NPS 2
 2. Jacket Materials for Pipe: 12 inches long by NPS 2
 3. Sheet Jacket Materials: 12 inches square.
 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket.

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materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS**2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:
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. Fibrex Insulations Inc.; Coreplus 1200
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation
 2. Type I, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

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- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
- b. Eagle Bridges – Marathon Industries; 225.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
- d. Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, adhesive shall have a VOC content of 80g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 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. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 met- ric perm) at 43 mil (1.09 mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 Deg F (Minus 29 to plus 82 Deg C).
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I. Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - b. Vimasco Corporation; 713 and 714.
 - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 4. Service Temperature Range: 0 to plus 180 Deg F (Minus 18 to plus 82 Deg C).
 - 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

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1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.7 SECUREMENTS

- A. Bands:
 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. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4 inch (19 mm) wide, stainless steel or Monel.
- C. Wire: 0.080 inch (2.0 mm) nickel-copper alloy.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

2.8 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 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. Engineered Brass Company
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products
 - c. McGuire Manufacturing
 - d. Plumberex
 - e. Truebro; a brand of IPS Corporation
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold- water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:

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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. TrueBro; a brand of IPS Corporation
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation
 - c. Or approved equal.
2. Description: Manufactured plastic enclosure for covering plumbing hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. 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 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and ends seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support,

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- and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
 - L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3 inch (75 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instruction, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
 - M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
 - N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
 - O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) 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. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

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4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.

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 the pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, 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

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“union.” Match size and color of pipe labels.

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- C. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flanges and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples 6 inches (150 mm) o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flanges.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.

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2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1 inch (25 mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below:
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections. Tests and Inspections:
 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Water (Hot & Cold):
 1. Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (13 mm) thick.
- B. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
 1. All Pipe Sizes: Insulation shall be of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (13 mm) thick.

END OF SECTION

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. Above ground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Designer and Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Designer's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
 - 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. Elkhart Products Corporation.
 - b. NIBCO Inc.
 - c. Viega.
 - 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O- ring seal in each end. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

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- H. Appurtenances for Grooved-End Copper Tubing:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International.
 - b. Shurjoint Piping Products.
 - c. Victaulic Company.
 2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 3. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: 300 psig (2070 kPa).

2.3 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
- B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.4 PEX-AL-PEX TUBE AND FITTINGS

- A. PEX-AL-PEX Distribution System: ASTM F 1281 tubing.
- B. Fittings for PEX-AL-PEX Tube: ASTM F 1281, metal-insert type with copper or stainless-steel crimp rings and matching PEX-AL-PEX tube dimensions.

2.5 PEX-AL-HDPE TUBE AND FITTINGS

- A. PEX-AL-HDPE Distribution System: ASTM F 1986 tubing.
- B. Fittings for PEX-AL-HDPE Tube: ASTM F 1986, metal-insert type with copper or stainless-steel crimp ring and matching PEX-AL-HDPE tube dimensions.

2.6.2.6

2.7 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.

2.8 TRANSITION FITTINGS

- A. General Requirements:
 1. Same size as pipes to be joined.

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2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWAC219.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
- D. Plastic-to-Metal Transition Fittings:
 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. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 2. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.
 2. Description:
 - a. CPVC or PVC four-part union.
 - b. Brass or stainless-steel threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.9 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Hart Industries International, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.
 2. Standard: ASSE 1079.
 3. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 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. Matco-Norca.

- b. Watts; a division of Watts Water Technologies, Inc.

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- c. Wilkins; a Zurn company.
- 2. Standard: ASSE 1079.
- 3. Factory-fabricated, bolted, companion-flange assembly.
- 4. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
- 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Pipeline Seal and Insulator, Inc.
 - 2. Nonconducting materials for field assembly of companion flanges.
 - 3. Pressure Rating: 150 psig (1035 kPa).
 - 4. Gasket: Neoprene or phenolic.
 - 5. Bolt Sleeves: Phenolic or polyethylene.
 - 6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
 - 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. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Victaulic Company.
 - 2. Standard: IAPMO PS 66.
 - 3. Electroplated steel nipple complying with ASTM F 1545.
 - 4. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - 5. End Connections: Male threaded or grooved.
 - 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION**3.1 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
- U. Install sleeve seals for piping penetrations of concrete walls and slabs.
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- W. Install PEX piping with loop at each change of direction of more than 90 degrees.
- X.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Joints for PEX Piping: Join according to ASTM F 1807.

3.3 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

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- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (3 m).
- F. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
- G. Install hangers for vertical PEX piping every 48 inches.
- H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. 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 (DN 65) and larger.

3.7 IDENTIFICATION

- A. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

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1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 ADJUSTING

- A. Perform the following adjustments before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

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2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller shall be one of the following:
 1. Soft copper tube, ASTM B 88, Type K solder-joint fittings and brazed joints.
 2. PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- E.
- F. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast- or wrought-] copper, solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper push-on-joint fittings; and push-on joints.
 4. PEX tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.
 5. PE-AL-PE tube, NPS 1 and smaller; fittings for PE-AL-PE tube; and crimped joints.
 6. PEX-AL-PEX tube, NPS 1 and smaller; fittings for PEX-AL-PEX tube; and crimped joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 shall be **one of** the following:
 1. Hard copper tube, ASTM B 88, Type L solder-joint fittings; and **soldered** joints.
 2. Hard copper tube, ASTM B 88, Type L copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, ASTM B 88, Type L grooved-joint, copper-tube appurtenances; and grooved joints.

3.12 VALVE SCHEDULE

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- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION

DOMESTIC WATER PIPING SPECIALTIES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated, water mixing valves.
 - 6. Strainers.
 - 7. Wall hydrants.
 - 8. Drain valves.
 - 9. Water-hammer arresters.
 - 10. Air vents.
 - 11. Trap-seal primer valves.
 - 12. Trap-seal primer systems.
 - 13. Specialty valves.
 - 14. Flexible connectors.
 - 15. Water meters.
- B. Related Requirements:
 - 1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Section 221116 "Domestic Water Piping" for water meters.
 - 3. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
 - 4. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS**2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES**

- A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 VACUUM BREAKER

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- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze.
- B. Laboratory-Faucet Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1035.
 - 3. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10) matching faucet size.
 - 4. Body: Bronze.
 - 5. End Connections: Threaded.
 - 6. Finish: Chrome plated.

2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers :
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

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- c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 WATER PRESSURE-REDUCING VALVES**A. Water Regulators:**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell International Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
4. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.6 BALANCING VALVES**A. Copper-Alloy Calibrated Balancing Valves:**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TACO Incorporated.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: 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.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES**A. Primary, Thermostatic, Water Mixing Valves:**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.

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- d. Powers; a division of Watts Water Technologies, Inc.
- e. Symmons Industries, Inc.
- 2. Standard: ASSE 1017.
- 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 4. Type: Cabinet-type, thermostatically controlled, water mixing valve.
- 5. Material: Bronze body with corrosion-resistant interior components.
- 6. Connections: Threaded or union inlets and outlet.
- 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
- 8. Valve Finish: Chrome plated.
- 9. Piping Finish: Chrome plated.
- 10. Cabinet: Factory fabricated, stainless steel, for recessed mounting and with hinged, stainless-steel door.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 - 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
 - 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2- 1/2 and larger.
 - 4. Screen: Stainless steel with round perforations unless otherwise indicated.
 - 5. Drain: Factory-installed, hose-end drain valve.

2.9 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: Rough bronze, or 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: Wheel handle.
 - 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.

2.10 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.

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- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - g. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - h. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
- 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 - 3. Pressure Rating: 125 psig
 - 4. Operation: Loose key.
 - 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 - 6. Inlet: NPS 3/4 or NPS 1
 - 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 - 8. Box: Deep, flush mounted with cover.
 - 9. Box and Cover Finish: Chrome plated.
 - 10. Retain "Outlet," "Box," and "Box and Cover Finish" subparagraphs above for concealed-outlet-type wall hydrants or "Outlet" and "Nozzle and Wall-Plate Finish" subparagraphs below for exposed-outlet-type wall hydrants.
 - 11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 - 12. Nozzle and Wall-Plate Finish: Polished nickel bronze

2.11 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 - 2. Pressure Rating: 400-psig minimum CWP.
 - 3. Size: NPS 3/4.
 - 4. Body: Copper alloy.
 - 5. Ball: Chrome-plated brass.
 - 6. Seats and Seals: Replaceable.
 - 7. Handle: Vinyl-covered steel.
 - 8. Inlet: Threaded or solder joint.
 - 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMTROL, Inc.
 - b. MIFAB, Inc.
 - c. Precision Plumbing Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products.
 - g. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage

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Products.

DOMESTIC WATER PIPING SPECIALTIES

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

- A. Bolted-Construction Automatic Air Vents:
 1. Body: Bronze.
 2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F
 3. Float: Replaceable, corrosion-resistant metal.
 4. Mechanism and Seat: Stainless steel.
 5. Size: NPS 3/8 minimum inlet.
 6. Inlet and Vent Outlet End Connections: Threaded.

2.14 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig (860 kPa) minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solderjoint.
 6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solderjoint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- B. Drainage-Type, Trap-Seal Primer Device:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
 3. Size: NPS 1-1/4 minimum.
 4. Material: Chrome-plated, cast brass.

2.15 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems:
 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. Precision Plumbing Products, Inc.
 2. Standard: ASSE 1044.
 3. Piping: NPS 3/4, ASTM B 88, Type L (ASTM B 88M, Type B); copper, water

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tubing.

DOMESTIC WATER PIPING SPECIALTIES

4. Cabinet: Recessed-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - 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.
6. Vacuum Breaker: ASSE 1001.

2.16 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Flex-Hose Co., Inc.
 2. Flexicraft Industries.
 3. Flex Pression, Ltd.
 4. Flex-Weld Incorporated.
- B. Hyspan Precision Products, Inc. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain- end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.
- D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
- E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. 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 unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe

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valve. Install pressure gages on inlet and outlet.

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- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve and pump.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- I. Install ground hydrants with 1 cu. yd. (0.75 cu. m) of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- J. Install draining-type post hydrants with 1 cu. yd. (0.75 cu. m) of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. (0.03 cu. m) of concrete block at grade.
- K. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.
- L. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.
- M. Install water-hammer arresters in water piping according to PDI-WH 201.
- N. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- O. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- P. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- Q. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.

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- B. Set field-adjustable flow set points of balancing valves.

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- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

SANITARY WASTE AND VENT PIPING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 1. Pipe, tube, and fittings.
 2. Specialty pipe fittings.
 3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa)
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 1. Notify Owner and Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
 2. Do not proceed with interruption of sanitary waste service without Owner's and Architect's written permission.

PART 2 - PRODUCTS**2.1 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy classes.

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- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- E. Cast-Iron, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MG Piping Products Company.
 - 2. Standard: ASTM C 1277.
 - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated

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according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 SPECIALTY PIPE FITTINGS**A. Transition Couplings:**

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) JCM Industries, Inc.
 - 5) Romac Industries, Inc.
 - 6) Smith-Blair, Inc.; a Sensus company.
 - 7) The Ford Meter Box Company, Inc.
 - 8) Viking Johnson.
 - b. Standard: AWWA C219.

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- c. Description: Metal, sleeve-type same size as, with pressure rating at least equal

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- to, and ends compatible with, pipes to be joined.
 - d. Center-Sleeve Material: Manufacturer's standard.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 - 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Hart Industries International, Inc.
 - 4) Jomar International Ltd.
 - 5) Matco-Norca, Inc.
 - 6) McDonald, A. Y. Mfg. Co.
 - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 8) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 - 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca, Inc.
 - 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 5) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
 - 4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.
 - b. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig
 - 3) Gasket: Neoprene or phenolic.

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- 4) Bolt Sleeves: Phenolic or polyethylene.

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- 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elster Perfection.
 - 2) Grinnell Mechanical Products.
 - 3) Matco-Norca, Inc.
 - 4) Precision Plumbing Products, Inc. Victaulic Company.
 - b. Description:
 - 1) Standard: IAPMO PS 66
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION**3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and

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reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction

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- of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
 - N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
 - O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
 - P. Install aboveground PVC piping according to ASTM D 2665.
 - Q. Install underground PVC piping according to ASTM D 2321.
 - R. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

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- G. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe

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and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 1. Install transition couplings at joints of piping with small differences in OD's.
 2. In Drainage Piping: Shielded, nonpressure transition couplings.
- B. Dielectric Fittings:
 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
 3. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. Shutoff Valves:
 1. Install shutoff valve on each sewage pump discharge.
 2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
 3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- B. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves with cleanout cover flush with floor.
 6. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 7. 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 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

SANITARY WASTE AND VENT PIPING**3.8 IDENTIFICATION**

- A. Identify exposed sanitary waste and vent piping.

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). 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 (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

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- 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, vent piping shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping shall be any of the following:
 - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

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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. Cleanouts.
 2. Floor drains.
 3. Trench drains.
 4. Channel drainage systems.
 5. Air-admittance valves.
 6. Roof flashing assemblies.
 7. Through-penetration firestop assemblies.
 8. Miscellaneous sanitary drainage piping specialties.
 9. Flashing materials.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
B. FOG: Fats, oils, and greases.
C. FRP: Fiberglass-reinforced plastic.
D. HDPE: High-density polyethylene plastic.
E. PE: Polyethylene plastic.
F. PP: Polypropylene plastic.
G. PVC: Polyvinyl chloride plastic.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
B. Coordinate size and location of roof penetrations.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Cultures: Provide 1-gal. (3.8-L) bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to 200 percent of amount installed, but no fewer than 2 1-gal. (3.8-L) bottles.

PART 2 - PRODUCTS

SECTION 22 13 19
SANITARY WASTE PIPING SPECIALTIES

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 - 2) MIFAB, Inc.
 - 3) Smith, Jay R. Mfg. Co.
 - 4) Tyler Pipe.
 - 5) Watts Drainage Products.
 - 6) Zurn Plumbing Products Group.
 2. ASME A112.3.1, Stainless-Steel Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 3. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
 4. Size: Same as connected drainage piping
 5. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 6. Closure: Countersunk plug.
 7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 8. Closure: Stainless-steel plug with seal.
- B. Metal Floor Cleanouts:
1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 - 2) Oatey.
 - 3) Sioux Chief Manufacturing Co., Inc.
 - 4) Smith, Jay R. Mfg. Co.
 - 5) Tyler Pipe.
 - 6) Watts Drainage Products.
 - 7) Zurn Plumbing Products Group.
 2. ASME A112.36.2M, Stainless-Steel Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 - 2) Kusel Equipment Co.
 - 3) Smith, Jay R. Mfg. Co.
 3. ASME A112.3.1, Stainless-Steel Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 4. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
 5. Size: Same as connected branch.
 6. Type: Heavy-duty, adjustable housing.
 7. Body or Ferrule: Stainless steel.

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

8. Clamping Device: Required.
9. Outlet Connection: Threaded.

10. Closure: Brass plug with straight threads and gasket.
11. Adjustable Housing Material: Cast iron with threads.
12. Frame and Cover Material and Finish: Stainless steel.
13. Frame and Cover Shape: Round.
14. Top Loading Classification: Extra Heavy or Heavy Duty.
15. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to clean-out.
16. Standard: ASME A112.3.1.
17. Size: Same as connected branch.
18. Housing: Stainless steel.
19. Closure: Stainless steel with seal.
20. Riser: Stainless-steel drainage pipe fitting to clean-out.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall- installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MIFAB, Inc.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products.
 - e. Zurn Plumbing Products Group;
2. Standard: ASME A112.6.3.
3. Body Material: Gray iron.
4. Clamping Device: Required.
5. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
6. Top or Strainer Material: Nickel bronze.
7. Top of Body and Strainer Finish: Nickel bronze.

B. Stainless-Steel Floor Drains:

1. ASME A112.3.1, Stainless-Steel Floor Drains:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.

- 2. ASME A112.6.3, Stainless-Steel Floor Drains:

- a. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - 1) Josam Company.
 - 2) Smith, Jay R. Mfg. Co.
 - 3) Tyler Pipe.
 - 4) Watts Drainage Products.
 - 5) Zurn Plumbing Products Group.
3. Standard: ASME A112.3.1.
4. Top or Strainer Material: Stainless steel.
5. Clamping Device: Required.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
 2. Standard: UL 1479 assembly of sleeve and stack fitting with fire stopping 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.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 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.
- B. Deep-Seal Traps:
 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 2. Size: Same as connected waste piping.
 - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.
- D. Air-Gap Fittings:
 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top

of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab. Size: As required for close fit to riser or stack piping.

- F. Stack Flashing Fittings:
 - 1. Description: Counter flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
 - 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- H. Frost-Resistant Vent Terminals:
 - 1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
 - 2. Design: To provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counter flashing.
- I. Expansion Joints:
 - 1. Standard: ASME A112.21.2M.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected soil, waste, or vent piping.
- J. Roof Flashing Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
 - 2. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm-) thick, lead flashing collar and skirt extending at least 8 inches (200 mm) from pipe, with galvanized-steel boot reinforcement and counter flashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
 - 2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) 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 (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. 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.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- I. Assemble open drain fittings and install with top of hub 2 inches (51 mm) above floor.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- 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 vent caps on each vent pipe passing through roof.
- O. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- Q. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- R. Install wood-blocking reinforcement for wall-mounting-type specialties.
- S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 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. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20- kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
 - 2. 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 (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "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 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled FOG disposal systems and grease removal devices and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 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

SECTION 23 01 00
GENERAL PROVISIONS, MECHANICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Mechanical work covered by all sections within DIVISION 23 - MECHANICAL of these Specifications, including but not limited to:
 - a. Heating, ventilating, and air conditioning systems and equipment.
 - b. Plumbing systems and equipment.

1.2 RELATED SECTIONS

- A. DIVISION 9 - FINISHES.
- B. DIVISION 23 - MECHANICAL.
- C. DIVISION 26 - ELECTRICAL.

1.3 REFERENCE STANDARDS, CODES, FEES AND UTILITY CONNECTION CHARGES

- A. Local codes.
- B. State Codes.
- C. FM - Factory Mutual.
- D. Federal Codes.
- E. ASME Boiler Code.
- F. AGA - American Gas Association.
- G. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
- H. AABC - Associated Air Balance Council.
- I. ANSI - American National Standards Institute.
- J. ASME - American Society of Mechanical Engineers.
- K. NEMA - National Electrical Manufacturer's Association.
- L. NFPA - National Fire Protection Association.
- M. ARI - Air-Conditioning and Refrigeration Institute.
- N. UL - Underwriters Laboratories, Inc.
- O. OSHA - Occupational Safety and Health Act.
- P. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc.
- Q. Contractor shall make arrangements with utility company(ies) for their services and metering work. Pay all charges therefor, and include the cost thereof in the contract price.

1.4 QUALITY ASSURANCE

- A. Furnish all equipment and specialties new and free from defects.
- B. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least two years prior to bid opening. Provide list of users upon request.
 - 2. Equipment having less than a two year use record, which in the opinion of the Engineer, provides significant benefits to the Owner such as improved energy efficiency, will be acceptable if it is a product of a manufacturer who has been regularly engaged in the manufacture of that specific type of product which has been used in similar applications for a period of two years. The Architect/Engineer reserves the right to require the Contractor to submit evidence to this effect for his approval.

3. Equipment Service: Products shall be supported by a service organization which maintains an adequate inventory of repair parts and is located, in the opinion of the Architect/Engineer, reasonably close to the site.
 4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
 5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- A. Welding: Before any welding is performed submit a copy of the Welding Procedure Specification (WPS) together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code.
1. Before any welder performs any welding, submit a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of the ASME Boiler and Pressure Vessel Code. The letter or symbol (as shown on the qualification test form) shall be used to identify the work of that welder and shall be affixed in accordance with appropriate construction code, to each completed weld.
 2. The types and extent of non-destructive examinations required for pipe welds are shown in Table 136.4 of the Code for Pressure Piping, ANSI/ASME B31.1.
- B. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished for record to the Architect/Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations may be cause for rejection of the material.
- C. When included, reflected ceiling plan drawings shall govern over mechanical and electrical drawings for location of ceiling-installed elements. Contractor to extend ductwork and conduit as required.
- D. In addition to all requirements specified hereinafter, each material and equipment item shall have all features as standard with its manufacturer and/or required for the complete operational system.
- E. Capacities, ratings, sizes, and other requirements not specified hereinafter shall be as scheduled or otherwise indicated on the drawings.
- F. Should the Contractor at any time discover a discrepancy in the drawings or with respect to a variance of code requirements, he shall notify the Architect/Engineer for clarification and shall not proceed with the work affected until clarification has been made.

1.5 SUBMITTALS

- A. Submittals and shop drawings shall be submitted in accordance with these CONTRACT DOCUMENTS and in accordance with the following:
1. At a minimum provide an electronic copy of submittals in pdf format and at least one hard copy to maintain in the engineers office.
 2. Submit shop drawings, manufacturers data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication, or delivery of the items to the job site. Partial submittals will not be acceptable and will be returned without review. All equipment, material, and manufacturer's literature shall be submitted for approval at one time and in a tabulated binder. Control drawings and the controls equipment submittal may be submitted at a later time, but as soon as practical after the contract has been awarded and after the general equipment submittal has been made. However, every attempt shall be made to include the complete controls submittal with the general equipment submittal at one time.
 3. The submittal shall include summary cover sheet(s) and manufacturer's literature under each tab of the submittal binder which together clearly indicate compliance or deviation from the specifications and drawings.

4. Submission material and all shop drawings shall be marked with the appropriate identification relating the equipment to the drawings. Mark and reference each item on the submittal summary sheet and the manufacturer's literature to the appropriate paragraph number in the specifications. Manufacturer's standard catalogs will not be accepted.
5. Failure to comply with the above for a complete and clear submittal may result in resubmittal.
- B. Operating instructions and parts lists.
 1. Before requesting acceptance of work, furnish the number of printed and hardback bound sets required.
 2. Equipment and systems.
 - a. Complete description of equipment and systems and basic operating features.
 - b. Manufacturer's name, model number, service manual, spare parts list, and descriptive literature for all components
 3. Maintenance instructions.
 4. Listing of possible breakdown and repairs.
 5. Instruction for starting and operation.
 6. Detailed and simplified one line, color coded flow and wiring diagrams.
 7. Schedule of valve identification.
- C. Field test report as required by Section 230593 - BALANCING AND TESTING BY INDEPENDENT AGENCY.

1.6 JOB CONDITIONS

- A. Examine related work and surfaces before starting work of any section.
 1. Report in writing, conditions which will prevent proper provision of this work.
 2. Installed work which interferes with architectural or any other work, or which deviates from drawings and specifications without prior approval, shall be altered by contractor, without cost to Owner, to clear such interferences, or to comply with the drawings and specifications. Interferences or discrepancies which may be discovered or anticipated shall be reported promptly. Architect/Engineer shall have privilege of making minor changes without additional cost, provided that such changes are made before commencing work on items involved.
- B. Continuity of Services and Connections to Existing Work:
 1. At no additional cost to Owner, provide all necessary temporary connections and temporary facilities to accomplish the required continuity of services and existing operations.
 2. Arrange all work to interfere as little as possible with the normal existing operations. Do not interrupt any existing utility or other service or existing operation at any time without Owner's prior approval. After each interruption has been made, make all necessary connections and alterations, and restore services and avoid interferences with normal existing operations as quickly as possible.
 3. Install new work and connect to existing work with minimum interference to existing facilities and maintain water and air tightness when applicable.
 4. Temporary shutdowns of existing services:
 - a. At no additional charges.
 - b. At times not to interfere with normal operation of existing facilities.
 - c. Only with written consent of Owner.
 5. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
 6. Connect new work to existing work in neat and satisfactory high quality workmanship manner.
 7. Restore existing disturbed work to original or better conditions.

1.7 ACCURACY OF DATA AND DRAWINGS

- A. Drawings are generally diagrammatic, and where not dimensioned or detailed, indicated approximate locations of work. Examine carefully existing buildings and structures, existing systems, and all other contract drawings, and install work to conform as nearly as possible to locations and arrangements indicated, with only such minor adjustments as necessary to coordinate mechanical work with other work, and to avoid interferences therewith. All piping and ductwork, offsets, rises, and fittings are not necessarily shown; however, provide these as required by the conditions involved.
- B. Building and structure dimensions: TAKE THESE FROM ARCHITECTURAL AND FROM ACTUAL MEASUREMENTS OF EACH EXISTING BUILDING AND EACH EXISTING STRUCTURE INVOLVED.

1.8 COORDINATION

- A. Carefully examine the architectural, electrical, heating and air-conditioning, plumbing, fire protection, structural, and site plan drawings and specifications, and coordinate this work among trades to avoid delay.
- B. In general, permanent openings or knockout panels are provided to permit only future service or replacement of system components, not the entire assembly. The Contractor shall coordinate his equipment delivery with construction progress so that installation may be made in an orderly manner.
- C. The structural design is based on installed locations of the equipment only. Any necessary shoring or other protection necessary for moving heavy equipment to installed location is the responsibility of the Contractor. Take extra precautions in using any existing structure for hoisting or temporary support.
- D. Wherever piping, conduits, ducts, or other items are to run in the same general direction, elevation, or location, coordinate for the proper allocation of the space position. If necessary, consult the Architect/Engineer, whose decision shall be final.
- E. Wherever work is to be concealed or installed above ceilings, maintain adequate clearance to allow for access, repairs, and removal of all devices.
- F. Coordinate setting of sleeves, anchor bolts, and inserts as required to accommodate equipment before concrete is set and masonry is placed.

1.9 ELECTRICAL CHARACTERISTICS, MOTORS, MOTOR STARTERS, CONTROLS, AND WIRING

- A. Electrical Characteristics: Refer to electrical section for electrical characteristics of motors specified or scheduled under the Mechanical Section.
- B. Motor Sizes: Motor horsepower specified in Mechanical Section and/or indicated on mechanical drawings are approximate, and are not intended to limit motor sizes. Each motor shall be of proper size to operate continuously the actual equipment driven thereby, without overload on motor under all operating conditions, except as otherwise specified.
- C. Motor starters and other electrical control devices: Generally, motor starters for equipment motors shall be furnished by contractor. Also, provide electrical control devices required for the Mechanical system, unless otherwise specified.
- D. All motor starters shall comply with specifications for motor starters as specified in DIVISION 26.
- E. In addition to the items specified in DIVISION 26, starters that operate in parallel with other starters shall be equipped with auxiliary contacts on the main disconnect for breaking one leg of the control power. In these cases, the secondaries of the starter transformers shall be properly phased.
- F. Installation of electrical devices, EXCEPT those factory mounted on equipment: electrical control devices which require electrical connections ONLY, shall be installed by contractor; electrical control devices which required piping, linkage, remote bulb, or other mechanical connections IN ADDITION TO electrical connections, shall be installed by contractor, ready for electrical connections. Electric wiring: All electric wiring required to operate the mechanical systems, EXCEPT wiring which is factory installed on equipment, shall be done by contractor, in accordance with approved wiring diagrams which shall be furnished by this Section.
- G. Install name plates with full data on all motors, starters, and disconnect switches.

1.10 TRANSPORTATION AND HANDLING

- A. Pay all transportation and handling charges. Immediately report any damage to equipment received to the carrier so that job progress will not be delayed.
- B. All items received by the Contractor shall be left in their original containers, or as shipped, where possible, until installed in final locations.
- C. All items shall be protected from the elements. If stored outside, provide blocking to raise the base of each item well above ground and/or water levels.
- D. Provide additional protection for items subject to damage, where necessary, so that when installed, the items will be in new condition.
- E. Supply electrical items that might be damaged by condensation with heated air in an enclosed area until placed into service.

1.11 CUTTING AND PATCHING

- A. Execute cutting (including excavating), fitting, and patching of work required to:
 - 1. Make several parts fit properly.
 - 2. Uncover work to provide for installation of ill timed work.
 - 3. Remove defective work.
 - 4. Remove work not complying with the requirements of the contract documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Where work is cut for any reason, restore cut and damaged areas with new materials meeting requirements of the contract documents.
- B. In addition to the requirements above and upon written instructions of the Architect/ Engineer, provide cutting, fitting, and patching to:
 - 1. Uncover work to provide observation of covered work.
 - 2. Remove samples of installed materials for testing.
- C. Do not endanger work by cutting or altering work or any part of it.
- D. Prior to cutting that affects structural safety of project, submit written notice to Architect/Engineer requesting consent to proceed with cutting, including:
 - 1. Identification of project.
 - 2. Description of affected work.
 - 3. Necessity for cutting.
 - 4. Affect on other work and on structural integrity of project.
 - 5. Description of proposed work. Designate scope of cutting and patching, trades to execute work, products proposed to be used, and extent of refinishing.
 - 6. Alternatives to cutting and patching.
 - 7. Designation of party responsible for cost of cutting and patching.
- E. Prior to cutting and patching done on the instruction of the Architect/Engineer, submit cost estimate.
- F. Should conditions of work or schedule indicate the need for change of materials or methods, submit written recommendations Architect/Engineer, including conditions indicating the need for change, recommendations for alternative materials or methods, submittals as required for substitution of materials, and cost estimate for changing materials or methods.
- G. Submit written notice designating time work will be uncovered to provide for observation.
- H. Costs caused by ill timed or defective work and work not complying with requirements of the contract documents, including costs of additional services of Architect/Engineer, shall be borne by the party responsible for the ill timed, defective, or non-complying work.

1.12 INSTRUCTION TO OWNER/OPERATING PERSONNEL

- A. The Contractor shall furnish the services of factory trained instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified. The instruction will be for 8 hours. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given after the equipment or system has been accepted for regular operation. When significant changes or modifications in the equipment or system are made under the terms of the contract, additional instruction shall be provided to acquaint the operating personnel with the changes or modifications.

PART 2 - PRODUCTS

2.1 MATERIALS, SUBSTITUTIONS, AND PRODUCT OPTIONS

- A. Manufacturers or Trade Names:
The use of manufacturer's names and catalog numbers in these specifications or on the drawings indicates the type, size, rating, capacity, design, quality, or kind of materials required, and a closed specification is not intended, and similar and equal products of any reputable manufacturer which will satisfactorily perform the required functions will be acceptable, unless otherwise indicated by the words NO SUBSTITUTES, or unless otherwise specifically stated. The Architect/Engineer reserves the right to reject all materials which he deems not equal to those specified, or which he decides will not satisfactorily perform the required functions.
 - 1. Any manufacturer providing equipment for this project shall provide a written guarantee to the Contractor stipulating that any parts used in the equipment so provided will be readily available for a minimum of ten years from date of shipment from the factory. The Contractor shall, in turn, provide the Owner with these guarantees in the brochures submitted covering all the equipment used.

2.2 VALVE TAG IDENTIFICATION

- A. Minimum 1-1/2 inch diameter.
- B. Brass or aluminum.
- C. Identifying numbers and letters shall be stamped 1/4 inch (minimum) height.
- D. Fasten to valve with 18 (minimum) gauge solid copper or galvanized steel wire.

2.3 NAME PLATE IDENTIFICATION

- A. Four by two inch (minimum) size engraved and laminated plastic nameplate or black lamicaid sheet with white lettering.

2.4 PIPE IDENTIFICATION

- A. Brady B-500 or equal self-sticking vinyl cloth markers and pipe marker arrows.

2.5 MOTORS

- A. All motors 10 hp and larger shall be high efficiency motors in accordance with NEMA MA-1-12.53b and IEEE 112A, Test Method B, with guaranteed minimum efficiency of 88.5 percent, an across-the-line minimum power factor of 85 percent (for synchronous speeds of 1,800 and 3,600 rpm), and a service factor of 1.15.
- B. Every electric motor shall comply with NEMA Standard and be sized and designed to operate continuously at full load and full speed without causing noise, vibration, or temperature rise in excess of its rating.

Motors on belt drive equipment shall be furnished with apparatus for belt tension adjustment slide rails, idler pulley, or similar. Motors shall be of sufficient size for the duty to be performed and shall not exceed the motor's full rated load when the driven equipment is operating at specified capacity under the most severe conditions likely to be encountered. Insulation shall be Class F with Class B rise and moisture, fungus, and oil resistant treatment and shall be of a type designed and constructed to withstand the severe moisture conditions and the wide range of ambient temperature to which the motors will be subjected. Unless otherwise specified, all motors shall have open drip-proof frames and shall be rated for continuous full load operation without exceeding the standard temperature rise permitted for the frame construction and class of insulation used.

PART 3 - EXECUTION

3.1 FIELD TESTS

- A. All piping shall be free of leaks, and test gauges shall show no loss of pressure for at least 30 minutes after source of test pressure has been cut off, or as noted. Pipes may be tested in sections as the work progresses. Repair and retest all sections failing to pass tests, as required to obtain approval of tests. No caulking, welding, or brazing will be permitted on threaded pipe or fittings to stop leaks. Replace with new material all cracked or otherwise defective pipe and fittings of all types, as approved. Furnish suitable testing equipment, give all applicable authorities ample advance notice of all proposed tests and readiness of work for inspections, and advance notice of all proposed tests and readiness of work for inspections, and conduct each test in their presence, as approved. Do not conceal or insulate piping and do not conceal ductwork until all inspections have been made and all required tests have been approved by all applicable authorities. Submit results for review.
- B. Provide required labor, material, equipment, and connections.
- C. Test all piping, EXCEPT as otherwise specified below, as follows: hydrostatic test, at 150 percent of normal operating pressure of piping involved, or 100 psi, whichever is higher, AFTER removing all air from piping involved in test.
 - 1. Natural gas and fuel oil piping: 50 psi test using air or inert gas.
 - 2. Soil, waste, vent, roof drainage, and acid waste piping: standard water test, by filling piping with water up to top of vent stack or highest point of piping test section involved, but no section tested with less than a ten foot head with no pressure loss for at least 30 minutes.
 - 3. Compressed air: air test at 150 percent of normal working pressure of piping involved, or 100 psi, whichever is higher.
 - 4. Test all equipment in accordance with sections specified hereinafter.
- D. Test all ductwork in accordance with leakage test method recommended in latest edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible". After remedying audible leaks, total leakage on system shall not exceed one percent of system total design air flow rate.

3.2 ADJUSTING AND CLEANING

- A. Flush or blow all welding slag, pipe joint compound, loose scale, and other debris from pipework before connecting equipment thereto.
After systems have been tested and before any field painting is commenced, clean up all work thoroughly. Remove all foreign matter which has accumulated in ducts, casings, enclosures, fixtures, and equipment. Clean and polish all valves, plates, and other surfaces that are not to be painted, so that they present a new and acceptable appearance. Put systems in operation, test all fixtures and other equipment, remedy all leaks and defects, make all necessary adjustments, and remove all air from water circulating systems. Adjust all air and water flows to indicated and/or required quantities, and adjust all controls and other items as required to balance system and provide uniform air flows and uniform temperatures in air conditioned areas. Demonstrate that all controls and mechanical equipment function satisfactorily, as specified, as indicated, and as approved.
- B. Strainers and Dirt Pockets: Clean out each of these; REMOVE EACH STRAINER SCREEN FOR CLEANING.

- C. Circulating Water Systems: Completely drain each of these, and refill with clean water.
- D. After systems have been tested and before putting any part of or the entire system in operation for Owner's beneficial use, insure that all necessary adjustments have been made.
 - 1. Bearings and other items requiring lubrication, except factory permanently lubricated type: lubricate each of these as recommended by its manufacturer; this includes lubricated type plug valves.
 - 2. Belts: adjust each of these to proper tension.
 - 3. Filters: replace each disposable ("throw-away") filter with a new clean filter (except blanket roll and high efficiency type). Clean each cleanable filter. NOTE: ALL FILTERS SHALL BE IN PLACE DURING TESTING AND ADJUSTING.
 - 4. Motor load tests: make an ammeter check of actual running current of each motor in mechanical system under operating conditions. Correct all motors which are found to be overloaded, as approved.

3.3 INSTALLATION

- A. Equipment rooms and other areas in which equipment is to be installed have limiting dimensions. Install all mechanical work within these areas substantially as indicated, with ample unobstructed access space around each piece of equipment to facilitate proper installation, operation, and maintenance of equipment, and to allow ample space for plumbing, electrical, and other equipment indicated to be installed therein. Minor revisions in layout may be made subject to approval, but major changes in layout to accommodate proposed equipment which differs substantially from specified equipment in size and arrangement may not be considered or will be subjected to the provisions of paragraph 2.1 C. hereinbefore. Each bidder shall determine before bidding that equipment upon which he proposes to base his bid will conform to these requirements. Install each equipment item in accordance with its manufacturer's recommendations, and as indicated on the drawings, and/or specified. If the drawings and/or specifications conflict with the manufacturer's recommendations, report this to the Architect/Engineer for his decision before proceeding with the work involved.
- B. Generally, install pipework and ductwork as follows unless otherwise indicated.
 - 1. Finished areas: conceal pipework and ductwork within pipe chases, above suspended ceiling, and within other building construction, and other finished areas, unless otherwise indicated.
Unfinished areas: install aboveground pipework and ductwork exposed in areas where pipe chases or suspended ceilings are not indicated or concealing is otherwise impracticable, in mechanical and electrical equipment rooms, manufacturing areas, warehouse, or storage areas, and other unfinished areas.
 - 2. ALL areas: install pipework and ductwork parallel or at right angles with beams, walls, ceilings, and other building lines, in straight lines between required direction changes, with vertical runs plumb. Install exposed pipework and ductwork as close as practicable to walls, columns, ceilings, and overhead construction, and to provide maximum headroom and minimum interference with usable building space.

3.4 REMOVAL AND RELOCATION OF EXISTING WORK

- A. Disconnect, remove or relocate material, equipment, piping, and other work as required for installation of new systems shown on drawings.
- B. Provide new material and equipment related for relocated equipment.
- C. Plug or cap and seal active existing piping or ductwork behind or below finish.
- D. Do not leave long dead end branches:
 - 1. Cap or plug as close to active line as possible.

- E. Salvaged Existing Mechanical Materials and Equipment: Promptly haul away from Owner's premises all materials and equipment which are removed from existing system and are neither indicated nor required to be reused in the completed project, EXCEPT as otherwise specified. Owner may select certain removed existing materials and equipment and retain them for his future use. Before removing any existing materials and equipment, determine from Owner which of these materials and equipment he desires to retain. Remove all Owner selected materials and equipment without unnecessary damage thereto, and safely store them at locations designated by Owner.

3.5 CUTTING AND PATCHING

- A. Inspect existing conditions of work, including elements subject to movement or damage during cutting and patching and excavating and backfilling.
- B. After uncovering work, inspect conditions affecting installation of new products.
- C. Provide shoring, bracing, and support required to maintain structural integrity of the project.
- D. Provide protection for other portions of the project.
- E. Provide protection from the elements.
- F. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances and finishes.
- G. Execute cutting and demolition by methods that prevent damage to other work and provide proper surfaces to receive installation of repairs and new work.
- H. Refinish the entire surfaces where cutting and patching work occurs to provide an even, continuous surface to the nearest intersections. Where assemblies are damaged by cutting and patching, refinish entire assemblies.

3.6 PAINTING

- A. All equipment shall be factory prime coated and painted, however, the following may be shop prime coated and made ready for painting:
 - 1. Tanks.
 - 2. Structural supports and frames.
- B. Uncoated Hangers, Supports, Rods, and inserts shall be prime coated.
- C. Apply paint to exposed piping according to the following, unless otherwise indicated:
 - 1. Interior insulated piping: Use two coats of semi-gloss, acrylic-enamel finish. Paint to match the existing.
 - 2. Interior or Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer. Paint to match existing.
 - 3. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 - 4. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
- D. Paint piping specialties to match piping.
- E. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- F. Marred surfaces of prime coated or factory painted surfaces shall be painted and/or primed to match adjacent coat.

3.7 IDENTIFICATION

- A. Identify valves, (including main pipe sectionalizing valves and branch valves) except those on or within hand reach of equipment controlled thereby with a minimum 1-1/2 inch diameter round brass or aluminum tag stamped with 1/4 inch (minimum) height letters designating material controlled by valve, and attached to valve body with 18 (minimum) gauge solid copper or galvanized steel wire. Submit a typed valve identification schedule with the operating instructions and parts list submittal described above under 1.5 SUBMITTALS.

- B. Identify piping and ductwork with Brady B-500 or equal self-sticking vinyl cloth pipe markers and pipe marker arrows, each sized as recommended by marker manufacturer for outside diameter of pipe (including pipe insulation) labeled therewith. Marker background colors shall conform to OSHA and ANSI pipe identification standards. Each pipe marker shall be lettered to indicate the material contained in the pipeline involved, and arrows shall indicate direction of material flow in the pipelines. Install appropriate pipe markers, each with a marker arrow adjacent thereto, on all above ground pipelines on 20 foot maximum centers, with at least one marker and arrow in each vertical run between floor and ceiling.
- C. Equipment: Label each major mechanical equipment item (such as AHU, pump, fan, condensing unit, boiler, water heaters, etc.) with nameplate engraved with equipment designation and number, and securely attached to equipment.

END OF SECTION

SECTION 23 05 00
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.
1. Piping materials and installation instructions common to most piping systems.
 2. Concrete base construction requirements.
 3. Dielectric fittings.
 4. Flexible connectors.
 5. Mechanical sleeve seals.
 6. Equipment nameplate data requirements.
 7. Labeling and identifying mechanical systems and equipment is specified in Division 23 Section "Mechanical Identification."
 8. Nonshrink grout for equipment installations.
 9. Field-fabricated metal and wood equipment supports.
 10. Installation requirements common to equipment specification sections.
 11. Cutting and patching.
 12. Painting and finishing.
- B. Pipe and pipe fitting materials are specified in Division 23 piping system Sections.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Construction Agreement and Division 1 Specification Sections, apply to this Section.

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, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. CR: Chlorosulfonated polyethylene synthetic rubber.
 - 2. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 SUBMITTALS

- A. Submittals and shop drawings shall be submitted in accordance with Division 1 - SUBMITTALS.
- B. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
- C. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- D. Coordination Drawings: For access panel and door locations.

1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dielectric Unions:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Co.
 - c. Eclipse, Inc.; Rockford-Eclipse Div.
 - d. Epco Sales Inc.
 - e. Hart Industries International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
 - 2. Dielectric Flanges:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Co.
 - c. Epco Sales Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - 3. Dielectric-Flange Insulating Kits:
 - a. Calpico, Inc.
 - b. Central Plastics Co.
 - 4. Dielectric Couplings:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 - 5. Dielectric Nipples:
 - a. Grinnell Corp.; Grinnell Supply Sales Co.
 - b. Perfection Corp.
 - c. Victaulic Co. of America.

6. Metal, Flexible Connectors:
 - a. ANIMATE Industrial, Inc.
 - b. Central Sprink, Inc.
 - c. Flexicraft Industries.
 - d. Flex-Weld, Inc.
 - e. Grinnell Corp.; Grinnell Supply Sales Co.
 - f. Hyspan Precision Products, Inc.
 - g. McWane, Inc.; Tyler Pipe; Gustin-Bacon Div.
 - h. Mercer Rubber Co.
 - i. Metraflex Co.
 - j. Proco Products, Inc.
 - k. Uniflex, Inc.
7. Mechanical Sleeve Seals:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Thunderline/Link-Seal.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe 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 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) 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 (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32.
 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
 5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead

content.

- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.5 FLEXIBLE CONNECTORS

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig (860-kPa) minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
 1. 2-Inch NPS (DN50) and Smaller: Threaded.
 2. 2-1/2-Inch NPS (DN65) and Larger: Flanged.
 3. Option for 2-1/2-Inch NPS (DN65) and Larger: Grooved for use with keyed couplings.
- B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.7 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 1. Steel Sheet Metal: 0.0239-inch (0.6-mm) minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

2.8 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 3000-psi (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 15 piping Sections specify unique piping installation requirements.

- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Sleeves are not required for core drilled holes.
- N. Permanent sleeves are not required for holes formed by PE removable sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS (DN150) and larger, penetrating gypsum-board partitions.
 - 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.

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Q. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise

indicated. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) in diameter and larger.
 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 7 Section "Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- U. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 5. 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:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. 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.
 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: ASTM D 2235 and ASTM D 2661.

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- c. CPVC Piping: ASTM D 2846 and ASTM F 493.

- d. PVC Pressure Piping: ASTM D 2672.
 - e. PVC Nonpressure Piping: ASTM D 2855.
 - f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
- 9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- V. Piping Connections: Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. 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.
- E. Install equipment giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 PAINTING AND FINISHING

- A. Apply paint to exposed piping according to the following, unless otherwise indicated:
 - 1. Interior insulated piping: Use two coats of semi-gloss, acrylic-enamel finish. Paint to match the existing.
 - 2. Interior or Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer. Paint to match existing.
 - 3. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 - 4. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish

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coats over rust-inhibitive metal primer.

- B. Paint piping specialties to match piping.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 5000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified on the structural drawings.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.7 GROUTING

- A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

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OUTSIDE AIR UNIT

Part 1 - General

1.1 Related Documents

1.2 General Description

- A. This section includes the design, controls and installation requirements for packaged rooftop units / outdoor air handling units.

1.3 Quality Assurance

- A. Packaged air-cooled condenser units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.
- B. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
- C. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
- D. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.
- E. Unit Energy Efficiency Ratio (EER) shall be equal to or greater than that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
- F. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

1.4 Submittals

- A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics and connection requirements. Installation, Operation, and Maintenance manual with startup requirements shall be provided.
- B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

1.5 Delivery, Storage, and Handling

- A. Unit shall be shipped with doors screwed shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.
- B. Follow Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
- C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.

1.6 Warranty

- A. Manufacturer shall provide a limited "parts only" warranty for a period of 12 months from the date of equipment startup or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for Installation, Operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and filters.

OUTSIDE AIR UNIT**Part 2 - Products****2.1 Manufacturer**

- A. Products shall be provided by the following manufacturers:
1. AAON
 2. Substitute equipment may be considered for approval that includes at a minimum:
 - a. R-410A refrigerant
 - b. Variable capacity compressor with 10-100% capacity control
 - c. Direct drive supply fans
 - d. Double wall cabinet construction
 - e. Insulation with a minimum R-value of 13
 - f. Stainless steel drain pans
 - g. Hinged access doors with lockable handles
 - h. All other provisions of the specifications must be satisfactorily addressed

2.2 Rooftop Units

- A. General Description
1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, gas heaters, and unit controls.
 2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
 3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 4. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
 5. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
 6. Installation, Operation, and Maintenance manual shall be supplied within the unit.
 7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
 8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
- B. Construction
1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
 2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
 3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
 4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not

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exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
 6. Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
 7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
 9. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
 10. Unit shall include lifting lugs on the top of the unit.
- C. Electrical
1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
 2. Unit shall be provided with a factory installed and factory wired 115V, 13 amp GFI outlet disconnect switch in the unit control panel.
 3. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
- D. Supply Fans
1. Unit shall include direct drive, unhusd, backward curved, plenum supply fans.
 2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
 3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
 4. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
- F. Cooling Coils
1. Evaporator Coils
 - a. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
 - b. Coils shall have interlaced circuitry and shall be standard capacity.
 - c. Coils shall be helium leak tested.
 - d. Coils shall be furnished with factory installed thermostatic expansion valves.
- G. Refrigeration System
1. Unit shall be factory charged with R-410A refrigerant.

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2. Compressors shall be scroll type with thermal overload protection, independently circuited and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.
 3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
 4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
 5. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.
 6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed replaceable core liquid line filter driers.
 7. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.
 8. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
- H. Condensers
1. Air-Cooled Condenser
 - a. Condenser fans shall be a vertical discharge, axial flow, direct drive fans.
 - b. Coils shall be designed for use with R-410A refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes or coils shall be constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and aluminum end casings. Fin design of copper tube coils shall be sine wave rippled.
 - c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
 - d. Coils shall be helium leak tested.
 - e. Condenser fans shall be VFD driven variable speed for condenser head pressure control. Factory provided and factory programmed VFDs shall continuously modulate the fan air flow to maintain head pressure at acceptable levels. Cooling operation shall be allowed down to 35°F with adjustable compressor lockouts.
- I. Gas Heating
1. Stainless steel heat exchanger furnace shall carry a 25 year non-prorated warranty, from the date of original equipment shipment from the factory.
 2. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
 3. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
 4. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.

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5. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Gas heating assemblies shall be capable of operating at any firing rate between 100% and 30% of their rated capacity.
- J. Filters
1. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, upstream of the cooling coil.
- K. Outside Air/Economizer
1. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 cfm of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return actuator. Unit shall include outside air opening bird screen, outside air hood, and barometric relief dampers.
- M. Controls
1. Factory Installed and Factory Provided Controller
 - a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 - b. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 - c. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
 - d. Make Up Air Controller
 1. Unit shall modulate cooling with constant airflow to meet ventilation outside air loads. Cooling capacity shall modulate based on supply air temperature.
 2. With modulating hot gas reheat, unit shall modulate cooling and hot gas reheat as efficiently as possible, to meet outside air humidity loads and prevent supply air temperature swings and overcooling of the space.
 3. Unit shall modulate heating with constant airflow to meet ventilation outside air loads. Heating capacity shall modulate based on supply air temperature.
 - e. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a LonWorks or BACnet network. [WattMaster Orion Controls System]

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N. Accessories

1. Unit shall be provided with a safety shutdown terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

2.3 Curbs

- A. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
- B. Solid bottom curb shall be factory assembled and fully lined with 1 inch neoprene coated fiberglass insulation and include a wood nailer strip.

Part 3 - Execution

3.1 Installation, Operation, and Maintenance

- A. Installation, Operation, and Maintenance manual shall be supplied with the unit.
- B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
- C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

END OF SECTION

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Equipment supports.
- B. Related Sections:
 - 1. Metal Ducts for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Cooper B-Line, Inc.
 - b. Unistrut Corporation; Tyco International, Ltd.
 - c. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 1. Piping Technology & Products, Inc.
 2. Rilco Manufacturing Co., Inc.
 3. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless-] steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and

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shear capacities appropriate for supported loads and building materials where used.

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-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 (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and

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completely cured. Install fasteners according to manufacturer's written instructions.

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

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4. Shield Dimensions for Pipe: Not less than the following:

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- a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 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 (40 mm)

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C. PAINTING

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- D. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- E. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 6. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required,

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with steel-pipe base stanchion support and cast-iron floor flange.

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- E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- F. 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 (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) piping installations.
- G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

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- a. Light (MSS Type 31): 750 lb (340 kg).

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- b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- I. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - 7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- J. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- K. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION

SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes mechanical identification materials and devices.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Construction Agreement and Division 1 Specification Sections, apply to this Section.

1.3 SUBMITTALS

- A. Submittals and shop drawings shall be submitted in accordance with Section 01 33 00 - SUBMITTALS.
- B. Product Data: For identification materials and devices.

1.4 QUALITY ASSURANCE

- A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

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MECHANICAL IDENTIFICATION

- A. General: Products specified are for applications referenced in other Division 23 Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 - 2. Location: Accessible and visible.
- C. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type.
Include color-coding according to ASME A13.1, unless otherwise indicated.
- D. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive, vinyl type with permanent adhesive.
- E. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers, extending 360 degrees around pipe at each location.
- F. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers, at least 3 times letter height and of length required for label.
- G. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 1. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.
- H. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils (0.08 mm) thick.
 - 1. Width: 1-1/2 inches (40 mm) on pipes with OD, including insulation, less than 6 inches (150 mm); 2-1/2 inches (65 mm) for larger pipes.
 - 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- I. Valve Tags: Stamped or engraved with 1/4-inch (6-mm) letters for piping system abbreviation and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole for fastener.
 - 1. Material: 3/32-inch- (2.4-mm-) thick plastic laminate with 2 black surfaces and a white inner layer.

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2. Material: Valve manufacturer's standard solid plastic.
3. Size: 1-1/2-inches (40-mm) diameter, unless otherwise indicated.

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4. Shape: As indicated for each piping system.
- J. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- K. Valve Tag Fasteners: Brass, wire-link chain; beaded chain; or S-hooks.
- L. Access Panel Markers: 1/16-inch- (2-mm-) thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch (3-mm) center hole for attachment.
- M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
 2. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
 1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Brown: Energy reclamation equipment and components.
 4. Blue: Equipment and components that do not meet criteria above.
 5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
 6. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 7. Size: 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
 1. Size: 3-1/4 by 5-5/8 inches (85 by 145 mm).
 3. Fasteners: Brass grommets and wire.
 4. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

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P. Lettering and Graphics: Coordinate names, abbreviations, and other

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designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

PART 3 - EXECUTION

3.1 LABELING AND IDENTIFYING PIPING AND DUCT SYSTEMS

- A. Install pipe markers on each system. Include arrows showing normal direction of flow.
- B. Marker Type: Stenciled markers complying with ASME A13.1.
- C. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, noninsulated pipes.
- D. Fasten markers on pipes and insulated pipes smaller than 6 inches (150 mm) OD by one of following methods:
 1. Snap-on application of pretensioned, semirigid plastic pipe marker.
 2. Adhesive lap joint in pipe marker overlap.
 3. Laminated or bonded application of pipe marker to pipe or insulation.
 4. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 3/4 inch (20 mm) wide, lapped a minimum of 1-1/2 inches (40 mm) at both ends of pipe marker, and covering full circumference of pipe.
- E. Fasten markers on pipes and ducts 6 inches and larger by one of following methods:
 1. Laminated or bonded application of pipe marker to pipe or insulation.
 2. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 1-1/2 inches (40 mm) wide, lapped a minimum of 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.
 3. Strapped to pipe or insulation with manufacturer's standard stainless-steel bands.
- F. Locate 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 according to the following:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and

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terminal units.

Mark each pipe at branch, where flow pattern is not obvious.

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3. Near penetrations through walls, floors, ceilings, or 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 a maximum of 50-foot (15-m) intervals along each run. Reduce intervals to 25 feet (7.5 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.2 VALVE TAGS

- A. Install on control valves and control devices in piping systems.
- B. Valve Tag Application Schedule: Tag valves according to size, shape, color scheme, and with captions similar to those indicated in the following:
- C. Tag Material: Brass.
- D. Tag Size and Shape: According to the following:
 1. Cold Water: 2 inches (50 mm), round.
- E. Tag Color: According to the following:
 1. Cold Water: Blue.
- F. Letter Color: According to the following:
 1. Cold Water: White.
- G. Install mounted valve schedule in each major equipment room.

3.3 EQUIPMENT SIGNS AND MARKERS

- A. Install engraved plastic-laminate signs or equipment markers on or near each major item of mechanical equipment. Include signs for the following general categories of equipment:
 1. Pumps, chillers, condensers, and similar motor-driven units.
 2. Heat exchangers, cooling towers, and similar equipment.
 3. Fans, blowers, primary balancing dampers, and mixing boxes.
 4. Water-treatment systems, and similar equipment.

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- B. Plasticized Tags: Install within concealed space, to reduce amount of text in exposed sign outside concealment, if equipment to be identified is concealed

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above acoustical ceiling or similar concealment.

1. Identify operational valves and similar minor equipment items located in unoccupied spaces, including machine rooms, by installing plasticized tags.

3.4 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.
- B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION

BALANCING AND TESTING BY INDEPENDENT AGENCY

1 GENERAL

1.1 SECTION INCLUDES

- A. Work Included in This Section: Adjusting and balancing all heating, ventilating and air conditioning systems in conformity with applicable codes and authorities having jurisdiction, for, but not limited to the following:
 - 1. Perform operational testing of central station equipment, balancing of distribution system, and adjustment of terminal devices for HVAC systems of Project.
 - 2. Perform flow testing of hydronic systems, adjust and record liquid flow at each piece of equipment.
 - a. Each hot water and chilled water coil.
 - b. Each terminal heat transfer unit with coil.
 - 3. Provide instruments required for testing, adjusting and balancing operations.

1.2 RELATED SECTIONS

- A. DIVISION 15 - MECHANICAL.
- B. Section 15 01 00 - GENERAL PROVISIONS, MECHANICAL.
- C. Section 15 05 00 - BASIC MATERIAL AND METHODS - MECHANICAL.
- D. DIVISION 16 - ELECTRICAL.

1.3 REFERENCE STANDARDS

- A. Published Specifications Standards, tests, or recommended methods of trade, industry, or governmental organizations apply to work in this section where cited by abbreviations noted below:
 - 1. AABC - Associated Air Balance Council.
 - 2. SMACNA - Sheet metal and Air Conditioning Contractors National Association, Inc.

1.4 QUALITY ASSURANCE

- A. Total system balance shall be performed by an agency certified by the Associated Air Balance Council (AABC). All work done by this agency shall be under the direct supervision of a certified test and balance engineer.
- B. If so requested by the Engineer, the Balancing and Testing Agency shall conduct the specified tests in the Engineer's presence.

1.5 SUBMITTALS

- A. Submit the Following to Engineer:
 - 1. In list of materials submittal, furnish Engineer statement that:
 - a. Air Balance Company is a member of Air Balance Council.
 - b. It has satisfactorily balanced at least three systems of comparable type and size.
 - c. Sample forms for use in compiling and recording test and balance data.
 - 2. Final submission shall include records and tabulations required hereinafter.
- B. At least fifteen days prior to Trade Contractor's request for final inspection, submit required copies of final reports, on applicable reporting forms, for review.
 - 1. Schedule testing and balancing of parts of systems which is delayed due to seasonal, climatic, occupancy, or other conditions beyond control of Trade Contractor, as early as proper conditions will allow, after consultation with Architect/Engineer.
 - 2. Submit reports of delayed testing promptly after execution of those services.
 - 3. Form of final reports:
 - a. Each individual final reporting form must bear the signature of person who recorded data and that of supervisor of the reporting organization.
 - b. Identify instruments of all types which were used, and last date of calibration of each.

BALANCING AND TESTING BY INDEPENDENT AGENCY**1.6 JOB CONDITIONS**

- A. Prior to start of testing, adjusting, and balancing, verify that required "Job Conditions" are met:
 - 1. Systems installation is complete and in full operation.
 - 2. Outside conditions are within a reasonable range relative to design conditions.
 - 3. Lights are turned "on" when lighting is included in the cooling load.
 - 4. Special equipment such as computers, laboratory equipment, and electronic equipment are in full operation.

2 PRODUCTS**2.1 GENERAL**

- A. Balancing to be done by AABC certified balancing contractor.
- B. Products and materials shall be as described in pertinent sections of DIVISION 15 - MECHANICAL.

3 EXECUTION**3.1 AIR SYSTEM BALANCING**

- A. Operating test procedure shall be as follows:
 - 1. Records must be submitted in tabulated form to Architect/Engineer for review.
- B. Check that filters are installed, free of bypass, and clean, type as specified.
 - 1. Make allowance for air filter resistance at time of tests.
 - 2. Main air supply to be at design air quantity at pressure drop across filter banks midway between pressure drop for clean and dirty filters.
- C. Test and adjust blower rpm to design requirements.
- D. Test and record motor full load amperes.
- E. Make pitot tube traverse of main supply ducts and obtain design cfm at fans.
- F. Test and record system static pressures, suction and discharges.
- G. Test and adjust system for design recirculated air, cfm.
- H. Test and adjust system for design cfm outside air.
- I. Test and record entering DB heating and cooling temperature.
- J. Test and record entering WB cooling air temperature.
- K. Test and record leaving DB heating and cooling temperature.
- L. Test and record leaving WB cooling temperature.
- M. Adjust main supply, return, and exhaust air ducts to proper design cfm.
- N. Adjust zones to proper design cfm, supply, return, and exhaust.
- O. Test and adjust each diffuser, grille, and register to within 10 percent of design requirements.
- P. Identify each grille, diffuser, and register as to location area, size, type, and manufacturer.
- Q. Readings and tests of diffusers, grilles, and registers shall include:
 - 1. Required fpm velocity.
 - 2. Test resultant velocity.
 - 3. Required cfm.
 - 4. Test resultant cfm after adjustments.
- R. In cooperation with control manufacturer, set adjustments of automatically operated dampers and terminal boxes to operate as indicated.
- S. In cooperation with control manufacturer and mechanical contractor set adjustments of air terminal boxes as required to produce design performance.
- T. Adjust diffusers, throw pattern, grilles, and registers to minimize drafts.
- U. Test and record DB temperature in occupied zones.
- V. Make changes in pulleys, belts, and dampers as required for correct balance as required at no additional cost to Owner.
- W. Outside climatic conditions at the time of testing: Read and record DB and WB, temperatures, sunny, cloudy, or windy.
- X. Read and record entering air: WB and DB temperatures of outside air.

3.2 WATER SYSTEMS BALANCING

BALANCING AND TESTING BY INDEPENDENT AGENCY

- A. Provide the following instruments for field use:
 - 1. One set of pressure gauges and fittings.
 - 2. Dry bulb thermometer.
 - 3. Wet bulb thermometer.
 - 4. Thermocouple unit and thermocouples.
 - 5. Set of balancing cock adjustment wrenches.
 - 6. Portable field flowmeter.
- B. Prepare Water Systems for Balancing in the Following Manner:
 - 1. Open valve to full-open position.
 - 2. Check pump rotation.
 - 3. Check air vents at high points of water system.
 - a. Verify that all are installed and operating freely.
 - 4. Set temperature controls so all coils are calling for:
 - a. Full cooling: when balancing chilled water coils.
 - b. Full heating: when balancing hot water coils.
 - 5. Check operation of automatic valves.
 - 6. Check and set operating temperatures of heat exchangers and chillers to design requirements.
 - 7. Check and set operating temperatures of secondary and primary systems.
 - 8. Complete air balance must have been accomplished before actual water balance begins.
- C. Initial Adjustments:
 - 1. Set chilled water, condenser water and hot water pumps to proper gpm delivery.
 - 2. Adjust water flow of hot water through:
 - a. Heat exchangers.
 - 3. Check leaving water temperatures and return water temperatures at entry of new building and heat exchangers.
 - 4. Check water temperature at inlet side of cooling and heating coils.
 - 5. Proceed to balance each chilled water coil and hot water coil.
 - 6. Upon completion of flow reading and adjustments at coils, mark all settings and record all data.
- D. Detailed Balance: Upon completion of preparation and adjustments, proceed as follows:
 - 1. After adjustments to coils are made:
 - a. Recheck settings at pumps, temperature, and performance of entry water exchangers.
 - b. Readjust as required.
 - 2. Install pressure gauges on coil:
 - a. Read pressure drop through coil at set rate on call for full flow.
 - 3. Record and check following items at each cooling and heating element:
 - a. Inlet water temperature.
 - b. Leaving water temperature.
 - c. Pressure drop of each coil.
 - d. Pump operating suction and discharge head.
 - e. List all mechanical specifications of pumps.
 - f. Rated and actual running amperage of pump motor.
- E. Final Tabulation:
 - 1. Test all component systems of air conditioning system during an operational test, in presence of Engineer's representative.
 - 2. After balancing air conditioning components, put entire system into operation.
 - a. Record all pressures, temperatures, gpm, cfm, velocities, etc.
 - b. Check recorded data against design schedules.
 - 3. Approved test reports shall be included in "Operating Instructions" submitted as specified under DIVISION 1.

3.1 CONTROL COORDINATION

- A. Cooperate with control installer and equipment installer making adjustments to following items

BALANCING AND TESTING BY INDEPENDENT AGENCY
as required to accomplish indicated performance:

BALANCING AND TESTING BY INDEPENDENT AGENCY

1. Terminal air boxes.
 2. Air valves.
 3. Fan inlet vanes.
- B. The HVAC Section shall furnish copies of the manufacturer's literature and other data to the Balancing and Testing Agency for their use in balancing the air and water systems: pump curves; fan performance data and curves; evaporator, flow curves; air handling unit coil flow curves; and other pertinent air and water distribution data.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor/Outdoor supply, return, exhaust and outdoor air.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water- vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for

DUCT INSULATION

maintenance.

- B. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS**2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. 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. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide the following] [provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements provide one of the following
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127. Eagle Bridges - Marathon Industries; 225.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-03/11-70. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller

DUCT INSULATION

Company; 85-50.Mon-Eco Industries, Inc.; 22-25.

DUCT INSULATION**2.3 MASTICS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 JACKETS

- A. Insulation system indicate with factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 - 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor

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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.

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3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- L. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
 1. Comply with requirements in Section 078413 "Penetration Firestopping "firestopping and

DUCT INSULATION

fire-resistive joint sealers.

- E. Insulation Installation at Floor Penetrations:

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1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **100** percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface

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with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

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- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **100** percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75- mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation

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with vapor-barrier mastic.

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6. Where PVC jackets are indicated, install with 1-inch (25-mm) 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. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below"
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildewproof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. All Supply return, and Outside air ducts.
 2. Exhaust ductwork connected to energy recovery unit.
- B. Items Not Insulated:
 1. Fibrous-glass ducts.
 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 3. Factory-insulated flexible ducts.
 4. Factory-insulated plenums and casings.
 5. Flexible connectors.
 6. Vibration-control devices.
 7. Factory-insulated access panels and doors.

3.10 DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed ductwork:
 1. Mineral-Fiber Blanket: 2 inches (50 mm)
- B. Exposed ductwork.
 1. Mineral-Fiber Blanket: 2 inches (50 mm)

END OF SECTION

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating HVAC piping systems:
- B. Related Sections:
 - 1. Section 15180 "Duct Insulation."

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after

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installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS**2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Flexible Elastomeric Insulation: 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 following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- F. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FACTORY-APPLIED JACKETS

- A. 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 FIELD-APPLIED JACKETS

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- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
 - B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paperbacking.
 - C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
- Metal Jacket: Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water. GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to

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insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

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4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) oc
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 3. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 4. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
 1. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations. 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 (50 mm).

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- C. Seal jacket to wall flashing with flashing sealant. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- 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. 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.
 - 5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric- reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 7. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 - 8. 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,

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test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape

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insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as 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 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions

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with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.

- B. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75- mm-) wide joint strips at end joints.
- C. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

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3.9 PIPING INSULATION SCHEDULE, GENERAL

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- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 PIPING INSULATION SCHEDULE

- A. Chilled Water/ Condenser Water:
 - 1. : Insulation shall be :
 - a. Mineral-Fiber, Preformed Pipe, Type I 2 inches (50 mm) thick.
- B. Refrigerant Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch (25 mm)

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Provide as indicated on drawings

END OF SECTION

CONTROLS**PART 1 - GENERAL****1.1 SECTION INCLUDES**

- .1 Products Furnished But Not Installed Under This Section
- .2 Products Installed But Not Furnished Under This Section
- .3 Related Sections
- .4 Description
- .5 Approved Building Automation System Manufacturers
- .6 Quality Assurance
- .7 System Performance
- .8 Submittals
- .9 Warranty
- .10 System Maintenance
- .11 Remote Monitoring
- .12 Ownership of Proprietary Material

1.2 DESCRIPTION

- A. The Building Automation System shall be as indicated on the drawings and described in these specifications and shall be installed as an integrated system. System shall be accessible via a graphical user interface. System must be fully integrated and coordinated with mechanical equipment DDC controllers furnished and installed in the equipment manufacturer's factory as specified in those sections. The intent of the BAS is to integrate all mechanical equipment into one system for global monitoring, control, and alarming associated with the building. It is the BAS manufacturer's responsibility to provide all the design, engineering, and field coordination required to ensure all equipment sequence of operations are met as specified and the designated BAS operators have the capability of managing the building mechanical system to ensure occupant comfort while maintaining energy efficiency.
- B. The BAS shall meet both BACnet and LonTalk communication standards to ensure the system maintains "interoperability" to avoid proprietary arrangements that will make it difficult for the Owner to consider other BAS manufacturers in future projects. The controllers listed under the scope of work shall be Trane BACnet MSTP only at the B-ASC or B-AAC level and BACnet IP and BACnet MSTP at the B-BC level. These open protocol communication standards are discussed in more detail later in this specification.
- C. Controls provided by equipment manufactures shall be provided with BACnet MS/TP or BACnet IP interface. Controllers must allow for bi-directional data communication and all points needed to control equipment shall be made available to BAS contractor.
- D. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems and terminal devices on this project.
- E. The BAS shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.
- F. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers. The mechanical systems and terminal devices shall be provided with factory mounted DDC controls that will permit each system to operate in a stand-alone fashion. As such, in the event of a BAS network

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communication failure, or the loss of an individual controller, the other DDC controllers shall continue to independently operate and communicate to the BAS. Field mounted controllers shall not be accepted on these systems.

- G. Communication between DDC controllers and all workstation(s) shall be over a high- speed network. All nodes on this network shall be peers. The operator shall not have to know the controller identifier or location to view or control a point (object). Application Specific Controllers shall be constantly scanned by the Building Controllers to update point information and alarm information globally.
- H. The BAS manufacturer shall provide all hardware and software necessary to implement the functions and sequence of operations specified.

1.3 MANUFACTURERS

- 1. Trane, Siemens, Automated Logic, JCI,

1.4 QUALITY ASSURANCE**A. BAS Manufacturer Qualifications**

- 1. The BAS manufacturer shall have an established business office within 50 miles of the project site and must provide 24 hours/day, 7 days/week response in the event of a customer warranty or service call.
- 2. The BAS Manufacturer shall have factory trained and certified personnel providing all engineering, service, startup, and commissioning field labor for the project from their local office location, including certification from VRF manufacture. BAS manufacturer shall be able to provide training certifications for all local office personnel upon request.
- 3. The BAS shall be provided by a single manufacturer and this manufacturer's equipment must consist of operator workstation software, Web-based hardware/software, Open Standard Protocol hardware/software, Custom application Programming Language, Graphical Programming Language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, actuators, etc.) need not be manufactured by the BAS manufacturer listed in Section 1.5 of this specification.
- 4. Independent representatives of BAS manufacturers are not acceptable. BAS vendor must be corporate owned entity of BAS manufacturer.

B. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.

- 1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
- 2. National Electrical Code -- NFPA 70.
- 3. Federal Communications Commission -- Part J.
- 4. ASHRAE/ANSI 135-2004 (BACnet) - (System Level Devices) - Building Controllers and PC Operator Workstations communicating on an Ethernet/IP protocol shall permit interoperability with other various building system manufacturers that are BACnet approved systems. (Unit level Devices) Custom Application Controllers and Application Specific Controllers shall utilize BACnet MS/TPcommunications.

C. All products used in this installation shall be currently manufactured, and shall have been applied to a minimum of three previous projects. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.**1.5 SYSTEM PERFORMANCE****A. Performance Standards. The BAS system shall conform to the following:**

- 1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points.

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All current data shall be displayed within 20 seconds of the operator's request.

2. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.
3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.
4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current within the prior 60 seconds.
5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 30 seconds.
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciations. All workstations on the network shall receive alarms within 5 seconds of each other.
9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

1.6 SUBMITTALS

- A. BAS manufacturer shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software being provided for this project. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications. Five (5) copies are required. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats once they have been approved and as-built drawings have been completed.
- B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the BAS manufacturer of furnishing quantities required based upon contract documents.
- C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with the specifications or which is deemed valuable in documenting and understanding the system to be installed.
- D. Project Record Documents: Upon completion of installation, submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
 1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .dwg or .dxf drawing files shall also be provided.
 2. Testing and Commissioning Reports and Checklists signed off by trained factory (equipment manufacturers) and field (BAS) commissioning personnel.
 3. Operating and Maintenance (O & M) Manuals - These shall be as-built versions of the submittal product data. In addition to the information required for the submittals, Operating & Maintenance manual shall include:
 - a. Names, address and 24-hour/7-day per week telephone numbers of Contractor personnel managing and installing equipment, along with service personnel responsible for supporting the ongoing warranty and services of the control system.
 - b. Procedures for operating the BAS including logging on/off, alarm management,

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- generation of reports, trends, overrides of computer control, modification of setpoints, and other interactive system requirements.
- c. Description of the programming language including syntax, statement descriptions, algorithms, calculations, point database creation and modification, program creation and modification, and operator use of the editor.
 - d. Explanation of how to design and install new points, new DDC controllers, and other BAS hardware.
 - e. Preventative Maintenance and calibration procedures; hardware troubleshooting; and hardware repair and/or replacement procedures.
 - f. Documentation of all software program logic created for Custom Programmable Controllers including the overall point database. Provide one set of magnetic media containing files of the software and point database.
 - g. One set of electronic media containing files of all operator color graphic screens for the project.
 - h. A list of recommended spare parts including pricing, manufacturer, supplier, and part numbers.
 - i. Documentation, installation, and maintenance information for all third party hardware/software products provided including personal computers, printers, hubs, sensors, valves, etc.
 - j. Original issue media for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
 - k. Licenses, Guarantee, and Warranty documents for all equipment and systems.
 - l. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.) and task descriptions.
- E. Training Manuals: The BAS manufacturer shall provide a course outline and copies of training manuals at least two weeks prior to the start of any corporate training class to be attended by the Owner.

1.7 WARRANTY

- A. Warrant all work as follows:
- 1. BAS system labor and materials shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no charge to the Owner. The BAS manufacturer shall respond to the Owner's request for warranty service within 24 hours of the initiated call and will occur during normal business hours (8AM-5PM).
 - 2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the BAS is operational, and has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of the warranty period.
 - 3. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by the Owner must be granted prior to the installation of these updates.
 - 4. The BAS manufacturer shall provide a web-accessible Users Network for the proposed System and give the Owner free access to question/answer forum, graphics library, user tips, upgrades, and training schedules for a one year period of time correlating with the warranty period.

1.8 SYSTEM MAINTENANCE

- A. Perform Building Automation System preventative maintenance and support for a period of 1 year (beginning the date of substantial completion).
- 1. Make a minimum of 2 complete Building Automation System inspections, in addition to

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normal warranty requirements. Inspections to include:

- a. System Review – Review the BAS to correct programming errors, failed points, points in alarm, and points that have been overridden manually.
 - b. Seasonal Control Loop Tuning – Control loops are reviewed to reflect changing seasonal conditions and / or facility heating and cooling loads
 - c. Sequence of operation verification – Systems all verified to be operating as designed and in automatic operation. Scheduling and setpoints are reviewed and modified.
 - d. Database back-up
 - e. Operator coaching
2. Technician shall review critical alarm log and advise owner of additional services that may be required.
 3. Technician shall provide a written report to owner after each inspection.
- B. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of owner.

1.9 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project developed hardware and software shall become the property of the Owner. This includes but is not limited to:
 - B. Operator Graphic files
 - C. As-built hardware design drawings
 - D. Operating & Maintenance Manuals
 - E. BAS System software database
 - F. Controller application programming databases
 - G. Application Specific Controller configuration files
 - H. Advanced Application Controller configuration and programming files
 - I. Required Licensed software

PART 2 - PRODUCTS**2.1 SECTION INCLUDES**

- .1 General Description
- .2 Architecture/Communication
- .3 Operator Interface
- .4 Application and Control Software
- .5 System Controllers
- .6 Equipment Controllers
- .7 Auxiliary Control Devices

2.2 GENERAL DESCRIPTION

- A. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 1 year. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least 5 years after completion of this contract.

2.3 ARCHITECTURE/COMMUNICATION

- A. This project shall be comprised of a high speed Ethernet network utilizing BACnet/IP communications between System Controllers and Workstations. Communications between System Controllers and sub-networks of Custom Application Controllers and/or Application Specific Controllers shall utilize BACnet MSTP (RS485) communications.

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- a. Each System Controller shall perform communications to a network of Custom Application and Application Specific Controllers using BACnet/MSTP (RS485) as prescribed by the BACnet standard. Each System Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.
2. Custom Application (Equipment) and Application Specific (Zone) Controllers shall meet the following communication requirements
 - a. Communicate to Building Controller via BACnet MS/TP
 - b. To ensure integration to the installed system and additions the Controller must be BTL Testing Lab listed for the following: Advance Applications Controller (B-AAC) or BACnet Application Specific Controllers (B-ASC).
 - c. To allow maximum communications speed and co-existence with other controllers the Controller shall support at a minimum the following BACnet MS/TP master baud rate: 9600, 19200, 38400, 76800.
 - d. In case of communications failure stand-alone operation shall use default values or last values for remote sensors read over the network such as outdoor air temperature.
 - e. In the event of communication failure the Controller shall operate independently until communication is reestablished.
2. The Owner will provide all communication media, connectors, repeaters, network switches, and routers necessary for the high speed Ethernet network. An active Ethernet port will be provided adjacent to each System Controller and operator interface (PC) for connection to this high speed Ethernet network
3. All values within the system (i.e. schedules, datalogs, points, software variables, custom program variables) shall be readable and controllable (where appropriate) by any System Controller or BACnet Workstation on the communications network via BACnet

2.4 OPERATOR INTERFACE

- A. Building Automation System shall be implemented as an extension of an existing owner BAS. Operator interface shall be accessible via the existing owner BAS operator interface. The operator interface shall reside on the Enterprise wide network, which is same high- speed communications network as the System Controllers. The Enterprise wide network will be provided by the owner and supports the Internet Protocol (IP).
- B. Operator Interface
 1. The operator interface shall be accessible via a web browser.
 2. The operator interface shall support the following Internet web browsers:
 - a. Internet Explorer 8.0+
 - b. Firefox 4.0+
 - c. Chrome 10.0+
 3. The operator interface shall support the following mobile web browsers:
 - a. iOS (iPad/iPhone) V4.0+
 - b. Android (Tablet) V4.0+
 - c. Android (Phone) V2.3+
 4. System Security
 - a. Each operator shall be required to login to the system with a user name and password in order to view, edit, add, or delete data.
 - b. User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.

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- c. Each operator shall be allowed to change their user password
 - d. The System Administrator shall be able to manage the security for all other users
 - e. The system shall include pre-defined "roles" that allow a system administrator to quickly assign permissions to a user.
 - f. User logon/logoff attempts shall be recorded.
 - g. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
 - h. All system security data shall be stored in an encrypted format.
5. Database
- a. Database Save. A system operator with the proper password clearance shall be able to archive the database on the designated operator interface PC.
 - b. Database Restore. The system operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
6. On-Line Help and Training
- a. Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
 - b. On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.
7. System Diagnostics
- a. The system shall automatically monitor the operation of all network connections, building management panels, and controllers.
 - b. The failure of any device shall be annunciated to the operators.
8. Equipment & Application Pages
- a. The operator interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:
 - 1) Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:
 - a) ALL mechanical equipment that is controlled via the BAS. These graphics shall show all points dynamically as specified in the points list.
 - b) Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.
 - 2) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.
 - 3) Historical Data (As defined in Automatic Trend Log section below) for the equipment or application without requiring a user to navigate to a data log page and perform a filter.
9. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, Floorplan graphics, and graphics that summarize conditions on each floor of each building included in this contract. Floorplan graphics shall be created to represent the building layout and provide system equipment locations on the associated graphics.
- a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point and-click navigation between zones or equipment, and to edit set points and other specified parameters.

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- b. Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
 - c. Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
 - d. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - e. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).
10. Custom Graphics
- a. The operator interface shall be capable of displaying custom graphics in order to convey the status of the facility to its operators.
 - b. Graphical Navigation. The operator interface shall provide dynamic color graphics of building areas, systems and equipment.
 - c. Graphical Data Visualization. The operator interface shall support dynamic points including analog and binary values, dynamic text, static text, and animation files.
 - d. Custom background images. Custom background images shall be created with the use of commonly available graphics packages such as Adobe Photoshop. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as GIF and JPEG.
11. Dashboard-style Graphics
- a. Graphics in the form of dashboards that provide “at-a-glance” views of operation shall be provided for controlled systems and subsystems.
 - 1) Dashboards shall be provided in addition to standard operator interface screens that can be used for advanced-level diagnostics and system configuration.
 - 2) Dashboards must allow, without any clicks, an operator to determine if the system depicted is operating as designed or if investigation is required.
 - 3) Dashboards shall be customizable.
 - 4) Dashboards shall reside in and be provided by enterprise, or system level devices that are part of the automation system.
 - b. Application dashboards shall provide a summary of the application conditions.
 - 1) Application dashboards shall utilize [gauges, charts, bars, status points] or other similar “at a glance” representations to depict critical operating conditions as defined by user.
 - 2) Application dashboards must depict the impact of system optimization strategies deployed.
 - c. RTU plant Dashboard
 - 1) RTU RTU shall get an enable signal from BAS and control its own destiny depending on the parameters sent to it by BAS system dashboard shall depict summary information for plant and individual chillers including mode, status, chilled water set point and supply temperatures, load, and control point, in addition to pump status, tower status, condenser water treatment system status, and other points defined by end user using status points and color indicators.
 - 2) Chiller plant dashboard shall depict current load, pressure, flow, and chilled water and condenser water supply and return temperatures using gauges.
 - 3) Chiller plant dashboard shall depict average chilled water temperature, condenser

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water temperature, load, and efficiency using bar graphs.

- 4) Chiller plant dashboard shall depict plant efficiency based on calculations in accordance with ASHRAE Guideline 22.

12. Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.

13. Manual Control and Override.

- a. Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
- b. Temporary Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
- c. Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.
- d. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

14. Engineering Units

- a. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system.
- b. Unit selection shall be able to be customized by locality to select the desired units for each measurement.
- c. Engineering units on this project shall be IP.

15. Scheduling. A user shall be able to perform the following tasks utilizing the operator interface:

- a. Create a new schedule, defining the default values, events and membership.
- b. Create exceptions to a schedule for any given day.
- c. Apply an exception that spans a single day or multiple days.
- d. View a schedule by day, week and month.
- e. Exception schedules and holidays shall be shown clearly on the calendar.
- f. Modify the schedule events, members and exceptions.
- g. Global Scheduling Support
 - 1) Assign attributes for individual schedules in order to facilitate quick selection of similar schedules across multiple buildings.
 - 2) The system shall allow ability to make changes to weekly schedules of all schedules in the system through single edit action.
 - 3) Ability to apply an exception to any or all of the schedules in a system through a single edit action.
 - 4) Allow user to specify different events for each day of the week when applying exceptions to schedules.
 - 5) Allow user to enact an emergency schedule for any or all of the schedules in the system through a single click action.

16. Trend Logs

- a. Trend Logs Definition.
 - 1) The operator interface shall allow a user with the appropriate security permissions to define a trend log for any data in the system.

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- 2) The operator interface shall allow a user to define any trend log options as

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described in the Application and Control Software section.

- b. Trend Log Viewer.
 - 1) The operator interface shall allow Trend Log data to be viewed and printed.
 - 2) The operator interface shall allow a user to view trend log data in text-based (time – stamp/value). The operator shall be able to view the data collected by a trend log in a graphical chart in the operator interface.
 - 3) Trend log viewing capabilities shall include the ability to show a minimum of 5 points on a chart.
 - 4) Each data point trend line shall be displayed as a unique color.
 - 5) The operator shall be able to specify the duration of historical data to view by scrolling and zooming.
 - 6) The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.
 - c. Export Trend Logs.
 - 1) The operator interface shall allow a user to export trend log data in CSV or PDF format for use by other industry standard word processing and spreadsheet packages.
17. Alarm/Event Notification
- a. An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon.
 - b. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any operator interface.
 - 1) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
 - 2) Alarm/event messages shall use full language, easily recognized descriptors.
 - 3) An operator with the proper security level may acknowledge and clear alarms/events.
 - 4) All alarms/events that have not been cleared by the operator shall be stored by the building controller.
 - 5) The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.
 - c. Alarm Processing.
 - 1) The operator shall be able to configure any object in the system to generate an alarm when transitioning in and out of a normal state.
 - 2) The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
18. Reports and Logs.
- a. The operator interface shall provide a reporting package that allows the operator to select reports.
 - b. The operator interface shall provide the ability to schedule reports to run at specified intervals of time.
 - c. The operator interface shall allow a user to export reports and logs from the building controller in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Acceptable formats include:
 - 1) CSV, HTML, XML, PDF
 - d. Reports and logs shall be readily printed to the system printer.
 - e. Provide a means to list and access the last 10 reports viewed by the user.

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- f. The following standard reports shall be available without requiring a user to manually configure the report:
 - 1) All Points in Alarm Report: Provide an on demand report showing all current alarms.
 - 2) All Points in Override Report: Provide an on demand report showing all overrides in effect. Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
 - 3) Points report: Provide a report that lists the current value of all points
- 19. FCU. An operator shall be able to view and control (where applicable) the following parameters via the operator interface:
 - a. System Mode
 - b. System Occupancy
 - c. occupancy status
 - d. Supply air cooling and heating set points
 - e. Average space temperature
 - f. Minimum space temperature
 - g. Maximum space temperature

2.5 APPLICATION AND CONTROL SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator interface.
 - 1. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
 - a. Weekly Schedule. Provide separate schedules for each day of the week.
 - b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
 - c. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
 - d. Optimal Start. The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.
 - 2. Trend Log Application
 - a. Trend log data shall be sampled and stored on the System Controller panel and shall be capable of being archived to a BACnet Workstation for longer term storage.
 - 1) Trend logs shall include interval, start-time, and stop-time.
 - 2) Trend log intervals shall be configurable as frequently as 1 minute and as infrequently as 1 year.

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- b. Automated Trend Logs.
 - 1) The system controller shall automatically create trend logs for defined key measurements for each controlled HVAC device and HVAC application.
 - 2) The automatic trend logs shall monitor these parameters for a minimum of 7 days at 15 minute intervals. The automatic trend logs shall be user adjustable.
- 3. Alarm/Event Log
 - a. Any object in the system shall be configurable to generate an alarm when transitioning in and out of a normal or fault state.
 - b. Any object in the system shall allow the alarm limits, warning limits, states, and reactions to be configured for each object in the system.
 - c. An alarm/event shall be capable of triggering any of the following actions:
 - 1) Route the alarm/event to one or more alarm log
 - a) The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself.
 - 2) Route an e-mail message to an operator(s)
 - 3) Log a data point(s) for a period of time
 - 4) Run a custom control program

2.5 SYSTEM CONTROLLERS

- A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in Application and Control Software section.
 - 1. The System Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 2. The controller shall provide a USB communications port for connection to a PC
 - 3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 4. All System Controllers shall have a real time clock.
 - 5. Data shall be shared between networked System Controllers.
 - 6. The System Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
 - c. Create a retrievable file of the state of all applicable memory locations at the time of the failure.
 - d. Automatically reset the System Controller to return to a normal operating mode.
 - 7. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at -40 C to 50 C [-40 F to 122 F].
 - 8. Clock Synchronization.
 - a. All System Controllers shall be able to synchronize with a NTP server for automatic time synchronization.
 - b. All System Controllers shall be able to accept a BACnet time synchronization command for automatic time synchronization.
 - c. All System Controllers shall automatically adjust for daylight savings time if applicable.
 - 9. Serviceability

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- a. Provide diagnostic LEDs for power, communications, and processor.
- b. The System Controller shall have a display on the main board that indicates the current operating mode of the controller.
- c. All wiring connections shall be made to field removable, modular terminal connectors.
 - d. The System controller shall utilize standard DIN mounting methods for installation and replacement.
- 10. Memory. The System Controller shall maintain all BIOS and programming information indefinitely without power to the System controller
- 11. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage
- 12. BACnet Test Labs (BTL) Listing. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Test Labs.

2.6 EQUIPMENT CONTROLLERS

- A. Advanced Application Controllers (AAC) shall be microprocessor-based DDC controllers which through hardware or firmware design control specified equipment. They are user programmable and are used to control equipment or applications of medium and high complexity. Examples are controllers for Air Handlers, Boiler Plants, Etc..
 - 1. For ease of troubleshooting, the Controller shall support data trend logging
 - a. 25,000 samples minimum
 - b. Trends shall be capable of being collected at a minimum sample rate of once every second
 - c. Trends shall be capable of being scheduled or triggered.
 - 2. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the Controller.
 - 3. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
 - a. Storage conditions:
 - 1) Temperature: -67°F to 203°F (-55°C to 95°C)
 - 2) Humidity: Between 5% to 100% RH (non-condensing)
 - b. Operating conditions:
 - 1) Temperature: -40°F to 158°F (-40°C to 70°C)
 - 2) Humidity: Between 5% to 100% RH (non-condensing)
 - c. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum
 - d. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 F to 158 F [- 40 C to 70 C].
 - 4. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:
 - a. Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.
 - b. Shall support flexibility in sensor type, the Controller shall be of reading sensor input ranges of 0 to 10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.
 - c. Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.

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- d. Shall support flexibility in sensor type, the Controller and/or expansion modules shall

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- support dry and wetted (24VAC) binary inputs.
- e. The controller support pulse accumulator for connecting devices like energymeters.
- f. In order to support a wide range of devices, the Controller's binary output shall be able to drive at least 10VA each.
- g. Any I/O that is unused by functionality needed for the equipment shall be available to be used by custom program on the Controller and by any other controller on the network. The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.
- h. The Controller shall provide a dedicated static pressure input.
- 5. Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:
 - a. For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.
 - b. Expansion I/O can be mounted up to 200m from control
 - c. Expansion I/O can be added in as small as 4 point increments.
 - d. To keep BACnet MS/TP network traffic to a minimum, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed)
- 6. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.
 - a. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.
 - b. Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box
 - c. Software service tool connection through all of the following methods: direct cable connection to the Controller, connection through another controller on BACnet link and through the Controller's zone sensor.
 - d. For configuration, programming, and testing of controller programs must, for safety purposes, be able to be accomplished with the power off to the equipment and the controller.
 - e. The Controller software tool service port shall utilize standard of-the-shelf USB printer cable.
 - f. Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.
 - g. To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.
 - h. For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).
 - i. To aid in service replacement, the Controller shall allow for setting its BACnet address must be rotary switches that correspond to a numerical value for the address to allow the setting of the address without the need of a service tool or the control being powered (DIP switch methodologies are not allowed).
 - j. Controller data shall persist through a power failure.
- 7. Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
- 8. Transformer for the Controller must be rated at minimum of 115% of ASC power

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consumption, and shall be fused or current limiting type. 24 VAC, +/- 15% nominal, 50-60 Hz, 24 VA plus binary output loads for a maximum of 12 VA for each binary output.

9. Controller must meet the following Agency Compliance:
 - a. UL916 PAZX, Open Energy Management Equipment
 - b. UL94-5V, Flammability
 - c. FCC Part 15, Subpart B, Class B Limit
 - d. BACnet Testing Laboratory (BTL) Listed
 - e. cUL Marked for international compliance
 - f. CE Marked for international compliance
- B. Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which through hardware or firmware design control specified equipment. They are not user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
 1. Application Specific Controller are only allowed when both the following
 - a. The equipment is compressor based or boiler based and
 - b. The controller is provided by the equipment manufacturer and warrantied as part of the equipment.
- C. Zone Controllers are controllers that operate equipment that control the space temperature of single zone. Examples are controllers for VAV, Fan coil, Blower Coils, Unit Ventilators, Heat Pumps, and Water Source Heat Pumps.
 1. Software
 - a. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.
 - b. Stand-Alone Operation: Each piece of equipment specified in section A shall be controlled by a single controller and provide stand-alone control in the event of communication failure. In case of communications failure stand-alone operation shall use default values or last values for remote sensors read over the network such as outdoor air temperature.
 - c. For controlling ancillary devices and for flexibility to change to sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.
 2. Environment Controller hardware shall be suitable for the anticipated ambient conditions.
 - a. Storage: -55 to 203 ° F (-48 to 95° C) and 5 to 95% Rh, non-condensing.
 - b. Operating: -40 to 158 ° F (-40 to 70 ° C) and 5 to 95% Rh, non-condensing.
 - c. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum
 - d. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 F to 158 F [- 40 C to 70 C].
 3. Input/Output:
 - a. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4- 20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
 - b. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.
 - c. For flexibility in selection and replacement of binary sensors, the controller shall support dry and wetted (24VAC) binary inputs.
 - d. For flexibility in selection and replacement devices, the controller's shall have binary

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output which are able to drive at least 12VA each.

- e. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).
 - f. For future needs, any I/O that is unused by functionality of equipment control shall be available to be used by custom program on the controller and by another controller on the network.
 - g. For future expansion and flexibility, the controller shall have either on board or through expansion, 50 hardware input/output points. Expansion points must communicate with the controller via an internal communications bus. Expansion points must be capable of being mounted up to 200 meters from the controller. Expansion points that require the BACnet network for communication with the controller are not allowed.
4. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.
- a. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
 - b. All binary output shall have LED's indicating the output state.
 - c. All wiring connections shall removable without the use of a tool.
 - d. Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link and through the controller's zone sensor.
 - e. For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.
 - f. Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.
 - g. BACnet Mack Address shall be set using decimal (0-9) based rotary switches.
 - h. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.
 - i. BACnet trending objects resident on controller
 - 1) Minimum of 20,000 trending points total on controller
 - 2) Shall be capable of trending all BACnet points used by controller
 - 3) Shall be capable of 1 second sample rates on all points
5. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
6. Transformer for the controller must be rated at minimum of 115% of ASC power consumption, and shall be fused or current limiting type. 24 VAC, +/- 15% nominal, 50-60 Hz, 24 VA plus binary output loads, for a maximum of 12 VA for each binary output.
7. Agency Approval: The controller shall have meet the Agency Compliance:
- a. UL916 PAZX, Open Energy Management Equipment
 - b. UL94-5V, Flammability
 - c. FCC Part 15, Subpart B, Class B Limit

2.7 AUXILIARY CONTROL DEVICES

A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:

- 1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with

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reinforced corner bracing.

2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
 3. Damper shaft bearings shall be as recommended by manufacturer for application.
 4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
 5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
 6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
- B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.
- C. Electric damper/valve actuators.
1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
 2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
 3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
 4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
 5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
 6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 7. Actuators shall be Underwriters Laboratories Standard 873 listed.
 8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.
- D. Control Valves
1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
 2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Water Valves:
 - 1) Two-way: 150% of total system (pump) head.
 - 2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - b. Steam Valves: 150% of operating (inlet) pressure.
- E. Binary Temperature Devices
1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
 2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.

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3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

F. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings.
5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].
6. [Optional] The space temperature, setpoint, and override confirmation will be annunciated by a digital display for each zone sensor. The setpoint will be selectable utilizing buttons.

G. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

H. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

I. Flow Switches

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified:
3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.

J. Relays

1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

K. Transformers and Power Supplies

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1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be

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furnished with over-current protection in both primary and secondary circuits for Class 2 service.

2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0 C and 50 C.
4. Unit shall be UL recognized.

L. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

M. Pressure Transducers

1. Transducer shall have linear output signal. Zero and span shall be field adjustable.
2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.

N. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
2. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide on/off power switch with over-current protection for control power sources to each local panel.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. The Contract Documents shall be thoroughly examined for coordination of control devices their installation, wiring, and commissioning. Coordinate and review mechanical equipment specifications, locations, and identify any discrepancies, conflicts, or omissions that shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- B. The BAS manufacturer shall inspect the jobsite in order to verify that control equipment can be installed as required, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.2 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit, parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by National Electric Code (NEC).

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Control panels shall be attached to structural walls or properly supported in a free- standing configuration, unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

- D. Verify integrity of all control wiring to ensure continuity and freedom from shorts and grounds prior to commencing the startup and commissioning procedures.
- E. All control device installation, and wiring shall comply with Contract Documents, acceptable industry specifications, and industry standards for performance, reliability, and compatibility. Installation and wiring shall be executed in strict adherence to local codes and standard practices referenced in Contract Documents.

3.3 WIRING

- A. All control and interlock wiring shall comply with the National, Local Electrical Codes, and Section 26000 of these Contract Document specifications. Where the requirements of this section differ with those in Section 26000, the requirements of this section shall take precedence.
- B. Where Class 2 wires are in concealed and accessible locations; including ceiling return air plenums, approved cables outside of electrical raceway can be used provided that the following conditions are met:
 - 1. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
 - 2. All cables shall be UL listed for application (i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose).
- C. Do not install Class 2 wiring in conduits containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two via control relays and transformers.
- D. Where Class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using industry approved fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.
- E. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- F. Maximum allowable voltage for control wiring shall be 120Vac. If only higher voltages are available for use, the BAS manufacturer shall provide step-down transformers to achieve the desired control voltages.
- G. All control wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- H. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with Contract Documents and National and/or Local Codes.
- I. Conduit and wire sizing shall be determined by the BAS manufacturer in order to maintain manufacturer's recommendation and must meet National and Local Codes.
- J. Control and status relays are to be located in pre-fabricated enclosures that meet the application. These relays may also be located within packaged equipment control panel enclosures as coordinated. These relays shall not be located within Class 1 starter enclosures.
- K. Follow manufacturer's installation recommendations for all communication and network bus cabling. Network or communication cabling shall be run separately from all control power wiring.
- L. Adhere to Section 16000 requirements for installation of electrical raceways.
- M. BAS manufacturer shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the jobsite.

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- N. Flexible metal conduits and liquid-tight flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

3.4 FIBER OPTIC CABLE SYSTEM (WHERE APPLICABLE)

- A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.
- B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacturer's specifications.

3.5 Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.**3.6 INSTALLATION OF SENSORS**

- A. Sensors required for mechanical equipment operation shall be factory installed and wired as specified in mechanical equipment specifications. BAS manufacturer shall be responsible for coordinating these control devices and ensuring the sequence of operations will be met. Installation and wiring shall be in accordance with the BAS manufacturer's recommendations.
- B. Sensors that require field mounting shall meet the BAS manufacturer's recommendations and be coordinated with the mechanical equipment they will be associated.
- C. Mount sensors rigidly and adequately for the environment the sensor will operate.
- D. Room temperature sensors shall be installed on concealed junction boxes properly supported by the block wall framing. For installation in dry wall ceilings, the low voltage sensor wiring can be installed exposed in the wall and must meet applicable National and Local Electrical Codes.
- E. All wires attached to wall mounted sensors shall be sealed off to prevent air from transmitting in the associated conduit and affecting the room sensor readings.
- F. Install duct static pressure tap with tube end facing directly down-stream of air flow.
- G. Install space static pressure sensor with static sensing probe applicable for space installation where applicable.
- H. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- I. All pipe mounted temperature sensors shall be installed in matched thermowells. Install all liquid temperature sensors with heat conducting fluid in thermal wells for adequate thermal conductance.
- J. Wiring for space sensors shall be concealed in building drywall. EMT conduit is acceptable within mechanical equipment and service rooms.
- K. Install outdoor air temperature sensors on north wall complete with sun shield at manufacturer's recommended location and coordinated with Engineer.

3.7 FLOW SWITCH INSTALLATION

- A. Coordinate installation of flow switch with Mechanical Contractor who will be responsible for installing a thread-o-let in steel piping applications. Copper pipe applications will require the use CxCxF Tee, and no pipe extensions or substitutions will be allowed.
- B. Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream, or two feet, whichever is greater, from pipe fittings and other inline potential obstructions.
- C. Install in accordance with manufacturers' instructions, which will require proper flow direction, horizontal alignment with flow switch mounting on the top of pipe.

3.8 VALVE & DAMPER ACTUATOR INSTALLATION

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- A. Mount and link multiple control damper actuators where required, per manufacturer's instructions.
- B. To compress seals when spring-return actuators are used on normally closed dampers, power the actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
- C. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions. Coordinate any installation problems with Sheet metal Contractor.
- D. Valves - Actuators shall be mounted on valves with adapters approved by both the actuator and valve manufacturer. Actuators and adapters shall be mounted in the factory as an approved design arrangement and shall not be field modified.

3.9 IDENTIFICATION OF HARDWARE AND WIRING

- A. All field wiring and cabling, including that within factory mounted, and wired control panels and devices for mechanical equipment, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information for troubleshooting, maintenance, and service purposes. BAS manufacturer to coordinate this labeling requirement with mechanical equipment manufacturer as it relates to controls.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served and correlate them to the BAS design drawings.
- C. Identify control panels with minimum 1-cm letters on laminated plastic nameplates.
- D. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.10 BAS DDC CONTROLLERS

- A. Provide a separate DDC Controller for individual HVAC mechanical equipment. DDC Controllers shall be factory mounted, installed, and wired by mechanical equipment manufacturer as specified. BAS manufacturer to furnish and coordinate DDC controllers and control devices and ensure that installation and wiring adhere to BAS manufacturer's design recommendations. For those mechanical equipment units that do not have factory installed controls specified, the BAS manufacturer shall field mount controls and coordinate all installation and termination information to ensure the specified sequence of operations are met.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type (analog or digital) found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used in each controller.
- C. Future use of spare I/O point capacity shall require providing the field instrument and control device, field wiring, engineering, programming, and commissioning. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.11 PROGRAMMING

- A. Provide sufficient internal memory for all controllers to ensure specified sequence of operations, alarming, trending, and reporting requirements are achieved. BAS manufacturer shall provide a minimum of 25% spare memory capacity for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
 - 1. Provide programming for individual mechanical systems to achieve all aspects of the sequence of operation specified. It is the BAS manufacturer's responsibility to ensure all mechanical equipment functions and operates as specified in sequence of operations. Provide sufficient programming comments in controller application software to clearly

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describe each section of the program. The comment statements shall reflect the language

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used in the sequence of operations.

D. BAS Operator's Interface

1. Provide color graphics for each piece of mechanical equipment depicting sufficient I/O to monitor and troubleshoot operation. Additionally, provide individual floor plans of the building allowing an operator to quickly view the overall floor plan area for any out of tolerance conditions that may need addressing. Operator color graphics shall include Chiller Plant, Cooling Tower System, Boiler Plant, Air Handling Units, Rooftop Units, VAV Terminal Boxes, Fan Coil Units, Unit Ventilators, Heat Exchangers, Exhaust Fans, etc. These graphics shall depict all points dynamically as specified in the points list and/or indicated in sequence of operation.
2. The BAS manufacturer shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
3. As part of this execution phase, the BAS manufacturer shall perform a complete test of the operator interface. Test duration shall be a minimum of (8) hours on-site. Tests shall be made in the presence of the Owner and/or Engineer.

3.12 CLEANING

- A. The BAS manufacturer's installing contractor(s) shall clean up all debris resulting from their installation activities on a daily basis. The installation contractors shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Owner, Construction Manager, General Contractor, and/or Mechanical Contractor.
- B. At the completion of work in any area, the installation contractor shall clean all of their work, equipment, etc., making it free from dust, dirt and debris.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage. Any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.13 PROTECTION

- A. The BAS installation contractor shall protect all work and material from damage by their work or personnel, and shall be liable for all damage.
- B. The BAS manufacturer shall be responsible for their work and equipment until final inspection, testing, and acceptance. The BAS installing contractor shall protect their work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.14 TRAINING

- A. Provide minimum of (2) classroom training sessions, and (4) hours for each session, throughout the contract period. The training will be provided for personnel designated by the Owner.
- B. The Owner training shall enable personnel to proficiently operate the BAS by being able to create, modify and delete programming; add, remove and modify physical points for individual controllers; and add additional controllers when required.
- C. These objectives will be divided into three logical groupings; participants may attend one or more of these, depending on level of knowledge required:
 1. Day-to-day BAS Operators
 2. BAS Troubleshooting & Maintenance
 3. Maintenance Manager: Parts Inventory

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- D. Provide course outline and materials prior to schedule training session. The instructor(s) shall provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained and experienced in teaching this technical material.

3.15 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Contract Documents.
- B. BAS manufacturer shall continually monitor the field installation for building code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. BAS installing Contractor(s) shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.16 TEST AND BALANCE ASSISTANCE

- A. All work related to this project shall be subject to the performance of test and balance. BAS contractor shall provide assistance to the test and balance contractor during test and balance process. BAS contractor must have a representative on site anytime that the test and balance contractor is on site or as required directed by the test and balance contractor. BAS contractor shall receive a minimum of 72 hours' notice before being required onsite.

3.17 ACCEPTANCE

- A. The BAS will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

END OF SECTION

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig (690 kPa)
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 2 psig (13.8 kPa) but not more than 5 psig (34.5 kPa), and is reduced to secondary pressure of more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa).
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Dielectric fittings.

1.6 INFORMATIONAL SUBMITTALS

- A. 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.
- B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with

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- other services and utilities.
- C. Qualification Data: For qualified professional engineer.
- D. Welding certificates.
- E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.10 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
 1. Notify engineer no fewer than two days in advance of proposed interruption of natural-gas service.

1.11 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS**2.1 PIPES, TUBES, AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including

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bolts, nuts, and gaskets of the following material group, end connections, and facings:

- a. Material Group: 1.1.

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- b. End Connections: Threaded or butt welding to match pipe.
- c. Lapped Face: Not permitted underground.
- d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o- rings, and spiral-wound metal gaskets.
- e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72 inches (1830 mm.)
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.
 - 2. Nitrile seals.
 - 3. Hand operated with automatic shutoff when disconnected.
 - 4. For indoor or outdoor applications.
 - 5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
 - 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig (862 kPa).
- D. Basket Strainers:
 - 1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
 - 3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig (862 kPa).
- E. T-Pattern Strainers:
 - 1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 - 2. End Connections: Grooved ends.
 - 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 - 4. CWP Rating: 750 psig (5170 kPa).
- F. 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.

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2.3 JOINING MATERIALS

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- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 - 1. Threaded Ends: Comply with ASME B1.20.1.
 - 2. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 3. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
 - 4. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
 - 1. CWP Rating: 125 psig (862 kPa)
 - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 - 3. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE; blowout proof.
 - 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 8. CWP Rating: 600 psig (4140 kPa).
 - 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valvebody.
- D. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flowserve.
 - b. Homestead Valve; a division of Olson Technologies, Inc.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Milliken Valve Company.
 - e. Mueller Co.; Gas Products Div.
 - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
 - 2. Body: Cast iron, complying with ASTM A 126, Class B.

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3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.

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5. Stem Seal: Compatible with natural gas. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig (862 kPa).
8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body. 11.

2.5 EARTHQUAKE VALVES

- A. Earthquake Valves: Comply with ASCE 25.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Vanguard Valves, Inc.
 2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 3. Maximum Operating Pressure: 5 psig (34.5 kPa).
 4. Cast-aluminum body with nickel-plated chrome steel internal parts.
 5. Nitrile-rubber valve washer.
 6. Sight windows for visual indication of valve position.
 7. Threaded end connections complying with ASME B1.20.1.
 8. Wall mounting bracket with bubble level indicator.

2.6 PRESSURE REGULATORS

- A. General Requirements:
 1. Single stage and suitable for natural gas.
 2. Steel jacket and corrosion-resistant components.
 3. Elevation compensator.
 4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.
- B. Line Pressure Regulators: Comply with ANSI Z21.80.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 6. Orifice: Aluminum; interchangeable.
 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not

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connected to vent piping.

12. Maximum Inlet Pressure: see schedule

FACILITY NATURAL-GAS PIPING

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
 - d. .

2.8 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches (900 mm) below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

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3. Replace pipe having damaged PE coating with new pipe.

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- E. Install fittings for changes in direction and branch connections.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.

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5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash

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chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

- b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

3.5 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless- steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).

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3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).

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4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

B. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1/2 and NPS 5/8 (DN 15 and DN 18): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 3/4 and NPS 7/8 (DN 20 and DN 22): Maximum span, 84 inches (2134 mm); minimum rod size, 3/8 inch (10 mm).
4. NPS 1 (DN 25): Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

3.8 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

- A. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 PAINTING

- A. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel flat
 - d. Color: per architect
- B. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

FACILITY NATURAL-GAS PIPING

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: [Alkyd anticorrosive] [Quick-drying alkyd] metal primer.

FACILITY NATURAL-GAS PIPING

- b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat.
 - d. Color per architect.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
 - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
- B. Aboveground natural-gas piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.

END OF SECTION

SECTION 23 31 00

LOW VELOCITY DUCTWORK

1 GENERAL

1.1 SECTION INCLUDES:

- A. Ductwork
- B. Fasteners
- C. Sealants
- D. Duct Cleaning

1.2 RELATED SECTIONS

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

1.3 REFERENCES

- A. American Conference of Governmental Industrial Hygienists: Industrial Ventilation.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, ASHRAE:
 - 1. ASHRAE Handbook and Product Directory.
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc., SMACNA:
 - 1. SMACNA's HVAC Duct Construction Standards - metal and Flexible.

1.4 Definitions

- A. Duct Sizes: Inside clear dimensions.
- B. Low Pressure: Static pressure in duct less than 2 inch w.g. and velocities less than 2,000 FPM.

1.5 SUBMITTAL

- A. Submit in accordance with fabrication Division 1.
- B. Provide shop drawings drawn to scale coordinated with existing conditions for all new stainless steel duct systems prior to fabricating of duct work to engineer.

1.6 REGULATORY REQUIREMENTS

- A. National Electrical Code, NEC (1987):
 - 1. NEC 300-21: Wiring Methods: Spread of Fire or Products of Combustion.
- B. National Fire Protection Association, NFPA:
 - 1. NFPA 90A: Air Conditioning and Ventilating Systems.
 - 2. NFPA 90B: Standard for Installation of Warm Air Heating and Air Conditioning Systems.
 - 3. NFPA 96: Standard for Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooling Equipment.
- C. Underwriters Laboratories, UL:
 - 1. UL 181: Factory-Made Duct Materials and Air Duct Connections.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Protect shop-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling.
 - 1. Stored materials subject to rejection due to damage.
 - 2. Ductwork exposed and painted in finished spaces protected and handled as decorative ductwork.

LOW VELOCITY DUCTWORK

2 PRODUCTS**2.1 MATERIALS**

- A. Ductwork Metal:
 - 1. Galvanized Steel: ASTM A525, lock-forming quality, 1.25 oz. zinc coating each side.
 - 2. Stainless Steel: ASTM A167, AISI Type 316, No. 4 directional polish where exposed to view.
- B. Supply ductwork to be galvanized steel
 - 1. Kitchen Exhaust ductwork to be welded stainless steel.
- C. Fire and Smoke Penetration Sealant: UL rated, flexible sealant, NEC 300-21.

2.2 FABRICATION

- A. Accessories:
 - 1. Fabricate ductwork with accessories such as air turns, extractors and volume dampers; installed during fabrication to greatest extent possible.
- B. Variation:
 - 1. Size round ducts installed in place of rectangular ducts from ASHRAE table of equivalent rectangular and round ducts. Maintain clearances to obstructions.
 - 2. No variation of duct configuration or sizes permitted except by written permission.
- C. Directional Change:
 - 1. Construct tees, bends and elbows with radius minimum 1-1/2 times width of duct on center line.
 - 2. Where not possible and where rectangular elbows used, provide air foil type or other type turning vanes specified in Section 15910.
- D. Size Change:
 - 1. Increase and decrease duct sizes gradually, not exceeding 15° divergence and 30° convergence, unless otherwise indicated on Drawings.
 - 2. Maximum Divergence Upstream of Equipment: 20° and 30° convergence downstream.
 - 3. Collars in caps not acceptable.
- E. Seams and Joints: In accordance with SMACNA standards.
 - 1. Contractor's Option: Transverse joints.
 - a. Acceptable Manufacturer:
 - (1) Ductmate Industries, Inc.: Ductmate System
 - 2. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so not to breathe, rattle, vibrate or sag.
 - 3. Fabricate seams and joints liquid-tight with continuous exterior welds or gasketed, bolted flanged connections in kitchen or other high-grease content ductwork.
- F. Maximum Air Leakage:
 - 1. Fabricate and seal ductwork to maintain following minimum air leakages, inward or outward.
 - a. Air Handled Each 50 Feet Main or Branch Duct: 1%.
 - b. Total Leakage Any Complete System: 5% of total air handled.
- G. Duct Gauges:
 - 1. Rectangular Ducts:

<u>Maximum Width in Inches</u>	<u>Minimum USS Gauge</u>
Up to 12	26
13 to 30	24
31 to 54	22

SECTION 23 31 00

LOW VELOCITY DUCTWORK

2. Round Ducts:

LOW VELOCITY DUCTWORKDuct Diameter in Inches Minimum USSGauge

Up to 13	26
14 to 22	24

H. Plenum Gauges: Same as associated duct system.

3 EXECUTION**3.1 INSTALLATION**

- A. Assemble and install ductwork in accordance with SMACNA standards, to achieve airtight and noiseless systems; capable of performing each indicated service.
 - 1. Align ductwork accurately at connections.
 - 2. Support ducts rigidly with suitable ties, braces, hangers and anchors which will hold ducts straight, plumb and free of sags and vibration.
- B. Electrical Equipment Spaces:
 - 1. Do not run ductwork through or over transformer vaults and other electrical equipment or elevator spaces and enclosures.
- C. Metal Duct Support:
 - 1. Support ductwork from building structure where not otherwise indicated.
 - a. Anchor with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps or special beam clamps.
 - 2. Support vertical ducts, at 12-foot spacing, by attachment to adjacent vertical structural surfaces or by direct bearing at floor penetrations and similar locations.
 - 3. Support horizontal ducts, located against structural walls and other similar adjacent vertical surfaces, at 8-foot spacing for ducts up to 40 inches horizontal dimension and 4-foot spacing for larger ducts.
 - 4. Hang horizontal rectangular ducts from overhead structure, at 10-foot spacing for larger ducts.
 - 5. Arrange hangers, supports and duct rests to permit free, unrestrained and noiseless expansion and contraction of duct.
 - 6. Where duct lining is not used, vertical members may be fastened to duct sides with sheet metal screws.
- D. Openings:
 - 1. Provide openings in ductwork to accommodate thermometers and controllers.
 - 2. Provide pitot tube openings for testing of systems; complete with metal cap with spring device or screw to ensure against air leakage.
 - 3. Where openings are provided in insulated or lined ductwork, install insulation material inside metal ring.
- E. Locate ducts with sufficient space around equipment to allow for normal operating and maintenance activities.
- F. Provide sleeved opening where ducts pass through smoke, fire and sound walls.
 - 1. Seal space between duct and sleeve airtight with mineral wool.
 - 2. Provide duct flange to cover and retain mineral wool.
- G. Where ducts pass through fire-rated walls, partitions, floors and ceilings, seal openings in accordance with NEC 300-21.
- H. Connections:
 - 1. Connect duct to equipment with flexible fabric, sheet metal clips, screws and washers.
 - 2. Make branch take-offs at 45° angle with area at trunk duct 1-1/2 times area of branch duct.
 - a. Provide volume or splitter damper at each take-off.
 - b. Prefabricated air scoops not acceptable.
 - c. Form take-offs of same material as associated duct system.
 - 3. Connect diffusers or troffer boots to low pressure ducts with 3-foot maximum length

SECTION 23 31 00

LOW VELOCITY DUCTWORK

of flexible duct, held in place with strap or clamps.

LOW VELOCITY DUCTWORK**I. Flexible Ductwork:**

1. Maximum Length: 3 feet, in accordance with NFPA 90. Install ductwork with minimum offsets and trim; not stretched between connection points.
2. Connect with factory-installed compression coupling each end or provide separate adjustable bond and clamp to secure duct to trunk fitting and to distribution unit fitting.
3. Where recommended by manufacturer, make connection with mastic duct tape and adjustable clamp.
 - a. Seal end of flexible duct with tape so no insulations exposed.
4. Where metal ducts are lined, provide insulated flexible duct so no unlined metal duct is exposed.
5. Support ductwork as recommended by manufacturer' with wide sheet metal bends so area of flexible duct is not reduced at hanger.

3.2 ADJUSTING AND CLEANING**A. Cleaning:**

1. Clean ductwork internally of dust and debris, unit-by-unit as installed.
2. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or where ductwork is to be painted.

B. Temporary Closure:

1. At ends of ducts not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering until time connections are to be completed.

END OF SECTION

SECTION 23 33 00

DUCTWORK ACCESSORIES

1 GENERAL

1.1 SECTION INCLUDES

- a. Access Doors.
- b. Fire Dampers.
- c. Balancing Dampers.
- d. Backdraft Dampers.
- e. Flexible Duct Connections.

1.2 RELATED SECTIONS

- A. DIVISION 1 - GENERAL REQUIREMENTS
- B. Section 23 01 00 - BASIC MECHANICAL REQUIREMENTS
- C. Section 23 06 00 - TESTING, ADJUSTING & BALANCING

1.3 QUALITY ASSURANCE

- A. Fire dampers shall be UL listed and constructed in accordance with UL Standard 555 Fire Dampers. Fire Dampers shall be rated for the protection required.
- B. Fusible links on fire dampers shall be constructed to UL Standard 33, Fusible Links for Fire Protection Service, and so labeled for appropriate fire resistance and temperature.
- C. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.
- D. Access doors shall be UL labeled, for rated protection required.

1.4 REFERENCE STANDARDS

- A. Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems.
- B. Fabricate in accordance with ASHRAE handbooks and SMACNA duct manuals.

1.5 SUBMITTALS

- A. Submit in accordance with Divisions 1.
- B. Submit shop drawings of factory fabricated assemblies.
- C. Submit samples of shop fabricated assemblies as requested.
- D. Submit manufacturers' printed installation instructions.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Air Balance
- B. Vent Products
- C. Ruskin
- D. Substitutions: Items of same function and performance are acceptable in conformance with Division 1.

2.2 ACCESS DOORS

- A. Fabricate rigid and close-fitting hinged doors of galvanized steel with sealing gaskets and quick fastening cam locking devices. For insulated ductwork, install minimum 1 inch thick insulation with sheet metal cover.
- B. Provide two hinges and two sash locks for sizes up to 18 inch square, two hinges and two compression latches with outside and inside handles for sizes up to 24 inch x 48 inch.
- C. Sizes:

DUCTWORK ACCESSORIES

1. For 6" to 8" ducts: 6" x 6"
(1 latch and 2 hinges).
 2. For 10" to 12" ducts: 10" x 10"
(1 latch and 2 hinges).
 3. For 12" to 16" ducts: 12" x 12"
(2 latches and 2 hinges).
- D. Install at all fire dampers, smoke dampers, back draft, dampers, control dampers and all temperature controls otherwise not accessible.
- E. Ceiling, wall, and floor access panels must line up with duct access doors.

2.3 FIRE DAMPERS

- A. Fire Rating:
1. Rated at 1-1/2 hours and so labeled.
 2. Rated at 1-1/2 hours and so labeled for up to 2 hour walls.
 3. Rated at 3 hours and so labeled for over 2 hour walls to 4 hour walls.
- B. Multi-blade type or drop leaf types:
1. Type A acceptable for all grilles and all ducts over 18" in height.
 2. Type B for ducts under 18" in height (100% free area). Contractor to verify job site clearances for style B dampers before submitting same.
 3. Type C for all high velocity applications, round or oval; (100% free area).
- C. All fire dampers to have 1/8" steel frames, 160 deg. F fusible link, 90 deg. blade openings, for vertical or horizontal mounting as shown on drawings, indicator arm, spring catch, with safety key slot locking device (locks dampers in place when closed). Fire dampers size shall be the same size as connecting ductwork. Duct liner shall be interrupted at each fire damper.
- D. Provide separate or integral collars as required with wall retaining angles, on both sides of walls, floors, ceilings, etc.
- E. All horizontal fire dampers to be spring loaded to close.
- F. Contractor to verify location to make sure that dampers are in correct location in fire walls or ceilings before installation. Discuss location with General Contractor before installation.
- G. Provide access panels at all fire dampers. Label these access panels "F.D." Access panels must be located to provide access to the fusible links and resetting devices. Grilles are acceptable as access.

2.4 DAMPERS

- A. Fabricated of galvanized steel, minimum 16 gage, and provide with quadrants or adjustment rod and lock screw. Must be capable of tight closing, with felt or vinyl edges.
- B. Fabricated splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration. Size on basis of straight air volume proportioning.
- C. Fabricated single blade dampers for duct sizes to 9-1/2 inch x 30 inch.
- D. Fabricated multi-blade damper of opposed blade pattern with maximum blade sizes 6 inch x 72 inch. Assemble center and edge crimped blade in prime coated or galvanized channel frame with suitable hardware. Must be capable of tight closing, with felt or vinyl edges.
- E. Construct damper blades for medium and high pressure systems to block a maximum of 70% of the air passage. Supply locking type handles.
- F. Fabricated multi-blade, parallel action gravity balanced backdraft dampers with blades a maximum of 6 inch width having felt or flexible vinyl sealing edges, linked together in rattle-free manner and with adjustment device to permit setting for varying differential static pressure.

2.5 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate of neoprene coated flameproof fabric (U.L. approved) approximately 4 inch wide tightly crimped into metal edging strip and attach to ducting and equipment by screws or bolts at 6 inch intervals.

2.6 APPLICATION

- A. Provide access doors for inspection and cleaning before and after filters, coils, fans, automatic

DUCTWORK ACCESSORIES

dampers, at fire dampers, and elsewhere as indicated. Review locations prior to fabrication.

DUCTWORK ACCESSORIES

- B. Provide 6 inch x 6 inch quick opening access doors for inspection at balancing dampers.
- C. Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings, and hinges.
- D. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.
- E. Provide balancing dampers on high pressure systems where indicated. Use splitter dampers only where indicated on Drawings.
- F. Provide flexible connections immediately adjacent to equipment in ducts associated ducts associated with fans and equipment subject to forced vibration.

3 EXECUTION**3.1 INSTALLATION**

- A. Install items in accordance with manufacturer's printed instructions.
- B. For connections to medium and high pressure fans, install 1/4 inch thick neoprene pad over fabric and hold in place with additional metal straps.

END OF SECTION

SECTION 23 74 14

OUTSIDE AIR UNIT

Part 1 - General

1.1 Related Documents

1.2 General Description

- A. This section includes the design, controls and installation requirements for packaged rooftop units / outdoor air handling units.

1.3 Quality Assurance

- A. Packaged air-cooled condenser units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.
- B. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
- C. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
- D. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.
- E. Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
- F. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

1.4 Submittals

- A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics and connection requirements. Installation, Operation, and Maintenance manual with startup requirements shall be provided.
- B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

1.5 Delivery, Storage, and Handling

- A. Unit shall be shipped with doors screwed shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.
- B. Follow Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
- C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.

1.6 Warranty

- A. Manufacturer shall provide a limited "parts only" warranty for a period of 12 months from the date of equipment startup or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for Installation, Operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and filters.

OUTSIDE AIR UNIT**Part 2 - Products****2.1 Manufacturer**

- A. Products shall be provided by the following manufacturers:
 - 1. AAON
 - 2. Substitute equipment may be considered for approval that includes at a minimum:
 - a. R-410A refrigerant
 - b. Variable capacity compressor with 10-100% capacity control
 - c. Direct drive supply fans
 - d. Double wall cabinet construction
 - e. Insulation with a minimum R-value of 13
 - f. Stainless steel drain pans
 - g. Hinged access doors with lockable handles
 - h. All other provisions of the specifications must be satisfactorily addressed

2.2 Rooftop Units

- A. General Description
 - 1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, gas heaters, and unit controls.
 - 2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
 - 3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 - 4. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
 - 5. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
 - 6. Installation, Operation, and Maintenance manual shall be supplied within the unit.
 - 7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
 - 8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
- B. Construction
 - 1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
 - 2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
 - 3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
 - 4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not

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exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
 6. Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
 7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
 9. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
 10. Unit shall include lifting lugs on the top of the unit.
- C. Electrical
1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
 2. Unit shall be provided with a factory installed and factory wired 115V, 13 amp GFI outlet disconnect switch in the unit control panel.
 3. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
- D. Supply Fans
1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
 2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
 3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
 4. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
- F. Cooling Coils
1. Evaporator Coils
 - a. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
 - b. Coils shall have interlaced circuitry and shall be standard capacity.
 - c. Coils shall be helium leak tested.
 - d. Coils shall be furnished with factory installed thermostatic expansion valves.
- G. Refrigeration System
1. Unit shall be factory charged with R-410A refrigerant.

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2. Compressors shall be scroll type with thermal overload protection, independently circuited and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.
 3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
 4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
 5. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.
 6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed replaceable core liquid line filter driers.
 7. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.
 8. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
- H. Condensers
1. Air-Cooled Condenser
 - a. Condenser fans shall be a vertical discharge, axial flow, direct drive fans.
 - b. Coils shall be designed for use with R-410A refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes or coils shall be constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and aluminum end casings. Fin design of copper tube coils shall be sine wave rippled.
 - c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
 - d. Coils shall be helium leak tested.
 - e. Condenser fans shall be VFD driven variable speed for condenser head pressure control. Factory provided and factory programmed VFDs shall continuously modulate the fan air flow to maintain head pressure at acceptable levels. Cooling operation shall be allowed down to 35°F with adjustable compressor lockouts.
- I. Gas Heating
1. Stainless steel heat exchanger furnace shall carry a 25 year non-prorated warranty, from the date of original equipment shipment from the factory.
 2. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
 3. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
 4. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.

OUTSIDE AIR UNIT

5. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Gas heating assemblies shall be capable of operating at any firing rate between 100% and 30% of their rated capacity.
- J. Filters
1. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, upstream of the cooling coil.
- K. Outside Air/Economizer
1. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 cfm of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return actuator. Unit shall include outside air opening bird screen, outside air hood, and barometric relief dampers.
- M. Controls
1. Factory Installed and Factory Provided Controller
 - a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 - b. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 - c. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
 - d. Make Up Air Controller
 1. Unit shall modulate cooling with constant airflow to meet ventilation outside air loads. Cooling capacity shall modulate based on supply air temperature.
 2. With modulating hot gas reheat, unit shall modulate cooling and hot gas reheat as efficiently as possible, to meet outside air humidity loads and prevent supply air temperature swings and overcooling of the space.
 3. Unit shall modulate heating with constant airflow to meet ventilation outside air loads. Heating capacity shall modulate based on supply air temperature.
 - e. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a LonWorks or BACnet network. [WattMaster Orion Controls System]

OUTSIDE AIR UNIT

N. Accessories

1. Unit shall be provided with a safety shutdown terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

2.3 Curbs

- A. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
- B. Solid bottom curb shall be factory assembled and fully lined with 1 inch neoprene coated fiberglass insulation and include a wood nailer strip.

Part 3 - Execution

3.1 Installation, Operation, and Maintenance

- A. Installation, Operation, and Maintenance manual shall be supplied with the unit.
- B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
- C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Supporting Devices For Electrical Components.
 - 2. Electricity-Metering Components.
 - 3. Concrete Equipment Bases.
 - 4. Electrical Demolition.
 - 5. Cutting And Patching For Electrical Construction.
 - 6. Touchup Painting.
- B. Related Sections:
 - 1. Section 03 30 00 (03300) - Cast-In-Place Concrete.
 - 2. Section 07 84 00 (07840) - Firestopping.
 - 3. Section 09 90 00 (09900) - Painting.

1.2 REFERENCES

- A. American Welding Society (AWS) Publications:
 - 1. D1.1 "Structural Welding Code - Steel"
- B. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
 - 1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
- C. National Fire Protection Association (NFPA) Publications:
 - 1. 70 "National Electric Code"
- D. National Electrical Manufacturer's Association (NEMA) Standards Publications:
 - 1. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
 - 1. Product Data: For electricity-metering equipment.
 - 2. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
 - 3. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. LEED Submittals:
 - 1. Credit EQc4.1: Low-Emitting Materials: VOC Data for Adhesives and Sealants:
 - a. Product Data or other documentation for each product/material highlighting VOC content information.
 - 1) Refer to VOC limit tables in Section 01 81 19 "Indoor Air Quality Requirements" for VOC limits for adhesive and sealant products in this Section.
 - b. Complete the LEED VOC Submittal Form as provided in Section 01 33 00 "Submittal and Substitution Procedures, for products in this Section.

COMMON WORK RESULTS FOR ELECTRICAL**1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. All work to be in accordance with latest requirements of the N.E.C. and all other applicable codes and regulations of authorities having jurisdiction over the work.

1.5 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 08 Section 08 31 00 (08310) - "Access Doors."
- E. Coordinate all work with Division 26. Electrical Contractor shall provide all wiring and final connection to all line voltage thermostats. Thermostat provided and installed by Division 15.
- F. All electrical drawings are to be read in conjunction with the project specifications and all other related contract drawings.
- G. The contractor shall examine the site and observe the conditions under which the work will be done or other circumstances which will affect the contemplated work. No allowance will be made subsequently in the connection for any error or negligence on the contractor's part.
- H. The contractor shall verify exact location, size and extent of all existing utilities, obstructions and/or other conditions which may affect the proposed work under the project. The contractor shall take every precaution to prevent damage to existing work and shall repair any damage as a result of this work.
- I. The contractor shall verify all door swings in the field and mount switches on knob side of doors or as approved by the engineer.
- J. The contractor shall carefully examine all contract drawings/specifications and be responsible for the proper fittings of materials and equipment at each location as indicated without substantial alteration. The drawings are generally diagrammatic and because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Furnishing such fittings that are required to meet such conditions shall be furnished and installed at no cost.

PART 2 PRODUCTS**2.1 SUPPORTING DEVICES**

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.
 - 1. Channel Thickness: Selected to suit structural loading.

COMMON WORK RESULTS FOR ELECTRICAL

- 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- H. Toggle Bolts: All-steel springhead type.
- 2.2 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING
 - A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
 - B. Meter Sockets: Comply with requirements of electrical power utility company.
 - C. Modular Meter Centers: Factory-coordinated assembly of a main meter center circuit-breaker unit with wireways, tenant meter socket modules, and tenant branch circuit breakers arranged in adjacent vertical sections, complete with interconnecting buses.
 - 1. Housing: NEMA 250, Type 3R enclosure.
- 2.3 CONCRETE BASES
 - A. Concrete Forms and Reinforcement Materials: As specified in Section 03 30 00 (03300) - "Cast-in-Place Concrete."
- 2.4 TOUCHUP PAINT
 - A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
 - B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 EXECUTION

- 3.1 ELECTRICAL EQUIPMENT INSTALLATION
 - A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
 - B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
 - C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
 - D. Right of Way: Give to raceways and piping systems installed at a required slope.
 - E. Coordinate work with other trades and install conduit and boxes to clear embedded ducts, openings, etc. and all structural features.
 - F. Unless otherwise noted, mounting heights, as shown, are from finished floor to top of panelboard and to centerline of other equipment. Coordinate all mounting heights with contract drawings, local code requirements, and all ADA requirements.
 - 1. Toggle (snap) switch: 4'-0".
 - 2. Enclosed circuit breaker: 5'-0"
 - 3. Disconnect (safety) switch: 5'-0".
 - 4. Motor starter: 5'-0".
 - 5. Panelboard: 6'-6".
- 3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION
 - A. Damp Locations, Pool Equipment Rooms, Storage Rooms and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
 - B. Dry Locations: Steel materials.

COMMON WORK RESULTS FOR ELECTRICAL

- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.3 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 7. Light Steel: Sheet-metal screws.
 - 8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

COMMON WORK RESULTS FOR ELECTRICAL**3.5 FIRESTOPPING**

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Section 07 84 00 (07840) "Firestopping."

3.6 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 (03300) "Cast-in-Place Concrete."

3.7 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.9 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Supporting devices for electrical components.
 - 2. Electricity-metering components.
 - 3. Concrete bases.
 - 4. Electrical demolition.
 - 5. Cutting and patching for electrical construction.
 - 6. Touchup painting.

3.10 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Section 09 90 00 (09900) - "Painting."

3.11 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- B. Related Documents:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- C. Related Sections:
 - 1. Section 07 84 00 (07840) - Firestopping
 - 2. Section 26 05 00 (16050) – Common Work Results for Electrical
 - 3. Section 26 05 53 (16075) – Identification for the Electrical Systems

1.2 REFERENCES

- A. National Electrical Contractors Association (NECA) Publications.
- B. National Electrical Manufacturer's Association (NEMA) Standards Publications:
 - 1. WC 26 "Binational Wire and Cable Packaging Standard"
 - 2. WC 70 "Power Cables Rated 2,000 V or Less for the Distribution of Electrical Energy"
- C. International Electrical Testing Association (NETA) Publications:
 - 1. ATS "Standard for Acceptance Testing Specifications"
- D. National Fire Protection Association (NFPA) Publications:
 - 1. 70 "National Electric Code"
- E. Occupational Safety & Health Administration (OSHA) Regulations:
 - 1. 1910.7 "Definition And Requirements For A Nationally Recognized Testing Laboratory"
- F. Underwriter's Laboratories, Inc. (UL) Standards:
 - 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
 - 2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

1.3 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
 - 1. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- B. Comply with NFPA 70.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver wires and cables according to NEMA WC 26.
- 1.6 COORDINATION
 - A. Coordinate layout and installation of cables with other installations.
 - B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Owner representative.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Wires and Cables:
 - a. None.
 - 2. Connectors for Wires and Cables:
 - a. None.
- B. Approved Manufacturers:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corp.; Leviton Manufacturing Co. (800-366-2492)
 - b. General Cable. (859-572-8000)
 - c. Southwire Company (800-444-1700)
 - d. Alcan Cable Division of Alcan Aluminum Corporation (770-392-2368)
 - 2. Connectors for Wires and Cables:
 - a. AMP Incorporated (800-522-6752)
 - b. O-Z/Gedney Unit (847) 268-6200
 - c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
 - d. Alcan Cable Division of Alcan Aluminum Corporation (770-392-2368)

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Rubber Insulation Material: Comply with NEMA WC 70.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 70.
- D. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 70.
- E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 70.
- F. Conductor Material: Copper
 - 1. Feeders 1/0 ampere or greater may be aluminum "Alcan Stabiloy #8000", or approved substitution by listed manufacturers.
- G. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
- H. Multi conductor Cable: Metal-clad cable, Type MCI.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**2.3 CONNECTORS AND SPLICES**

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type RHW or THWN, in raceway.
- B. Horizontal Feeders: Type THHN/THWN, in raceway.
- C. Vertical Feeders: Type THHN/THWN in raceway or type MC cable.
- D. Fire-Pump Feeder: Type MI, 3-conductor.
- E. Horizontal Branch Circuits: Type THHN/THWN, in raceway.
- F. Vertical Branch Circuits: Type THHN/THWN in raceway or Type MC Cable
- G. Fire alarm Circuits: Power-limited, fire-protective, signaling circuit cable.
- H. Class 1 Control Circuits: Type THHN/THWN, in raceway.
- I. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.
- J. Class 2 Control Circuits: Type THHN/THWN, in raceway.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's appropriate "Standard of Installation."
- B. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Section 26 05 00 - "Common Work Results for Electrical."
- F. Seal around cables penetrating fire-rated elements according to Section 07 84 00 (07840) "Firestopping."
- G. Identify wires and cables according to Section 26 05 53 "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding of Electrical Systems and Equipment.
 - a. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections:

1. Section 26 05 19 (16120) – Low Voltage Electrical Power Conductors and Cables.
2. Section 26 41 13 (13100) - Lightning Protection for Structures: For additional grounding and bonding materials.
3. Section 32 90 00 (02900) - Planting.

1.2 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. B3 "Standard Specification for Soft or Annealed Copper Wire"
2. B8 "Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft"
3. B33 "Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes"

B. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. C2 "ASC C2 Eighth Interim Collection of the National Electrical Safety Code"
2. 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements"
3. 837 "IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"
2. 780 "Standard for the Installation of Lightning Protection Systems"

D. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 96 "Standard for Safety for Lightning Protection Components"
3. 467 "Grounding and Bonding Equipment"

1.3 SUBMITTALS

A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:

1. Product Data: For the following:
 - a. Ground rods.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.
- B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 - 1. None.
- B. Approved Manufacturers:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Chance/Hubbell (573-682-5521)
 - b. Copperweld Corp. (931-433-7177)
 - c. Thomas & Betts, Electrical (800-816-7809)

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section 26 05 19 - "Low-Voltage Electrical Power Conductors and Cables."
- B. Material: Aluminum, copper-clad aluminum, and copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B3.
 - 2. Assembly of Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
- H. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- I. Ground Conductor and Conductor Protector for Wood Poles: As follows:

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. No. 4 AWG minimum, soft-drawn copper conductor.
 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.
- J. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.
- K. Equipment Ground Conductor (Green) shall be included with all circuit conductors. In addition, provide a neutral conductor where applicable.

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 per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: copper-clad steel.
1. Size: 120" long by 3/4" in diameter.

PART 3 EXECUTION**3.1 APPLICATION**

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
 2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- 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. Install equipment grounding conductors in all feeders and circuits.
- C. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- G. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
- J. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

3.3 INSTALLATION

- A. 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.
 - 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 2. 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.
- B. 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.
- C. 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.
- D. 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.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- F. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- G. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

3.4 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. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Non-contact 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 non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. 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 .
- G. 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.
- H. 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.

3.5 OVERHEAD-LINE GROUNDING

- A. Comply with IEEE C2 requirements. Use 2 or more parallel ground rods if a single ground rod electrode resistance to ground exceeds 25 ohms.
- B. Drive ground rods to a depth of 12 inches below finished grade in undisturbed earth.
- C. Ground Rod Connections: Use clamp-type connectors listed for the purpose for underground connections and connections to rods.
- D. Lightning Arresters: Separate arrester grounds from other grounding conductors.
- E. Secondary Neutral and Tank of Transformer: Interconnect and connect to grounding conductor.
- F. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING**

- A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- B. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and non-current-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.7 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 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.
 - 4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner representative promptly and include recommendations to reduce ground resistance.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**3.8 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 Section 32 90 00 (02900) - "Planting." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Raceways include the following:
 - a. RMC.
 - b. PVC, Schedule 40 or 80.
 - c. EMT.
 - d. FMC.
 - e. LFMC.
 - f. LFNC.
 - g. RNC.
 - h. Wireways.
 - i. Surface raceways.
2. Boxes, enclosures, and cabinets include the following:
 - a. Device boxes.
 - b. Floor boxes.
 - c. Outlet boxes.
 - d. Pull and junction boxes.
 - e. Cabinets and hinged-cover enclosures.

B. Related Sections:

1. Section 07 84 00 (07840) - Firestopping.
2. Section 26 05 00 (16050) – Common Work Results for Electrical: For raceways and box supports.
3. Section 26 27 26 (16140) - Wiring Devices: For devices installed in boxes and for floor-box service fittings.

1.2 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C80.1 "Electrical Rigid Steel Conduit (ERSC)"
2. C80.3 "Steel Electrical Metallic Tubing (EMT)"

B. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. ANSI/NEMA FB 1 "Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable"
2. ANSI/NEMA OS 1 "Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports"
3. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"
4. RN 1 "Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit"
5. TC 2 "Electrical Polyvinyl Chloride (PVC) Tubing and Conduit"
6. TC 3 "Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

D. Occupational Safety & Health Administration (OSHA) Regulations:

1. 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory"

E. National Electrical Contractors Association (NECA) Publications:

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

1. 111 "Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)"
- F. Underwriter's Laboratories, Inc. (UL) Standards:
 1. 1660 "Liquid-Tight Flexible Nonmetallic Conduit"
- 1.3 DEFINITIONS
 - A. EMT: Electrical metallic tubing.
 - B. FMC: Flexible metal conduit.
 - C. IMC: Intermediate metal conduit.
 - D. LFMC: Liquidtight flexible metal conduit.
 - E. LFNC: Liquidtight flexible nonmetallic conduit.
 - F. RMC: Rigid metal conduit.
 - G. RNC: Rigid nonmetallic conduit.
- 1.4 SUBMITTALS
 - A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 1. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- 1.5 QUALITY ASSURANCE
 - A. Comply with NFPA 70 "National Electric Code".
 - B. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in NFPA 70 "National Electric Code" Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
 3. Comply with NECA 111 "Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)"
- 1.6 COORDINATION
 - A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 1. Metal Conduit and Tubing:
 - a. None.
 2. Flexible Conduit:
 - a. None.
 3. Nonmetallic Conduit and Tubing:
 - a. None.
 4. Conduit Bodies and Fittings:
 - a. None.
 5. Metal Wireways:
 - a. None.
 6. Nonmetallic Wireways:
 - a. None.
 7. Surface Metal Raceways:
 - a. None.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

8. Surface Nonmetallic Raceways:
 - a. None.
9. Boxes, Enclosures, and Cabinets:
 - a. None.
- B. Approved Manufacturers:
 1. Metal Conduit and Tubing:
 - a. Anixter Brothers, Inc. (800-323-8166)
 - b. Carol Cable Co., Inc. (401-728-7000)
 - c. Wheatland Tube Co. (800-257-8128)
 2. Flexible Conduit:
 - a. Carol Cable Co., Inc. (401-728-7000)
 - b. Electri-Flex Co. (800-323-6174)
 3. Nonmetallic Conduit and Tubing:
 - a. Hubbell, Inc.; Raco, Inc. (800-722-6437)
 - b. Lamson & Sessions; Carlon Electrical Products (800-322-7566)
 - c. Thomas & Betts Corp. (800-816-7809)
 4. Conduit Bodies and Fittings:
 - a. Emerson Electric Co.; Appleton Electric Co. (800-727-5102)
 - b. Hubbell, Inc.; Killark Electric Manufacturing Co. (314-531-0460)
 - c. Lamson & Sessions; Carlon Electrical Products (800-322-7566)
 5. Metal Wireways:
 - a. Hoffman Engineering Co. (203-425-8900)
 - b. Keystone/Rees, Inc. (219-495-9811)
 - c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
 6. Nonmetallic Wireways:
 - a. Hoffman Engineering Co. (203-425-8900)
 - b. Lamson & Sessions; Carlon Electrical Products (800-322-7566)
 7. Surface Metal Raceways:
 - a. Airey-Thompson Co., Inc.; A-T Power Systems (800-421-6196)
 - b. Butler Manufacturing Co.; Walker Division (304-485-1611)
 - c. Wiremold Co. (The); Electrical Sales Division (800-621-0049)
 8. Surface Nonmetallic Raceways:
 - a. Hubbell, Inc.; Wiring Device Division (203-882-4900)
 - b. Panduit Corp. (800-777-3300)
 - c. Wiremold Co. (The); Electrical Sales Division (800-621-0049)
 9. Boxes, Enclosures, and Cabinets:
 - a. Hoffman Engineering Co.; Federal-Hoffman, Inc. (203-425-8900)
 - b. Hubbell Inc.; Killark Electric Manufacturing Co. (314-531-0460)
 - c. Thomas & Betts Corp. (800-816-7809)

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- C. EMT and Fittings: ANSI C80.3.
 1. Fittings: Set-screw or compression type.
- D. FMC: Zinc-coated steel.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings: NEMA FB 1; compatible with conduit/tubing materials.
- 2.3 NONMETALLIC CONDUIT AND TUBING
 - A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
 - B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
 - C. LFNC: UL 1660.
- 2.4 METAL WIREWAYS
 - A. Material: Sheet metal sized and shaped as indicated.
 - B. 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.
 - C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
 - D. Wireway Covers: As indicated
 - E. Finish: Manufacturer's standard enamel finish.
- 2.5 NONMETALLIC WIREWAYS
 - A. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections using plastic fasteners.
 - B. 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.
 - C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- 2.6 SURFACE RACEWAYS
 - A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
 - B. Surface Nonmetallic Raceways: 2-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
 - C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.
- 2.7 OUTLET AND DEVICE BOXES
 - A. Sheet Metal Boxes: NEMA OS 1.
- 2.8 FLOOR BOXES
 - A. Floor Boxes: Cast metal, fully adjustable, rectangular.
- 2.9 PULL AND JUNCTION BOXES
 - A. Small Sheet Metal Boxes: NEMA OS 1.
 - B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- 2.10 ENCLOSURES AND CABINETS
 - A. 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.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
 - B. 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.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**PART 3 EXECUTION****3.1 EXAMINATION**

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
- B. Indoors: Use the following wiring methods:
 - 1. Exposed on ceilings and wall in Mechanical Equipment Rooms galvanized rigid steel conduit.
 - 2. Concealed in spaces above hung ceiling and wall: Electrical Metallic Tubing (EMT).
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
 - 4. Damp or Wet Locations: Rigid steel conduit.
 - 5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
- C. Underground or concrete encased:
 - 1. Schedule 40 PVC.

3.3 INSTALLATION - GENERAL

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Do not install aluminum conduits embedded in or in contact with concrete.
- C. Set floor boxes level and adjust to finished floor surface.
- D. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- E. Size all conduits supplying motors and associated control equipment to include equipment grounding conductor sized per NFPA 70 whether or not shown on the drawings or specified.
- F. Unless otherwise noted, terminate all conduits stubbing up inside rooms or roof as follows:
 - 1. Conduits for AC power: Stub up 6" above finished floor and provide concrete sill to protect stub-ups.
 - 2. On PVC conduit for AC power and control cable, provide PVC to galvanized steel rigid conduit adaptor.
 - 3. Plug or cap all conduits during construction or until permanent conductors are installed. Taped ends will not be allowed.
- G. In exposed conduit runs longer than 300 feet, expansion fittings shall be installed. Where embedded conduit crosses a structural expansion joint, expansion and deflection fitting shall be installed.
- H. Tighten set screws of threadless fittings with suitable tools.
- I. Complete raceway installation before starting conductor installation.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**3.4 INSTALLATION - RACEWAYS**

- A. Minimum Raceway Size: 3/4-inch trade size (DN21).
- B. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- C. 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.
- D. Install raceways level and square and at proper elevations. Provide adequate headroom.
- E. Support raceways as specified in Section 26 05 00 (16050) - "Basic Electrical Materials and Methods."
- F. Use temporary closures to prevent foreign matter from entering raceways.
- G. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- H. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- I. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- J. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- K. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit or rigid steel conduit, before rising above floor.
- L. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- M. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - 2. Use insulating bushings to protect conductors.
- N. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- O. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- P. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- Q. Telephone and Signal System Raceways, 2-Inch Trade Size (DN53) and Smaller: In addition to the 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.

3.5 SURFACE RACEWAYS

- A. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
 2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
 3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.
 4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.

3.6 INSTALLATION - ACCESSORIES

- A. Install raceway sealing fittings according to manufacturer's written instructions. Locate 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 the boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- B. 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 the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- C. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- D. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.7 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the 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.

3.8 CLEANING

- A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.
 - 1. Section 03 30 00 (03300) - Cast-In-Place Concrete
 - 2. Section 04 20 00 (04200) - Unit Masonry
 - 3. Section 05 12 00 (05120) - Structural Steel
 - 4. Section 06 10 00 (06100) - Rough Carpentry
 - 5. Section 26 05 00 (15050) – Common Work Results for Electrical

1.2 REFERENCES

- A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
 - 1. A36 "Standard Specification for Carbon Structural Steel"
 - 2. A325 "Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength"
 - 3. A575 - 96 "Standard Specification for Steel Bars, Carbon, Merchant Quality, M Grades"
 - 4. A576 - 90b "Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality"
 - 5. A603 "Standard Specification for Zinc-Coated Steel Structural Wire Rope"
 - 6. A1011 "Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability"
- B. Manufacturers Standardization Society of the Valve and Fittings Industry. (MSS) Publications:
 - 1. SP-69 "ANSI/MSS Edition Pipe Hangers and Supports - Selection and Application"

1.3 DEFINITIONS

- A. IBC: International Building Code
- B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
- C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.4 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
 - 1. Product Data:
 - a. Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

- b. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by an agency approved by authorities having jurisdiction.
2. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs and calculations signed and sealed by a professional engineer.
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
3. Preapproval and Evaluation Documentation: By [California Office of Statewide Health Planning and Development (OSHPD)] [ICBO Evaluation Service] [an agency approved by authorities having jurisdiction], showing maximum ratings of restraints and the basis for approval (tests or calculations).
4. Coordination Drawings: Plans and sections drawn to scale and coordinating seismic bracing for electrical components with other systems and equipment, including other seismic restraints, in the vicinity.
5. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.
6. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
7. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

1.5 QUALITY ASSURANCE

- A. Comply with seismic restraint requirements in IBC, unless requirements in this Section are more stringent.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

1.6 PROJECT CONDITIONS

- A. See Structural Drawings

1.7 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 1. None.

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

- B. Approved Manufacturers:
 - 1. B-Line Systems, Inc (800-851-7415)
 - 2. Thomas & Betts Corp (800-816-7809)
 - 3. Unistrut Corporation (800-521-7730)

2.2 MATERIALS

- A. Use the following materials for restraints:
 - 1. Indoor Dry Locations: Steel, zinc plated.
 - 2. Outdoors and Damp Locations: Galvanized steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
 - 1. Materials for Channel: ASTM A1011, GR 33.
 - 2. Materials for Fittings and Accessories: ASTM A575, ASTM A576, or ASTM A36.
 - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
 - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
 - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
 - 2. Wire Rope Cable: Comply with ASTM A603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.

3.2 STRUCTURAL ATTACHMENTS

- A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
- B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
- C. Attachments to Existing Concrete: Use expansion anchors.
- D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
- E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
- F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
- G. Attachments to Wood Structural Members: Install bolts through members.
- H. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.3 ELECTRICAL EQUIPMENT ANCHORAGE

- A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
- B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, unit substations, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:
 - 1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
 - 2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
 - 3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
 - 4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
 - 5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.4 SEISMIC BRACING INSTALLATION

- A. Install bracing according to spacings and strengths indicated by approved analysis.
- B. Expansion and Contraction: Install to allow for thermal movement of braced components.
- C. Cable Braces: Install with maximum cable slack recommended by manufacturer.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS**3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION**

- A. Make flexible connections in raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform the following field quality-control testing:
 - 1. Testing: Test pull-out resistance of seismic anchorage devices.
 - a. Provide necessary test equipment required for reliable testing.
 - b. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - c. Schedule test with Owner, through Owner representative, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - d. Obtain Owner's representative approval before transmitting test loads to the structure. Provide temporary load-spreading members.
 - e. Test at least four of each type and size of installed anchors and fasteners selected by Owner representative.
 - f. Test to 90 percent of rated proof load of device.
 - g. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
 - h. Record test results.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

B. Related Sections:

1. Section 26 05 19 (16120) – Low Voltage Electrical Power Conductors and Cables
2. Section 26 05 33 (16130) - Raceways and Boxes for Electrical Systems
3. Section 26 24 00 (16440) – Switchboards and Panel Boards
4. Section 26 27 26 (16140) - Wiring Devices
5. Section 26 28 16 (16410) - Enclosed Switches and Circuit Breakers

1.2 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. ANSI/ASME A13.1 "Scheme for the Identification of Piping Systems"

B. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. C2 "ASC C2 Eighth Interim Collection of the National Electrical Safety Code"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

1.3 SUBMITTALS

A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:

1. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with IEEE C2.

B. Comply with NFPA 70 "National Electric Code"

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:

1. None.

B. Approved Manufacturers:

1. Brady USA, Inc. (800-541-1686)
2. Panduit corp. (800-777-3300)
3. Seton Identification Products (800-571-2596)

IDENTIFICATION FOR ELECTRICAL SYSTEMS**2.2 RACEWAY AND CABLE LABELS**

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
 - 1. Color: Black letters on orange field.
 - 2. Legend: Indicates voltage
- B. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- C. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- D. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend indicating type of underground line.
- E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
- H. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.

2.3 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

IDENTIFICATION FOR ELECTRICAL SYSTEMS**2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: According to color-coding.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches high, stenciled with paint at 10-foot intervals over a continuous, painted orange background. Identify the following:
 - 1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to conduits concealed within wall.
 - 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
 - 4. Entire surface of exposed conduits.
- F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
 - 1. Bands: Pre-tensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 - 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
 - 3. Apply the following colors to the systems listed below:
 - a. Fire Alarm System: Red.
 - b. Fire-Suppression Supervisory and Control System: Red and yellow.
 - c. Combined Fire Alarm and Security System: Red and blue.
 - d. Security System: Blue and yellow.
 - e. Mechanical and Electrical Supervisory System: Green and blue.
 - f. Telecommunication System: Green and yellow.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

- G. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- H. Circuit Identification Labels on Boxes: Install labels externally.
 - 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 - 2. Concealed Boxes: Plasticized card-stock tags.
 - 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- I. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- J. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.
 - 1. Color-code 208/120-V system as follows:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
 - 2. Color-code 480/277-V system as follows:
 - a. Phase A: Yellow.
 - b. Phase B: Brown.
 - c. Phase C: Orange.
 - d. Neutral: White with a colored stripe or gray.
 - e. Ground: Green.
 - 3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a 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. Use 1-inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
 - b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.
- K. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Tag Fasteners: Nylon cable ties.
 3. Band Fasteners: Integral ears.
- L. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- M. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- N. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Panelboards, electrical cabinets, and enclosures.
 2. Access doors and panels for concealed electrical items.
 3. Electrical switchgear and switchboards.
 4. Emergency system boxes and enclosures.
 5. Disconnect switches.
 6. Enclosed circuit breakers.
 7. Motor starters.
 8. Push-button stations.
 9. Power transfer equipment.
 10. Contactors.
 11. Remote-controlled switches.
 12. Dimmers.
 13. Control devices.
 14. Transformers.
 15. Telephone switching equipment.

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IDENTIFICATION FOR ELECTRICAL SYSTEMS

16. Fire alarm master station or control panel.
17. Security-monitoring master station or control panel.

END OF SECTION

SECTION 26 24 00

SWITCHBOARDS AND PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service and Distribution Switchboards Rated 600 V and Less.
2. Load Centers and Panelboards, Overcurrent Protective Devices, And Associated Auxiliary Equipment Rated 600 V and Less For The Following Types:
 - a. Lighting and Appliance Branch-Circuit Panelboards.
 - b. Distribution Panelboards.

B. Related Sections:

1. Section 03 30 00 (03300) - Cast-In-Place Concrete.
2. Section 26 05 19 (16490) - Low-Voltage Electrical Power Conductors and Cables.
3. Section 26 05 48 (16071) – Vibration and Seismic Controls for Electrical Work.
4. Section 26 05 53 (16075) – Identification for Electrical Systems.

1.2 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C39.1 "Requirements For Electrical Analog Indicating Instruments

B. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. C57.13 "IEEE "Standard Requirements for Instrument Transformers"

C. InterNational Electrical Testing Association (NICET)

D. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"
2. AB 1 "Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures"
3. EI 21.1, "Instrument Transformers for Revenue Metering (110 kV BIL and less)"
4. FU 1 "Low Voltage Cartridge Fuses"
5. PB 1 "Panelboards"
6. PB 1.1 "General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less"
7. PB 2 "Deadfront Distribution Switchboards"
8. PB 2.1 "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less"

E. National Institute for Certification in Engineering Technologies (NETA)

1. ATS "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems"

F. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

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G. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.
- F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for Project with the following supporting data:

1. Product Data:
 - a. For each type of switchboard, panelboard, overcurrent protective device, TVSS device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
2. Shop Drawings: For each switchboard, panelboard and related equipment.
 - a. 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:
 - 1) Enclosure types and details for types other than NEMA 250, Type 1.
 - 2) Bus configuration, current, and voltage ratings.
 - 3) Short-circuit current rating of switchboards and overcurrent protective devices.
 - 4) Descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - 5) Utility company's metering provisions with indication of approval by utility company.
 - 6) UL listing for series rating of installed devices.
 - 7) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - b. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
3. Manufacturer Seismic Qualification Certification: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 05 48 (16071) "Vibration and Seismic Controls for Electrical Work." Include the following:
 - a. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

SWITCHBOARDS AND PANELBOARDS

- b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
5. Field Test Reports: Submit written test reports and include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
6. Manufacturer's field service report.
7. Updated mimic-bus diagram for switchboard reflecting field changes after final switchboard load connections have been made, for record.
8. Maintenance Data: For Switchboards, Panelboards and components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Contract Closeout," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current curves, including selectable ranges for each type of overcurrent protective device.
9. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- 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 NEMA PB 2 for switchboards.
- D. Comply with NEMA PB1 for panelboards.
- E. Comply with NFPA 70.
- F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards, including clearances between switchboards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections of lengths that can be moved past obstructions in delivery path.
- B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

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- C. Handle switchboards according to NEMA PB 2.1.

1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner representative not less than seven days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
 - 2. Indicate method of providing temporary utilities.
 - 3. Proceed with utility interruptions only after receiving Owner's representative written authorizations.
- C. Environmental Limitations: Rate equipment for continuous operation under the following, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards, panelboards, 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.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 (03300) "Cast-in-Place Concrete."

PART 2 PRODUCT**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Switchboards:
 - a. None.
 - 2. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. None.
- B. Approved Manufacturers:
 - 1. Switchboards:
 - a. Eaton Corp.; Cutler-Hamer Products (800-498-2678)
 - b. General Electric Co.; Electrical Distribution & Control Div. (800-431-7867)
 - c. Siemens Energy & Automation, Inc. (800-964-4114)
 - d. Square D Co.; a Division of Groupe Schneider (888-778-2733)
 - 2. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corp.; Cutler-Hammer Products (800-498-2678)
 - b. General Electric Co.; Electrical Distribution & Control Div. (800-431-7867)
 - c. Siemens Energy & Automation, Inc. (800-864-4114)

SWITCHBOARDS AND PANELBOARDS

d. Square D Co.; a Division of Groupe Schneider (888-778-2733)

2.2 SWITCHBOARDS - MANUFACTURED UNITS

- A. Front-Connected, Front-Accessible Switchboard Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.
- B. Nominal System Voltage: 480Y/277 V
- C. Main-Bus Continuous: as shown on the drawings

2.3 SWITCHBOARDS - FABRICATION AND FEATURES

- A. Enclosure: Steel: NEMA 250, Type 1.
- B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- C. Barriers: Between adjacent switchboard sections.
- D. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- E. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- F. Hinged Front Panels: Allow access to circuit-breaker, metering, accessory, and blank compartments.
- G. Buses and Connections: Three phase, four wire, unless otherwise indicated. Include the following features:
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity or tin-plated, high-strength, electrical-grade aluminum alloy.
 - a. If bus is aluminum, use copper or tin-plated aluminum for circuit-breaker line connections.
 - b. If bus is copper, use copper for feeder circuit-breaker line connections.
 - 2. Ground Bus: 1/4-by-2-inch minimum size, drawn-temper copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 3. Contact Surfaces of Buses: Silver plated for copper to copper and copper to aluminum connections, silver or tin plating for aluminum to aluminum connections.
 - 4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 5. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
 - 6. Neutral Buses: 100 percent of the ampacity of the phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus is braced.
- H. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.4 SWITCHBOARDS - INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
 - 1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

SWITCHBOARDS AND PANELBOARDS

2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
- B. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.
 1. Meters: 4-inch diameter or 6 inches square, flush or semi-flush, with anti-parallax 250-degree scales and external zero adjustment.
 2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
- C. Instrument Switches: Rotary type with off position.
 1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- D. Feeder Ammeters: 2-1/2-inch minimum size with 90- or 120-degree scale. Meter and transfer device with an off position, located on overcurrent device door for indicated feeder circuits only.

2.5 SWITCHBOARDS - CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 PANELBOARDS - FABRICATION AND FEATURES

- A. Enclosures: Flush- and/or surface-mounted cabinets as indicated on drawings. NEMA PB 1, Type 1, to meet 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.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity or tin-plated aluminum.
- G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

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- I. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- J. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
- K. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- L. Gutter Barrier: Arrange to isolate individual panel sections.
- M. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.7 PANELBOARDS - SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.8 PANELBOARDS - LIGHTING AND APPLIANCE BRANCH-CIRCUITS

- A. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.9 PANELBOARDS - DISTRIBUTION

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker.
- C. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in 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.

2.10 LOAD CENTERS

- A. Overcurrent Protective Devices: Plug-in, full-module circuit breaker.
- B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.11 SWITCHBOARD AND PANELBOARDS - OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, 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. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.

SWITCHBOARDS AND PANELBOARDS

- c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
- 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
- 6. GFCI Circuit Breakers: Single- and two-pole configurations with 5mA trip sensitivity.
- 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 material of conductors.
 - 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. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

2.12 ACCESSORY COMPONENTS AND FEATURES

- A. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.13 IDENTIFICATION

- A. Mimic Bus for Switchboard: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram. Coordinate mimic-bus segments with devices in switchboard sections to which applied. Produce a concise visual presentation of principal switchboard components and connections.
- B. Presentation Media: Painted graphics in color contrasting with equipment factory-finished background to represent bus and components, complete with lettered designations.

PART 3 EXECUTION**3.1 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Install panelboards and accessories according to NEMA PB 1.1

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- C. Support switchboards on concrete bases, 4-inch nominal thickness.

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- D. Comply with mounting and anchoring requirements specified in Section 26 05 48 (16071) "Seismic Controls for Electrical Work."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- F. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- G. Mounting of Panelboards: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- H. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- I. Install filler plates in unused spaces.
- J. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- K. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53 (16075) "Identification for Electrical Systems".
- B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.5 CONNECTIONS

- A. Install equipment grounding connections for switchboards with ground continuity to main electrical ground bus.
- B. 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.

3.6 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate

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compliance; otherwise, replace with new units and retest.

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- C. Infrared Scanning: Switchboard only. After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panel so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switchboards checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.7 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.8 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. 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

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Individually Mounted Switches and Circuit Breakers Used for the following:
 - a. Service Disconnect Switches.
 - b. Feeder And Equipment Disconnect Switches.
 - c. Feeder Branch-Circuit Protection.
 - d. Motor Disconnect Switches.

B. Related Sections:

1. Section 26 05 19 (16490) - Low-Voltage Electrical Power Conductors and Cables: For fuses in fusible disconnect switches.
2. Section 26 05 53 (16075) - Identification for Electrical Systems.
3. Section 26 24 00 (16440) - Switchboards and Panelboards: For individually enclosed, fused power-circuit devices used as feeder disconnect switches.
4. Section 26 27 26 (16140) - Wiring Devices: For attachment plugs and receptacles, and snap switches used for disconnect switches.

1.2 REFERENCES

A. InterNational Electrical Testing Association (NICET)

B. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. AB 1 "Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures"
2. FU 1 "Low Voltage Cartridge Fuses"
3. KS 1 "Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

D. National Institute for Certification in Engineering Technologies (NETA)

1. ATS "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems"

E. Occupational Safety & Health Administration (OSHA) Regulations:

1. OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907
2. 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory"

F. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

ENCLOSED SWITCHES AND CIRCUIT BREAKERS**1.3 SUBMITTALS**

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
 - 1. Product Data:
 - a. Descriptive data and time-current curves.
 - b. Let-through current curves for circuit breakers with current-limiting characteristics.
 - c. Coordination charts and tables and related data.
 - 2. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.
 - 3. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of owners representative and owners, and other information specified.
 - 4. Field test reports indicating and interpreting test results.
 - 5. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 01.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: In addition to the requirements specified in Section 01 45 00 - "Quality Control," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the InterNational Electrical Testing Association (NICET)
 - 1. Testing Agency's Field Supervisor: Person currently certified by NETA or InterNational Electrical Testing Association (NICET), to supervise on-site testing specified in Part 3 of this Specification Section.
- B. Source Limitations: Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.
- C. Comply with NFPA 70 for components and installation.
- D. Listing and Labeling: Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Disconnect Switches:
 - a. None
 - 2. Fusible Switches:
 - a. None
 - 3. Molded-Case Circuit Breakers:
 - a. None

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- 4. Combination Circuit Breaker and Ground Fault Trip:
 - a. None
- 5. Molded-Case, Current-Limiting Circuit Breakers:
 - a. None
- B. Approved Manufacturers:
 - 1. Disconnect Switches:
 - a. General Electric Co.; Electrical Distribution and Control Division (800-431-7867)
 - b. Siemens Energy & Automation, Inc. (800-964-4114)
 - c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
 - d. Eaton Corp. Cutler-Hammer Products (800-498-2678)
 - 2. Fusible Switches:
 - a. General Electric Co.; Electrical Distribution and Control Division (800-431-7867)
 - b. Siemens Energy & Automation, Inc. (800-964-4114)
 - c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
 - d. Eaton Corp. Cutler-Hammer Products (800-498-2678)
 - 3. Molded-Case Circuit Breakers:
 - a. General Electric Co.; Electrical Distribution and Control Division (800-431-7867)
 - b. Siemens Energy & Automation, Inc. (800-964-4114)
 - c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
 - d. Eaton Corp. Cutler-Hammer Products (800-498-2678)
 - 4. Combination Circuit Breaker and Ground Fault Trip:
 - a. General Electric Co.; Electrical Distribution and Control Division (800-431-7867)
 - b. Siemens Energy & Automation, Inc. (800-964-4114)
 - c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
 - d. Eaton Corp. Cutler-Hammer Products (800-498-2678)
 - 5. Molded-Case, Current-Limiting Circuit Breakers:
 - a. General Electric Co.; Electrical Distribution and Control Division (800-431-7867)
 - b. Siemens Energy & Automation, Inc. (800-964-4114)
 - c. Square D Co.; a Division of Groupe Schneider (888-778-2733)
 - d. Eaton Corp. Cutler-Hammer Products (800-498-2678)

2.2 DISCONNECT SWITCHES

- A. Enclosed, Non-fusible Switch: NEMA KS 1, Type HD, with lockable handle.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.
- C. Enclosure: NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
 - 1. Outdoor Locations: Type 3R.
 - 2. Kitchen Areas: Type 4X, stainless steel.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

3. Other Wet or Damp Indoor Locations: Type 4.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. Enclosed, Molded-Case Circuit Breaker: NEMA AB 1, with lockable handle.
- B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting rating to meet available fault current.
- C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.
- D. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
- E. Circuit Breakers, 400 A and Larger: Field-adjustable, short-time and continuous-current settings.
- F. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
- G. Current Limiters: Where indicated, integral fuse listed for circuit breaker.
- H. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
- I. Shunt Trip: Where indicated.
- J. Accessories: On drawings.
- K. Enclosure: NEMA AB 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
 1. Outdoor Locations: Type 3R.
 2. Kitchen Areas: Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: Type 4.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.
- B. Install disconnect switches and circuit breakers level and plumb.
- C. Install wiring between disconnect switches, circuit breakers, control, and indication devices.
- D. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Identify each disconnect switch and circuit breaker according to requirements specified in Section 26 05 53 (16075) - "Electrical Identification."

3.2 FIELD QUALITY CONTROL

- A. Testing: After installing disconnect switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3 ADJUSTING

- A. Set field-adjustable disconnect switches and circuit-breaker trip ranges as indicated or as directed in coordination study report.

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 finish including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 29 13

ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. AC Motor-Control Devices Rated 600 V and Less that are Supplied as Enclosed Units.
 - a. Manual Motor Controllers
 - b. Magnetic Motor Controllers
 - c. Variable-Frequency Controllers
 - d. Enclosed Timer Switches
 - e. Enclosures

B. Related Sections include the following:

1. Section 03 30 00 (03300) - Cast-In-Place Concrete.
2. Section 26 05 00 (16050) – Common Work Results for Electrical.
3. Section 26 05 19 (16120) - Low-Voltage Electrical Power Conductors and Cables.
4. Section 26 05 53 (16075) – Identification for Electrical Systems.

1.2 REFERENCES

A. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"
2. AB 1 "Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures"
3. ICS 2 "Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 6000 Volts"
4. KS 1 "Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)"
5. MG 1 "Motors and Generators"

B. National Institute for Certification in Engineering Technologies (NETA):

1. ATS "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

D. Occupational Safety & Health Administration (OSHA) Regulations:

1. 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory"

E. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

ENCLOSED CONTROLLERS**1.3 SUBMITTALS**

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data:
 - 1. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
 - 2. Maintenance Data: For products to include in the maintenance manuals specified in Division 01.
 - 3. 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.
 - 4. Qualification Data for Field Testing Agency: Certificates, signed by Contractor, certifying that agency complies with requirements specified in "Quality Assurance" Article below.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.
- B. Comply with NFPA 70.
- C. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.5 COORDINATION

- A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.
- B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described in Section 01 78 43 (01790) "Spare Parts and Material" that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver extra materials to Owner.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 - 1. None.
- B. Approved Manufacturers:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary (888-385-1221)
 - 2. Allen-Bradley Co.; Industrial Control Group (414-382-2000)
 - 3. Crouse-Hinds ECM.; Cooper Industries, Inc. Div. (315-477-5531)
 - 4. Eaton Corp.; Westinghouse & Cutler-Hammer Products (800-386-1911)
 - 5. General Electric Co.; Electrical Distribution & Control Div. (800-431-7867)

ENCLOSED CONTROLLERS

6. Siemens Energy & Automation, Inc. (800-964-4114)
7. Square D Co.; a Division of Groupe Schneider (888-778-2733)

2.2 MANUAL MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

2.3 MAGNETIC MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.
- B. Control Circuit: 120 V; obtained from integral control power transformer, unless otherwise indicated. Include a control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
- C. Combination Controller: Factory-assembled combination controller and disconnect switch with or without overcurrent protection as indicated.
 1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses indicated. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a Nationally Recognized Testing Laboratory.
 2. Non-fusible Disconnect: NEMA KS 1, heavy-duty, non-fusible switch.
 3. Circuit-Breaker Disconnect: NEMA AB 1, motor-circuit protector with field-adjustable short-circuit trip coordinated with motor locked-rotor amperes.
- D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect, and with appropriate adjustment for duty cycle.

2.4 VARIABLE-FREQUENCY CONTROLLERS

- A. Description: NEMA ICS 2, variable-frequency controller, listed and labeled as a complete unit and arranged to provide variable speed of a standard NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency.
- B. 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.
- C. Isolation Transformer: Match transformer voltage ratings and capacity to system and motor voltages; and controller, motor, drive, and load characteristics.
- D. Output Rating: 3-phase, 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- E. Output Rating: 3-phase, 6 to 66 Hz, with torque constant as speed changes.
- F. Output Rating: 3-phase, 6 to 120 Hz, with horsepower constant throughout speed range.
- G. Starting Torque: 100 percent of rated torque or as indicated.
- H. Speed Regulation: Plus or minus one percent.
- I. Ambient Temperature: 0 to 40 deg C.
- J. Efficiency: 95 percent minimum at full load and 60 Hz.
- K. Isolated control interface allows controller to follow 1 of the following over an 11:1 speed range:
 1. Electrical Signal: 4 to 20 mA at 24 V.
 2. Pneumatic Signal: 3 to 15 psig.

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ENCLOSED CONTROLLERS

- L. Internal Adjustability: Include the following internal adjustment capabilities:

ENCLOSED CONTROLLERS

1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 2 to 22 seconds.
 4. Deceleration: 2 to 22 seconds.
 5. Current Limit: 50 to 110 percent of maximum rating.
- M. Multiple-Motor Capability: Controller suitable for service to multiple motors and furnished with a separate overload relay and protection for each controlled motor. Shut off the controller and motors served by it when an overload relay is tripped.
- N. Self-protection and reliability features include the following:
1. Input transient protection by means of surge suppressors.
 2. Snubber networks to protect against malfunction due to system voltage transients.
 3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10 performance.
 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 5. Instantaneous overcurrent trip.
 6. Loss of phase protection.
 7. Reverse phase protection.
 8. Under- and overvoltage trips.
 9. Overtemperature trip.
 10. Short-circuit protection.
- O. Automatic Reset/Restart: Attempt 3 restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration will not damage controller, motor, or load.
- P. Status Lights: Door-mounted LED indicators to indicate the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- Q. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate controller output current, voltage, and frequency.
- S. Manual Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch indicator lights set and indicate mode selection.
- T. Integral disconnect.

ENCLOSED CONTROLLERS

- U. Bypass Controller: NEMA ICS 2, full-voltage, non-reversing motor controller, provides across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- V. Isolating Switch: Non-load-break switch arranged to isolate variable-frequency controller and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

2.5 ENCLOSED TIMER SWITCHES

- A. Timer switch for spa: Spring wound 0 to 30 minutes, by Tork or Intermatic.
- B. Timer switch for fireplaces: Inteliswitch TS-300, by Watt Stopper, digital electronic timer 10 minutes to 2 hours. Provide additional relay at fireplaces for fireplace control circuit, timer operates relay. Timer requires 120 volts to operate.

2.6 ENCLOSURES

- A. Description: Flush or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to meet 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.

2.7 ACCESSORIES

- A. Devices are factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break push-button station with a factory-applied hasp arranged so a padlock can be used to lock push button in depressed position with control circuit open.
- D. Control Relays: Auxiliary and adjustable time-delay relays.
- E. Elapsed Time Meters: Heavy duty with digital readout in hours.
- F. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
- G. Impulse sparkover voltage coordinated with system circuit voltage.
- H. Factory mounted with Nationally Recognized Testing Laboratory listed and labeled mounting device.

PART 3 EXECUTION**3.1 GENERAL**

- A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.
- C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.
- D. Use manual controllers for 3-phase motors up to 7-1/2 hp not requiring automatic or remote control.
- E. Push-Button Stations: In covers of magnetic controllers for manually started motors where

SECTION 26 29 13

ENCLOSED CONTROLLERS

indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

ENCLOSED CONTROLLERS

- F. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.2 INSTALLATION

- A. Install independently mounted motor-control devices according to manufacturer's written instructions.
- B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, including the pretesting and adjustment of solid-state controllers.
- C. Location: Locate controllers within sight of motors controlled.
- D. 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 conforming to Section 26 05 00 - "Common Work Results for Electrical."
- E. Install freestanding equipment on concrete housekeeping bases conforming to Section 03 30 00 - "Cast-in-Place Concrete."
- F. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

3.3 IDENTIFICATION

- A. Identify motor-control components and control wiring according to Section 26 05 53 "Electrical Identification."

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic control devices where available.
 - 1. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.
 - 2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

- A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

- A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
 - 2. Remove and replace malfunctioning units with new units, and retest.

3.7 CLEANING

- A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

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ENCLOSED CONTROLLERS

3.8 DEMONSTRATION

- A. Training: Engage a factory-authorized service representative to demonstrate solid-state and variable- speed controllers and train Owner's maintenance personnel.
 - 1. Conduct training as specified in Section 01 79 00 (01820) - "Training".
 - 2. Include training relating to equipment operation and maintenance procedures.

END OF SECTION

SECTION 26 43 13
SURGE PROTECTION FOR LOW VOLTAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Transient Voltage Surge Suppressors for Low-Voltage Power, Control, and Communication Equipment.
 - a. Service Entrance Suppressors
 - b. Plug-In Surge Suppressors
 - c. Control And Data Terminals
 - d. Enclosures

B. Related Sections:

1. Section 26 24 00 (16440) – Switchboards and Panelboards
2. Section 26 24 26 (16140) - Wiring Devices

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. C62.41 "Surge Voltages In Low-Voltage AC Power Circuits"
2. C62.45, "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits"

B. InterNational Electrical Testing Association (NICET)

C. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"
2. WD 6 "Wiring Devices—Dimensional Requirements"

D. National Institute for Certification in Engineering Technologies (NETA)

1. ATS "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems"

E. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

F. Underwriter's Laboratories, Inc. (UL) Publications:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"
3. 1283 "Electromagnetic Interference Filters"
4. 1449 "Transient Voltage Surge Suppressors"

1.3 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project and with the following supporting data:**

SURGE PROTECTION FOR LOW VOLTAGE

1. Product Certificates: Signed by manufacturers of transient voltage suppression devices, certifying that products furnished comply with the following testing and labeling requirements:
 - a. UL 1283 certification.
 - b. UL 1449 listing and classification.
2. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Failed test results and corrective action taken to achieve requirements.
3. Maintenance Data: For transient voltage suppression devices to include in maintenance manuals specified in Division 01.
4. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.
- B. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. IEEE Compliance: Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide for Surge Suppressor Testing."
- F. UL Compliance: Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449, third edition, "Transient Voltage Surge Suppressors."

1.5 PROJECT CONDITIONS

- A. Placing into Service: Do not energize or connect service entrance equipment to their sources until the surge protective devices are installed and connected.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Owner representative not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's representative written permission.

SURGE PROTECTION FOR LOW VOLTAGE

- C. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 85 percent, non-condensing.
 - 4. Altitude: Less than 20,000 feet above sea level.

1.6 COORDINATION

- A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.7 WARRANTY

- A. General Warranty: Special warranties 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. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Broad Line of Suppressors:
 - a. None
 - 2. Category A and Telephone/Data Line Suppressors:
 - a. None
- B. Approved Manufacturers:
 - 1. Broad Line of Suppressors:
 - a. Current Technology, Inc. (800-238-5000)
 - b. Liebert Corp. (614-888-0246)
 - c. Square D Co.; a Division of Group Schneider (888-778-2733)
 - 2. Category A and Telephone/Data Line Suppressors:
 - a. MCG Electronics, Inc. (800-851-1508)
 - b. NTE Electronics, Inc. (973-748-5089)
 - c. Telebyte Technology, Inc. (800-835-3298)

2.2 SERVICE ENTRANCE SUPPRESSORS

- A. Surge Protective Device Description: Modular design with field-replaceable modules and the following features and accessories:
 - 1. Fuses, rated at 200-kA interrupting capacity.
 - 2. Fabrication using bolted compression lugs for internal wiring.
 - 3. Integral disconnect switch.

SURGE PROTECTION FOR LOW VOLTAGE

4. Redundant suppression circuits.
 5. Redundant replaceable modules.
 6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 7. Red and green LED indicator lights for power and protection status.
 8. Audible alarm, with silencing switch, to indicate when protection has failed.
 9. One set of dry contacts rated at 5 a and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
 10. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: [240] kA per phase.
- C. Connection Means: Permanently wired.
- D. Protection modes and UL 1449, third edition, clamping voltage for grounded wye circuits with voltages of 480Y/277; 3-phase, 4-wire circuits, shall be as follows:
1. Line to Neutral: 1200 V for 480Y/277
 2. Line to Ground: 1200 V for 480Y/277
 3. Neutral to Ground: 1200 V for 480Y/277
- E. Protection modes and UL 1449, third edition, clamping voltage for voltages of 240, 480, or 600; 3-phase, 3-wire, delta circuits shall be as follows:
1. Line to Line: 2000 V for 480 V
 2. Line to Ground: 2000 V for 480 V

2.3 PLUG-IN SURGE SUPPRESSORS

- A. Description: Non-modular, plug-in suppressors with at least four 15-A, 120-V ac, NEMA WD 6, Configuration 15-15R receptacles, suitable to plug into a NEMA WD 6, Configuration 15-15R receptacle; with the following features and accessories:
1. LED indicator lights for power and protection status.
 2. LED indicator lights for reverse polarity and open outlet ground.
 3. Circuit breaker and thermal fusing. Unit continues to supply power if protection is lost.
 4. Close-coupled direct plug-in.
 5. Rocker-type on-off switch, illuminated when in the on position.
 6. One RJ11/12C telephone line protector, suitable for modem connection. Maximum clamping voltage 220 peak on pins No. 3 and 4.
- B. Peak Single-Impulse Surge Current Rating: 26 kA per phase.
- C. Protection modes and UL 1449 clamping voltage shall be as follows:
1. Line to Neutral: 475 V.
 2. Line to Ground: 475 V.
 3. Neutral to Ground: 475 V.

SURGE PROTECTION FOR LOW VOLTAGE**2.4 CONTROL AND DATA TERMINALS**

- A. Protectors for copper control, data, antenna and telephone conductors entering the building from the outside shall be as recommended by the manufacturer for the type of line being protected.

2.5 ENCLOSURES

- A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 EXECUTION**3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES**

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multi-pole, 15-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated.

3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Complete startup checks according to manufacturer's written instructions.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 07.19. Certify compliance with test parameters.
- B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain surge protective devices.
 - 1. Train Owner's maintenance personnel on procedures and schedules for maintaining suppressors.
 - 2. Review data in maintenance manuals. Refer to Section 01 78 23 (01830) - "Operation and Maintenance Data."
 - 3. Schedule training with Owner, through Owner representative, with at least seven days' advance notice.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior Lighting Units with Luminaires
2. Ballasts
3. Lamps
4. Luminaire Support Components
5. Accessories

B. Related Sections:

1. Section 03 30 00 (03300) - Cast-in-Place Concrete.
2. Section 26 05 26 (16060) - Grounding and Bonding for Electrical Systems.
3. Section 26 51 00 (16510) - Interior Lighting
4. Section 26 60 00 (16580) - Lighting Accessories: For programmable lighting control systems, time switches, additional photoelectric relays, power relays, and contactors.

1.2 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C2 "National Electrical Safety Code"
2. C78 "Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)"
3. C82.4 "Ballasts for High – Intensity – Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type)"

B. American Association of State Highway and Transportation Officials (AASHTO) Publications:

1. LTS-3 "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals"

C. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. A123 "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products"
2. A500 "Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"
3. B660 "Standard Practices for Packaging/Packing of Aluminum and Magnesium Products"

D. Illuminating Engineering Society (IES) Publications:

1. RP-8 "Roadway Lighting"

E. National Fire Protection Association (NFPA) Publications:

1. NFPA 70 "National Electric Code"

F. National Association of Architectural Metal Manufacturers (NAAMM) Publications:

1. "Metal Finishes Manual for Architectural and Metal Products"

G. Underwriter's Laboratories, Inc. (UL) Publications:

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1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

1.3 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
 1. For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - a. Materials and dimensions of luminaires and poles.
 - b. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - c. High-intensity-discharge luminaire ballasts.
 - d. Photometric data.
 2. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 3. Maintenance Data: For lighting units to include in maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

- A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by a testing agency acceptable to authorities having jurisdiction
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING OF POLES

- A. Package aluminum poles for shipping according to ASTM B660.
- 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. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent surface more than 1/4 inch deep. Do not apply tools to section of poles below ground-line.
- D. Retain factory-applied pole wrappings on fiberglass poles until just before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described in section 01 78 43 (01790) "Spare Parts and Materials" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

EXTERIOR LIGHTING**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Refer to Section 26 51 00 for list of approved manufacturers.
- B. Approved Manufacturers:
 - 1. Subject to compliance with requirements, provide the products indicated for each designation in the Light Fixture Matrix attached at the end of this Section.
 - 2. Refer to Section 26 51 00 for list of approved manufacturers.

2.2 LUMINAIRES

- A. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- B. Metal Parts: Free from burrs, sharp corners, and edges.
- C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
- H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.
- J. Photoelectric Relays: As follows:
 - 1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
 - 2. Relay Mounting: In luminaire housing.
- K. High-Intensity-Discharge Ballasts: Comply with ANSI C82.4. Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
 - 1. Ballast Fuses: One in each ungrounded supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
 - 2. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
 - 3. Open-circuit operation will not reduce average life.
 - 4. Noise: Uniformly quiet operation, with a noise rating of B or better.

EXTERIOR LIGHTING

- L. Lamps: Comply with the standard of the ANSI C78 series that is applicable to each type of lamp. Provide luminaires with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a luminaire, provide medium wattage lamp recommended by manufacturer for luminaire.

- 1. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

2.3 LUMINAIRE SUPPORT COMPONENTS

- A. Description: Comply with AASHTO LTS-3 for pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.
- B. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 100 mph (160 km/h) with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.
 - 1. Strength Analysis: For each pole type and luminaire combination, 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.
- C. Finish: Match finish of pole/support structure for arm, bracket, and tenon mount materials.
- D. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Will not cause galvanic action at contact points.
 - 2. Mountings: Correctly position luminaire to provide indicated light distribution.
 - 3. Anchor Bolts, Nuts, and Washers: Hot-dip galvanized after fabrication unless stainless-steel items are indicated.
 - 4. Anchor-Bolt Template: Plywood or steel.
- E. Pole/Support Structure Bases: Anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.
- F. Steel Poles: Tubing complying with ASTM A500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet in length with access handhole in pole wall.
 - 1. Grounding Provisions for Metal Pole/Support Structure: Welded 1/2-inch threaded lug, accessible through handhole and listed for copper conductor connection.
 - 2. Shafts: Square, straight.
- G. Metal Pole Brackets: Match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate luminaire.
- H. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- I. Concrete for Pole Foundations: Comply with Section 03 30 00 (03300) "Cast-in-Place Concrete."
 - 1. Design Strength: 3000-psig, 28-day compressive strength.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Steel: Grind welds and polish surfaces to a smooth, even finish.

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1. Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A123.
2. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
3. Interior: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
4. Polyurethane Enamel: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: Refer to Light Fixture Matrix.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Concrete Foundations: Construct according to Section 03 30 00 (03300) "Cast-in-Place Concrete."
 1. Comply with details for reinforcement and for anchor bolts, nuts, and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
 2. Finish for Parts Exposed to View: Trowel and rub smooth. Comply with Section 03 30 00 (03300) - "Cast-in-Place Concrete" for exposed finish.
- B. Embedded Poles: Set poles to indicated depth, but not less than one-sixth of pole length below finish grade. Dig holes large enough to permit use of tampers the full depth of hole. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- C. Install poles as follows:
 1. Use web fabric slings (not chain or cable) to raise and set poles.
 2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 3. Secure poles level, plumb, and square.
 4. Grout void between pole base and foundation. Use non-shrinking or expanding concrete grout firmly packed in entire void space.
 5. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- D. Luminaire Attachment: Fasten to indicated structural supports.
- E. Luminaire Attachment with Adjustable Features or Aiming: Attach luminaires and supports to allow aiming for indicated light distribution.
- F. Lamp luminaires with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.

3.2 CONNECTIONS

- A. Ground equipment.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Ground metal poles/support structures according to Section 26 05 26 (16060) - "Grounding and Bonding for Electrical Systems."

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1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect luminaires to grounding system with No. 6 AWG conductor.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:
 1. Measure light intensities at night if specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.
 2. Check intensity and uniformity of illumination.
 3. Check excessively noisy ballasts.
- E. Prepare a written report of tests, inspections, observations and verifications indicating and interpreting results.
- F. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.4 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.
- B. Adjust amiable luminaires and luminaires with adjustable lamp position to provide required light distributions and intensities.

END OF SECTION

SECTION 26 60 00

LIGHTING ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time Switches
2. Photoelectric Relays
3. Multi-pole Lighting Relays and Contactors.
4. Hearing Impaired Door Annunciator
5. Occupancy Sensors
 - a. Indoor Occupancy Sensors
 - b. Switchbox-Mounted Occupancy Sensors

B. Related Sections:

1. Section 01 81 13 - Sustainable Design Requirements
2. Section 10 14 00 (10400) - Signage
3. Section 26 05 00 (16050) - Common Work Results For Electrical.
4. Section 26 05 19 (16120) - Low-Voltage Electrical Power Conductors and Cables.
5. Section 26 05 33 (16130) - Raceways and Boxes For Electrical Systems.
6. Section 26 05 53 (16075) - Identification for Electrical Systems.
7. Section 26 24 00 (16440) - Switchboards and Panelboards
8. Section 26 27 26 (16140) - Wiring Devices: For wall-box dimmers and manual light switches.

1.2 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C62.41 "IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits"

B. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. ICS 2 "Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 6000 Volts"

C. National Fire Protection Association (NFPA) Publications:

1. NFPA 70 "National Electric Code"

D. Underwriter's Laboratories, Inc. (UL) Publications:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 508 "Standard for Industrial Control Equipment"
3. 773A "Nonindustrial Photoelectric Switches for Lighting Control"
4. 917 "Standard for Safety for clock-Operated Switches"
5. 1449 "Transient Voltage Surge Suppressors"

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data:
 - a. Include dimensions and data on features, components, and ratings for lighting

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control devices.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:
 - 1. Section 26 24 00 (16440) - "Switchboards and Panelboards."

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Contactors and Relays:
 - a. None
 - 2. Time Switches:
 - a. None
 - 3. Photoelectric Relays:
 - a. None
 - 4. Occupancy Sensors:
 - a. None
 - 5. Hearing Impaired Door Annunciator:
 - a. None
- B. Approved Manufacturers:
 - 1. Contactors and Relays:
 - a. Challenger Electrical Equipment Corp. (412-920-2400)
 - b. Cutler-Hammer Products; Eaton Corporation (800-498-2678)
 - c. GE Lighting Controls (888-437-3765)
 - d. Hubbell Lighting, Inc. (864-599-6000)
 - e. Siemens Energy and Automation, Inc. (800-964-4114)
 - f. Square D Co.; a Division of Groupe Schneider, Power Management Organization (888-778-2733)
 - 2. Time Switches:
 - a. Diversified Electronics, Inc. (800-874-0619)
 - b. Intermatic, Inc. (815-675-7000)
 - c. Tork, Inc. (914-664-3542)
 - d. Leviton Manufacturing Co., Inc. (718-229-4040).
 - 3. Photoelectric Relays:
 - a. Allen-Bradley/Rockwell Automation (414-382-2000)
 - b. Intermatic, Inc. (815-675-7000)
 - c. Rhodes: M H Rhodes, Inc. (800-548-3647)
 - d. Tork, Inc. (914-664-3542)
 - e. Honeywell, Inc.; Home and Building Controls (800-328-5111)

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- f. Hubbell Lighting, Inc. (864-599-6000)
 - g. Leviton Manufacturing Co., Inc. (718-229-4040).
 - h. Lutron Electronics Co., Inc. (800-523-9466)
 - i. Philips Lighting Company (800.555.0050)
 - j. Watt Stopper, Inc. (The) (800-879-8585)
- 4. Hearing Impaired Door Annunciator:
 - a. Edwards Signaling, UTC Fire & Security (800-336-4206)
- 2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS
 - A. Line-Voltage Surge Protection: Include in all 120- and 277-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.
- 2.3 HEARING IMPAIRED DOOR ANNUNCIATOR.
 - A. Guestroom Door Annunciator Kit: Visual signaling device with strobe, hall push button station, and transformer. Minimum high intensity 150 candela visual signal.
 - B. Approved Manufacturer:
 - 1. Edwards Signaling
 - C. The kit shall consist of the following components:
 - 1. Push Button: No. 20
 - 2. Cover Plate: No. 147-10
 - 3. Strobe in location shown on Drawings: No. 89STR (B)–AQ
 - 4. Auxiliary Strobe in bathroom: No. 89STR (B)-AQ
 - 5. Below strobes provide a small plaque in off-white plastic with black letters that reads **"DOOR BUTTON SIGNALER"** as well as Braille equivalent. Secure to wall with clear sanitary sealant.
 - a. Plaque: By Section 10 14 00 (10400) (Interior Signage Package).
 - 6. Transformer: No. 598
 - D. A disconnect switch from the door button power transformer shall be located on the wall in location shown on Drawings with an applied label on the cover plate reading **"DOOR SIGNAL OVERRIDE"**.
 - 1. Plaque: By Section 10 14 00 (10400) (Interior Signage Package).
 - E. Mount the push button at 48" above the floor on the corridor side next to the lock strike of the door.
 - F. Mount the strobe on the wall in location shown on Drawings at 80" above the floor.
 - G. Mount the auxiliary strobe on the bathroom wall in location shown on Drawings at 80" above the floor.
 - H. Screw components to walls using plastic plugs.
- 2.4 HEARING IMPAIRED DOOR ANNUNCIATOR.
 - A. Guestroom Door Annunciator Kit: Audible/visual signaling device with horn/strobe, hall push button station, and transformer. Minimum 82 dB sound pressure at 10 feet and a high intensity 110 candela visual signal.
 - 1. "Model 7005-G5 Hotel Room Annunciator Kit"; Edwards Signaling
 - a. Kit consisting of the following components:
 - 1) Model 6536-G5 Horn Strobe
 - 2) Model 592 Transformer
 - 3) Model 620 Push Button
 - 4) (Do not use 147-10 Face Plate)
 - b. Model 147-1 Face Plate (No text on plate).
 - 2. Locations as shown on Drawings.

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Plaque: By Section 10 14 00 (10400) (Interior Signage Package).

B. Doorbell Disable Switch:

1. Single Pole Toggle Switch: Refer to Section 26 27 26 (16140).
2. Cover Plate: Refer to Section 26 27 26 (16140).
3. Plaque: By Section 10 14 00 (10400) (Interior Signage Package).
4. Location as shown on Drawings.

2.5 TIME SWITCHES

A. Description: Solid-state programmable units with alphanumeric display complying with UL 917.

1. Astronomic dial.
2. Two contacts, rated 30 A at 277-V ac, unless otherwise indicated.
3. Two pilot-duty contacts, rated 2 A at 240-V ac, unless otherwise indicated.
4. Eight-day program uniquely programmable for each weekday and holidays.
5. Skip-day mode.

2.6 PHOTOELECTRIC RELAYS

A. Description: Solid state, with single-pole, double-throw dry contacts rated to operate connected relay or contactor coils or microprocessor input, and complying with UL 773A.

B. Light-Level Monitoring Range: 0 to 3500 fc with an adjustment for turn-on/turn-off levels.

C. Time Delay: Prevents false operation.

D. Outdoor Sealed Units: Weathertight housing, resistant to high temperatures and equipped with sun-glare shield and ice preventer.

2.7 MULTI-POLE CONTACTORS AND RELAYS

A. Description: Electrically operated and mechanically held, and complying with UL 508 and NEMA ICS 2.

1. Current Rating for Switching: UL listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballasts with 15 percent or less total harmonic distortion of normal load current).
2. Control Coil Voltage: Match control power source.

2.8 INDOOR OCCUPANCY SENSORS

A. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
6. Indicator: Digital display, to show when motion is detected during testing and normal

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operation of sensor.

7. Bypass Switch: Override the "on" function in case of sensor failure.
- B. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.9 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- B. Wall-Switch Sensor (180-degree field of view):
 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
 4. Voltage: Match the circuit voltage type.
 5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 6. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
- C. Wall-Switch Sensor (210-degree field of view):
 1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.
 2. Sensing Technology: PIR.
 3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
 4. Voltage: Match the circuit voltage type.
 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install equipment level and plumb and according to manufacturer's written instructions.
- B. Mount lighting control devices according to manufacturer's written instructions and requirements in Section 26 05 00 - "Common Work Results for Electrical".

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- C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

3.2 CONTROL WIRING INSTALLATION

- A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Section 26 05 19 - "Low-Voltage Electrical Power Conductors and Cables" for low-voltage connections.
- B. Wiring Method: Install all wiring in raceway as specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- C. Bundle, train, and support wiring in enclosures.
- D. Ground equipment.
- E. Connections: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 - "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
- B. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
- C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
- D. Verify settings of photoelectric devices with photometer calibrated within previous six months.
- E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 - 1. Continuity tests of circuits.
 - 2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- F. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.5 CLEANING

- A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.6 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested, to adjust light levels, make program changes, and adjust sensors and controls to suit actual conditions.

END OF SECTION

SECTION 27 05 00

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Supporting Devices for Communication Components.
 - 2. Concrete Equipment Bases.
 - 3. Cutting and Patching For Communication Construction.
 - 4. Touchup Painting.
- B. Related Sections:
 - 1. Section 03 30 00 (03300) - Cast-In-Place Concrete.
 - 2. Section 07 84 00 (07840) - Firestopping.
 - 3. Section 09 90 00 (09900) - Painting.
 - 4. Division 26 and 28 Sections

1.2 REFERENCES

- A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
 - 1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
- B. American Welding Society (AWS) Publications:
 - 1. D1.1 "Structural Welding Code - Steel"
- C. National Fire Protection Association (NFPA) Publications:
 - 1. 70 "National Electric Code"
- D. U.S. Architectural & Transportation Barriers Compliance Board:
 - 1. Americans with Disabilities Act (ADA)

1.3 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:
 - 1. Product Data: For electricity-metering equipment.
 - 2. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
 - 3. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. All work to be in accordance with latest requirements of NFPA 70 and all other applicable codes and regulations of authorities having jurisdiction over the work.

COMMON WORK RESULTS FOR COMMUNICATIONS**1.5 COORDINATION**

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the communication installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing communication materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate communication service connections to components furnished by utility companies.
 - 1. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for communication items that are concealed by finished surfaces. Access doors and panels are specified in Section 08 31 00 (08310) - "Access Doors."
- E. Coordinate all work with Division 26.
- F. All communication drawings are to be read in conjunction with the Project specifications and all other related drawings.
- G. The contractor shall examine the site and observe the conditions under which the work will be done or other circumstances which will affect the contemplated work. No allowance will be made subsequently in the connection for any error or negligence on the contractor's part.
- H. The contractor shall verify exact location, size and extent of all existing utilities, obstructions and/or other conditions which may affect the proposed work under the project. The contractor shall take every precaution to prevent damage to existing work and shall repair any damage as a result of this Work.
- I. The contractor shall verify all door swings in the field and mount switches on knob side of doors or as approved by the Architect. The contractor shall carefully examine all contract drawings/specifications and be responsible for the proper fittings of materials and equipment at each location as indicated without substantial alteration. The drawings are generally diagrammatic and because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Furnishing such fittings that are required to meet such conditions shall be furnished and installed at no cost.

PART 2 PRODUCTS**2.1 SUPPORTING DEVICES**

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

COMMON WORK RESULTS FOR COMMUNICATIONS

- F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- H. Toggle Bolts: All-steel springhead type.

2.2 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Section 03 30 00 (03300) - "Cast-in-Place Concrete."

2.3 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 EXECUTION**3.1 ELECTRICAL EQUIPMENT INSTALLATION**

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.
- E. Coordinate work with other trades and install conduit and boxes to clear embedded ducts, openings, etc. and all structural features.
- F. Unless otherwise noted, mounting heights, as shown, are from finished floor to top of panelboard and to centerline of other equipment. Coordinate all mounting heights with contract drawings, local code requirements, and all ADA requirements.
 - 1. Toggle (snap) switch: 4'-0".
 - 2. Enclosed circuit breaker: 5'-0"
 - 3. Disconnect (safety) switch: 5'-0".
 - 4. Motor starter: 5'-0".
 - 5. Panelboard: 6'-6".

3.2 COMMUNICATION SUPPORTING DEVICE APPLICATION

- A. Damp Locations, Pool Equipment Rooms, Storage Rooms and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

COMMON WORK RESULTS FOR COMMUNICATIONS**3.3 SUPPORT INSTALLATION**

- A. Install support devices to securely and permanently fasten and support communication components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten communication items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 7. Light Steel: Sheet-metal screws.
 - 8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

COMMON WORK RESULTS FOR COMMUNICATIONS**3.4 FIRESTOPPING**

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Section 07 84 00 (07840) "Firestopping."

3.5 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 (03300) "Cast-in-Place Concrete."

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.7 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Supporting devices for communication components.
 - 2. Concrete bases.
 - 3. Cutting and patching for communication construction.
 - 4. Touch up painting.

3.8 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Section 09 90 00 (09900) - "Painting."

3.9 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 27 20 00

DATA COMMUNICATIONS CONDUIT

PART 1 – GENERAL

1.1 SUMMARY

- A. GENERAL DESCRIPTION: Empty conduit system for the Owners data communications system
- B. THE GENERAL PROVISIONS of the Contract including General and Supplementary Conditions, Division 1 General Requirements, and Instructions to Bidders apply to the Work included in this Division.

1.2 REFERENCES: Not applicable

1.3 SUBMITTALS: Not required.

1.4 SYSTEM DESCRIPTION

A. EXTENT OF WORK

- 1. As identified in the drawings and schedules.
- 2. Furnish and install an EMPTY CONDUIT SYSTEM for the data communications system, as described in these specifications and indicated on the drawings.

1.5 OWNER'S INSTRUCTIONS AND MAINTENANCE -

PART 3 – EXECUTION

3.1 EXAMINATION OF SITE

- A. REFER TO DIVISION 1 for General Requirements

3.2 PREPARATION: Not applicable

3.3 CONSTRUCTION

A. CONSTRUCTION / INSTALLATION

- 1. Minimum size raceway for data communications outlets shall be 1" conduit. Provide 1 conduit run to accessible ceiling space from each outlet unless otherwise noted. Provide and leave in place a suitable nylon pull cord to facilitate the installation of the data communications cables by others. Provide factory bends for data communications conduit runs. Do not install more than two 90° bends without installing a pull box. For conduit runs longer than 100'-0", install a pull box.
- 2. Furnish and install outlet boxes where shown on the drawings. Where these outlets are combined with other outlets, proper barriers must be provided.
- 3. Install a data communications type coverplate as required by the Owner on all outlet boxes that are intended for data communications use. Where outlets are un-used, provide blank coverplate.
- 4. Provide a bushing at all open conduit ends.

END OF SECTION

SECTION 27 30 00

TELEVISION CONDUIT SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

- A. GENERAL DESCRIPTION: Conduit system for a television distribution system.
- B. THE GENERAL PROVISIONS of the Contract including General and Supplementary Conditions, Division 1 General Requirements, and Instructions to Bidders apply to the Work included in this Division.

1.2 SYSTEM DESCRIPTION

A. EXTENT OF WORK

- 1. As identified in the drawings and schedules.
- 2. The work to be provided under these specifications consists of furnishing and installing a complete conduit system for a television distribution system within the building. Provisions shall be made for connecting to a cable T.V. service (CATV).
- 3. The Contractor shall furnish all necessary equipment, labor, and installation materials, whether specified or not, to provide a complete system.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.1 EXAMINATION OF SITE

- A. REFER TO DIVISION 1 for General Requirements

3.2 CONSTRUCTION

A. CONSTRUCTION / INSTALLATION

- 1. At each outlet location, provide flush mounted single gang outlet box with blank coverplate.
- 2. All equipment shall be installed in a neat and workmanlike manner.
- 3. All conduit shall be run concealed and all boxes shall be flush mounted. (Where possible)
- 4. From each outlet, provide 1" conduit with pull-line into accessible ceiling space, unless otherwise indicated on the drawings.
- 5. Provide a bushing at all open conduit ends.

END OF SECTION

SECTION 28 31 00

FIRE ALARM AND DETECTION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Automatic and Manual Fire Alarm System, complete per Marriott's Fire Protection and Life Safety Design Standards (Module 14), and applicable local, state and national codes
- B. Related Documents:
 - 1. Marriott's Fire Protection and Life Safety Design Standards (Module 14):
 - a. Marriott's Fire Protection and Life Safety Design Standards include Design Standards, performance criteria, reference standards and life safety process verification that define a comprehensive fire protection program.
- C. Related Sections:
 - 1. Section 14 24 23 (14240) – Elevators.
 - 2. Section 21 10 00 (13900) - Fire Protection.
 - 3. Section 27 05 00 (16050) – Common Work Results for Electrical

1.2 QUALITY ASSURANCE

- A. Equipment shall be manufactured by a firm who has been actively manufacturing fire alarm systems of the type required and shall have supplied similar equipment to comparable installations and rendered satisfactory service for a minimum of 10 years. All components of the fire alarm system shall be manufactured by the vendor supplying the equipment, and standard products of a single manufacturer.
- B. Material and equipment shall be new and UL listed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Avendra, LLC Preferred Manufacturers:
 - 1. None.
- B. Approved Manufacturers:
 - 1. Tyco Integrated Fire and Security
 - a. Contact: William Glover (443-259-3352)
 - b. Email: wglover@tyco.com
 - a. Approved Models:
 - 1) "EST/ADT 3000 Life Safety Control Panel Platform"
 - 2) "EST Quickstart Series Intelligent Life Safety Control Panels"
 - 3) "EST io 500 Intelligent Life Safety System"
 - 4) "CP-3500" (replaces CP-3000, CP300D and CP300DA)
 - 5) CP-3500D (replaces CP-3000, CP300D and CP300DA)
 - 2. SimplexGrinnell –Tyco Fire & Security
 - a. Contact: John Morgan (978-731-7352)

FIRE ALARM AND DETECTION SYSTEMS

- 1) Email: jmorgan@simplexgrinnell.com
- b. Approved Models:
 - 1) "Simplex 4020" (no longer manufactured but supported)
 - 2) "Simplex 4100 Classic" (no longer manufactured but supported)
 - 3) "Simplex 4100 Plus" (no longer manufactured but supported)
 - 4) "Simplex 4010" (only when supplied with a graphic annunciator)
 - 5) "Simplex 4100U"
 - 6) "Simplex 4100ES"
3. Siemens (Cerbeus, Pyrotronics Faraday) – Siemens Fire Safety (201-266-4516)
 - a. Contact: Matt Watson (240-401-0373)
 - 1) Email: matt.watson@siemens.com
 - b. Approved Models:
 - 1) "Siemens MXL System"
 - 2) "Siemens XLS System"
 - 3) "Siemens Desigo System"
 - 4) "Siemens Cerberus Pro System"
 - 5) "Siemens FS-250"
 - 6) "Faraday MPC System"
4. Honeywell Fore Safety Americas (Engineered Systems Distributors), Notifier (NESCO); Gamewell, FCI, Silent Knight IFP-2000, Honeywel)
 - a. Contact: John Brady (203-581-1235)
 - 1) Email: john.j.brady@honeywell.com
 - b. Approved Models:
 - 1) "Silent Knight IFP-2000"
 - 2) "Gamewell/FCI E3"
 - 3) "Gamewell/FCI S3"
 - 4) "Notifier Onyx Series"
 - 5) "Notifier NFS 320"
 - 6) "Notifier NFS 2-640"
 - 7) "Notifier NFS 2-3030"
 - 8) "Honeywell XLS 140" (peripherals must be Honeywell)
 - 9) "Honeywell XLS 3000" (peripherals must be Honeywell)
5. Edwards/UTC Fire and Security (860-284-3000) (Edwards Technology; Vigilant Fire & Life Safety)
 - a. Contact: Timm Weber (772-978-9296)
 - 1) Email: timw@fs.utc.com
 - b. Approved Models:
 - 1) "EST 3X"

FIRE ALARM AND DETECTION SYSTEMS

- 2) "EST 3"
 - 3) "io 500"
 - 4) "Vigilant VM" (same as EST3X)
 - 5) "Vigilant VS" (same as io-500)
6. Mircom (816-628-5348)
 - a. Contact: Todd Gustafson (816-914-8880)
 - 1) Email: tgustafson@mircom.com
 - b. Approved Models:
 - 1) "FX-2000 Series":
 - "FX-2003-6"
 - "FX-2003-12"
 - "FX-2003S-12"
 - "FX-2003-6N"
 - "FX-2003-12N"
 - "FX-2009-12"
 - "FX-2009S-12"
 - "FX-2009-12N"
 - "FX-2017-12A"
 - "FX-2017-12N"
7. VES (Formerly Viking Electronic Services) (800-270-3066)
 - a. Contact: Bo Woods (714-522-2246)
 - 1) Email: bwoods@hochiki.com
 - b. Approved Models:
 - 1) "eLAN Series"
 - 2) "eLAN RS Series"
 - 3) "Elite Series"
 - 4) "Elite RS Series"
8. Hochiki America Corporation (281-826-0165)
 - a. Contact: Bo Woods (714-522-2246)
 - 1) Email: bwoods@hochiki.com
 - b. Approved Models:
 - 1) FN-4127"
 - 2) "FN-2127
 - 3) "FN 1127""
9. Commercial Wireless Systems International (CWSI) (954-318-6005)
 - a. Contact: Scott Barrett (866-937-2537)
 - 1) Email: scott@cwsifire.com
 - b. Approved Models:
 - 1) "CP3000"
 - 2) "CP3000A"

FIRE ALARM AND DETECTION SYSTEMS

- 3) "CP3000D"
- 4) "CP3000DA"
- 10. Fike Facilities Protection Group
 - a. Contact: Tom Boyle (816-655-45113)
 - 1) Email: Tom.Boyle@Fike.com
 - b. Approved Models:
 - 1) "CyberCat 50"
 - 2) "CyberCat 254"
 - 3) "CyberCat 1016"
- 11. Potter Electric Signal Company
 - a. Contact: Mark Sandler (800-325-3936)
 - 1) Email: msandler@pottersignal.com
 - b. Approved Models:
 - 1) "P200"
 - 2) "P300"
 - 3) "P400"
 - 4) "P400R"

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install system in accordance with all national, state and local codes, UL standards, and the manufacturer's published instructions.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Includes (as applicable):
 - 1. Removal of improvements.
 - 2. Topsoil stripping.
 - 3. Removal of trees and other vegetation.
 - 4. Clearing and grubbing.
 - 5. Disconnecting or abandonment of existing utilities.
- B. Protect remaining site improvements from damage. Restore damaged work to condition existing before start of site clearing.
- C. Protect remaining trees and shrubs from damage and maintain vegetation. Employ a licensed arborist to repair tree and shrub damage. Restore damaged vegetation. Replace damaged trees that cannot be restored to full growth, as determined by arborist. No trees are to be removed without the direction of the Engineer.
- D. Do not store materials or equipment or permit excavation within drip line of remaining trees.
- E. Determine location of existing utility services before site clearing. Comply with local utility service requirements.
- F. Clearing limits shall be staked in the field by the Engineer.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SITE CLEARING

- A. Install erosion and sedimentation control measures before site clearing.
- B. Remove trees, shrubs, grass, and other vegetation, site improvements, or obstructions to permit installation of new construction. Removal includes digging out and off-site disposal of stumps and roots.
- C. Strip topsoil to depth indicated in geotechnical report. Stockpile topsoil that will be reused in the Work.
- D. In areas not to be further excavated, fill depressions resulting from site clearing. Place and compact satisfactory soil materials in 6- to 8-inch thick layers to density of surrounding soil.
- E. Dispose of waste materials, including trash, debris, and excess topsoil, off Owner's property. Burning or burial of waste materials on-site is not permitted.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Removal and storage of topsoil.
- B. Rough grading and subgrade preparation of the site for site structures and building pads.
- C. Replacement of topsoil and finish grading for planting.

1.02 RELATED REQUIREMENTS

- A. Section 00 7200 - General Requirements.
- B. Section 01 1000 - Summary and Scope of Work.
- C. Section 01 3000 - Administrative Requirements.
- D. Section 31 1000 - Site Clearing.
- E. Section 31 2316 - Excavation.
- F. Section 31 2323 - Fill: Filling and compaction.
- G. Section 31 2316.13 - Trenching: Trenching and backfilling for utilities.
- H. Section 31 2316.26 - Rock Removal.
- I. Section 32 9219 - Seeding: Finish ground cover.

1.03 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with Town of Arlington, Shelby County, Tennessee Department of Environmental and Conservation (TDEC) and other State Standards Agencies with jurisdiction.
 - 1. Maintain one copy on site of all permits.

1.05 QUANTITIES AND MATERIAL TYPES

- A. Unless specifically stated on the Drawings, the Owner makes no representation as to the quantity of materials or types of materials to be encountered during the grading operations. The Contractor must adhere to rough and finish grades as required by the Drawings, while assessing their own estimate of the quantity and types of materials to be encountered. Unless specifically stated on the Drawings, the grading operation shall be considered unclassified materials, with the Owner responsible for no additional cost due to quantity and/or types of materials encountered.

PART 2 PRODUCTS 2.01 MATERIALS

- A. Topsoil: See Section 31 2323 Fill.
- B. Other Fill Materials: See Section 31 2323 Fill.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.

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GRADING

- D. Notify utility company to remove and relocate utilities, if required.
- E. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, curbs, and other as indicated on drawings, from damage by grading equipment and vehicular traffic.
- F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- G. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- C. When excavating through roots, perform work by hand and cut roots with sharp axe.
- D. See Section 31 2323 Fill for filling procedures.
- E. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.04 SOIL REMOVAL AND STOCKPILING

- A. Stockpile topsoil to be re-used on site; remove remainder from site.
- B. Stockpile subsoil to be re-used on site; remove remainder from site.
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 6 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 6 inches.
- E. Place topsoil in areas where seeding and planting are indicated.
- F. Place topsoil where required to level finish grade.
- G. Place topsoil to the following compacted thicknesses:
 - 1. Areas to be Seeded with Grass: 6 inches.

SECTION 31 22 00

GRADING

2. Areas to be Sodded: 4 inches.
 3. Shrub Beds: 18 inches.
 4. Flower Beds: 12 inches.
 5. Planter Boxes: To within 3 inches of box rim.
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.
- J. Near plants and buildings spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. Lightly compact or roll placed topsoil.

3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).
- C. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.
- D. Top Surface of Finish Grade: Plus or minus 1/2 inch.

3.07 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.
- C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

- A. See Section 31 2323 Fill for compaction density testing.

3.09 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.

1.02 RELATED REQUIREMENTS

- A. Section 00 7200 - General Requirements.
- B. Section 01 1000 - Summary and Scope of Work.
- C. Section 01 3000 - Administrative Requirements.
- D. Section 01 7000 - Execution and Closeout Requirements: General requirements for dewatering of excavations and water control.
- E. Section 31 2200 - Grading: Grading.
- F. Section 31 2323 - Fill: Fill materials, filling, and compacting.
- G. Section 31 2316.13 - Trenching: Backfilling and compacting for utility trenches outside the building to utility main connections.
- H. Section 31 2316.26 - Rock Removal: Removal of rock during excavating.

1.03 PROJECT CONDITIONS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

1.04 QUANTITIES AND MATERIAL TYPES

- A. Unless specifically stated on the Drawings, the Owner makes no representation as to the quantity of materials or types of materials to be encountered during the grading operations. The Contractor must adhere to rough and finish grades as required by the Drawings, while assessing their own estimate of the quantity and types of materials to be encountered. Unless specifically stated on the Drawings, the grading operation shall be considered unclassified materials, with the Owner responsible for no additional cost due to quantity and/or types of materials encountered.

PART 2 PRODUCTS – (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 2200 Grading for additional requirements.

3.03 EXCAVATING

- A. Underpin adjacent structures that could be damaged by excavating work. Delegated Design: Design underpinning support system including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria required.
- B. Excavate to accommodate new structures and construction operations.
- C. Notify Engineer and Owner's Representative of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

SECTION 31 23 16

EXCAVATION

- D. Unbraced/unsupported side slopes of excavations deeper than 4 feet shall not be steeper than 2.5 Horizontal to 1 Vertical (2.5H:1V).
- E. Do not interfere with 45 degree bearing splay of foundations.
- F. Hand trim excavations. Remove loose matter.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume. See Section 31 23 16.26 Rock Removal for removal of larger material.
- H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23 Fill.
- I. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- J. Remove excavated material that is unsuitable for re-use from site.
- K. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 2200 Grading.
- L. Remove excess excavated material from site.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

3.05 PROTECTION

- A. Follow all applicable Occupational Safety and Health Administration (OSHA) regulations.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

SECTION 31 23 16.13

TRENCHING AND BACKFILL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Excavation for piped utility material and storm sewers.
- B. Provide necessary sheeting, shoring, and bracing.
- C. Prepare trench bottom with appropriate materials.
- D. Dewater excavation as required.
- E. Place and compact granular beds, as required.
- F. Backfilling.

1.2 RELATED WORK

- A. Section 31 10 00: Site Clearing.
- B. Section 31 00 00: Earthwork.

1.3 PRECAUTIONS

- A. Notify utility companies when necessary to disturb existing facilities and abide by their requirements for repairing and replacing.
- B. Protect all vegetation and other features to remain.
- C. Protect all control points.

PART 2 - PRODUCTS

2.1 BEDDING AND BACKFILL MATERIALS

- A. Stone: Crushed stone, slag, or washed gravel, ASTM D448, Size 6 or 7.
- B. Clean earth (free from organic material, cinders, ice, and rocks over 2 inches in the longest dimension) consisting of silts, silty clays, and clays, including inorganic clays and silts of low to medium plasticity.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install barriers and other devices to protect areas adjacent to construction.
- B. Protect and maintain all bench marks and other survey points.

3.2 EXCAVATION OF TRENCHES

- A. Perform in such a manner as to form a suitable trench in which to place the pipe and so as to cause the least inconvenience to the public.
- B. Maximum width at the crown of the pipe--2 feet plus the nominal diameter of the pipe.
- C. Cut pavement along neat, straight lines with either a pavement breaker or pavement saw.

TRENCHING AND BACKFILL

- D. Trench depth: for waterlines--sufficient to provide minimum cover of 36 inches over the top of the pipe or to the standard of the local utility if greater depth is required; for sewer lines--as shown on the Plans or as specified.
- E. Align trench as shown on the Plans unless realignment is necessary to avoid an unforeseen obstruction. Notify Engineer before realigning.
- F. For water pipe, shape the bottom of the trench to provide uniform bearing of the pipe on undisturbed earth throughout its entire length. Dig bell holes to aid in securing uniform support of the pipe.
- G. For sewer pipe, fill the bottom of the trench with granular material as specified herein.
- H. Where pipelines are below footings, the horizontal distance between footings and pipelines shall be as required to provide a slope not steeper than 1:1 ration between footing bottoms and the trench bottoms at any point.
- I. Where excavations bottoms at required elevations are found to be unstable, or where rock, cinders, rubbish or other deleterious materials are encountered, extend excavations down to firm earth and at least six inches below deleterious materials. Then excavation bottoms shall be brought up to pipe laying elevation by backfilling with suitable material compacted in place. Suitable materials and compaction shall be as specified below. Dispose of excavated unsuitable materials in an approved manner.

3.3 SHEETING, SHORING, AND BRACING

- A. When necessary or when directed by the Engineer, furnish, put in place, and maintain such sheeting, bracing, etc., as may be required to support the sides of the excavation and to prevent movement.
- B. Take care to prevent voids outside the sheeting.
- C. If voids are formed, immediately fill and ram to the satisfaction of the Engineer.
- D. Devise plans for performing this work subject to the approval of the Engineer.
- E. Unless adjacent facilities will be injured, remove all sheeting, shoring, and bracing after backfill has been placed to a depth of 18 inches over the pipeline.

3.4 ROCK EXCAVATION

- A. Wherever used as the name of an excavated material, the term "rock" shall mean any one or more of the following materials which in the Engineer's opinion require for their removal, drilling and blasting, wedging, sledging, or barring, or breaking up with power operated hand tools: boulders, pieces of concrete and pieces of masonry, each weighing more than 250 pounds; and solid ledge rock, concrete, and masonry, each with more than ½ cubic yard of volume.
- B. No measurement or allowance will be made for: soft or disintegrated rock or gravel which can be removed with a hand pick or power operated excavator or shovel; loose, sharpen, or previously blasted rock or broken stone in rock fillings or elsewhere; rock exterior to the limits of measurement allowed which may fall into the excavation; and removal of existing pavement.
- C. Where rock is encountered in pipe trenches, remove all rock from sides of trench to provide at least 6 inches horizontal clearance from the pipe bells on each side, and remove all rock from required sub-grade down to at least 4 inches below the bottom of the pipe bells. Bring trench bottom up to required sub-grade by backfilling with granular pipe embedment material as

TRENCHING AND BACKFILL

specified hereinafter, placed and compacted as required to provide uniform and continuous bearing of pipe barrels at every point between bell holes.

- D. When rock borings or soundings are provided, they are for information only and do not guarantee existing conditions. Make such investigations as deemed necessary to determine existing conditions.

3.5 USE OF EXPLOSIVES

- A. Conduct all blasting operations in accordance with prevailing municipal, state or other agency regulations, codes, ordinances, or laws.
- B. Exercise due caution when blasting adjacent to existing structures and pipelines.
- C. If structures or pipelines are damaged, promptly replace or repair them at no expense to Owner.
- D. Do not conduct blasting operations within 25 feet of water, sewer, gas or other utility lines, unless otherwise directed by the Engineer.
- E. Cover all shots with blasting mats to prevent flying material.

3.6 DISPOSAL OF EXCAVATED MATERIAL

- A. Satisfactorily dispose of all excess excavated material that cannot be used for or is not suitable for embankments.

3.7 UNAUTHORIZED EXCAVATION

- A. Unauthorized Excavation will be defined as an excavation outside or below the proposed lines and grades shown on the Plans or directed by the Engineer.
- B. Backfill areas of Unauthorized Excavation with the type material necessary (earth, rock, or concrete) to insure the stability of the structure of construction involved.

3.8 REMOVAL OF WATER

- A. Keep excavated areas free of water while work is in progress.
- B. Well-pointing shall be performed if required.
- C. Take particular precautions to prevent the displacement of structures or pipelines as a result of accumulated water.

3.9 OBSTRUCTIONS

- A. Obstructions shown on the Plans are for information only and do not guarantee their exact locations nor that other obstructions are not present.
- B. When utilities or obstructions are not shown on the plans but are present off the roadway at the location of the proposed pipeline route, the Contractor may request to relocate the pipeline in the roadway if necessary to avoid disturbing the utility or obstructions.
- C. If the relocation is approved, the Contractor shall receive compensation for additional granular backfill and pavement replacement.
- D. Exercise due care in excavating adjacent to existing obstructions and do not disturb same unless absolutely necessary.

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- E. In the event obstructions are disturbed, repair or replace as quickly as possible to the original condition.
- F. If required by the utility company, pay for the repair or replacement work performed by the forces of the utility company or other appropriate party.
- G. If replacement or repair of disturbed obstructions is not performed after a reasonable period of time, the Owner may have the necessary work done and deduct the cost of same from payments to the Contractor.

3.10 STORM SEWER BEDDING

- A. Construct earth bedding in a trench cut in natural ground or compacted embankment. 1. Bed pipe on 6" of material and sufficient additional material accurately shaped by a template to fit the lower part of the pipe exterior.
- 2. Ram and tamp in layers not over 6", in loose thickness, around the pipe to a minimum depth of 12 inches.
- 3. When bell and spigot pipe is to be placed, dig recesses in the bedding material of sufficient width and depth to accommodate the bell.

3.11 SANITARY SEWER BEDDING

- A. Always maintain proper grade and alignment during the bedding and tamping process. 1. Any pipe dislodged during this process shall be replaced by the Contractor at his expense.
 - 1. Dig bell holes to assure uniform support of the pipe.
- B. Bedding for PVC, VCP, and RCP sewers. 1. Completely encapsulate each sewer pipe section with 6" of granular material on the top, both sides, and the bottom of the pipe.
 - 1. For PVC sewer pipe, use Size 7 stone.
 - 2. Bedding for VCP and RCP sewer pipe may be rounded material where crushed material is not readily available.

3.12 BEDDING FOR WATERLINES

- A. Bed in a trench cut in natural ground.
- B. Dig bell holes to assure uniform support throughout the entire length of pipe.
- C. Excavate the trench in such a manner as to form a suitable bed on which to place the pipe.

3.13 INITIAL BACKFILLING

- A. Do not begin backfilling before the Engineer has inspected the grade and alignment of the pipe, the bedding of the pipe, and the joints between the pipe. If backfill material is placed over the pipe before an inspection is made, reopen the trench in order for an inspection to be made.
- B. Perform backfilling by hand, together with tamping, until fill has progressed to 18" above the top of the pipe.
 - 1. Deposit loose soil free from lumps, clods, frozen material, or stones in layers approximately 6" thick.
 - 2. Compact by hand, or with manually operated machine tampers actuated by compressed air or other suitable means.
 - 3. Use tamps and machines of a suitable type which do not crush or otherwise damage the pipe.

TRENCHING AND BACKFILL

3.14 FINAL BACKFILLING

- A. After the backfill has reached a point 18" or more above the top of the pipe, perform final backfilling depending upon the location of the work and danger from subsequent settlement.
- B. Backfilling in unimproved areas.
 - 1. Dispose of and replace all soft or yielding material which is unsuitable for trench backfilling with suitable material.
 - 2. Deposit backfill to the surface of the ground by dragline, bulldozer, or other suitable equipment in such a manner so as not to disturb the pipe.
 - 3. Neatly round sufficient surplus excavated material over the trench to compensate for after settlement.
 - 4. Dispose of all surplus excavated material.
 - 5. Prior to final acceptance, remove all mounds to the elevation of the surrounding terrain.
- C. Remove all trash and debris from excavations. Place backfill and fill in layers not more than 8 inches in loose depth at optimum moisture content. Compact each layer under structures, building slabs, pavements, and walkways to 95 percent of maximum dry density according to ASTM D698; elsewhere to not less than 90 percent.
- D. Backfilling beneath pavements where non-rigid and rigid type surfacing is to be replaced.
 - 1. Use "Satisfactory Soil" as defined in Earthwork section.
 - 2. Carefully deposit in uniform layers, not to exceed 6" thick.
 - 3. Compact each layer thoroughly by rolling, ramming, and tamping with tools suitable for that purpose in such a manner so as to not disturb the pipe.
- E. Crushed stone for pavement maintenance and shoulder replacement.
 - 1. Where possible, salvage and reuse all base material that is removed during construction.
 - 2. Wet and thoroughly compact crushed stone and blade to tie into the existing surface prior to final acceptance.
- F. Local Inspections 1. Provide for all local inspections.

END OF SECTION

EROSION AND SEDIMENT CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by the Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 02230 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- B. Section 02300 - Earthwork: Temporary and permanent grade changes for erosion control.

1.03 PERFORMANCE REQUIREMENTS

- A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP).
- B. Comply with requirements of State of Mississippi, Mississippi Department of Environmental Quality.
- C. Comply with all requirements of construction plans for erosion and sedimentation control.
- D. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
 - 2. Owner will withhold payment to equivalent to all fines resulting from non-compliance with applicable regulations.
- F. Timing: Put preventive measures in place prior to disturbance of surface cover and before precipitation occurs.
- G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 5 years.
- H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.

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EROSION AND SEDIMENT CONTROLS

3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 1. Prevent windblown soil from leaving the project site.
 2. Prevent tracking of mud onto public roads outside site.
 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- J. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- L. Open Water: Prevent standing water that could become stagnant.
- M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.04 SUBMITTALS

- A. Erosion and Sedimentation Control Plan:
 1. Submit within 2 weeks after Notice to Proceed.
 2. Obtain the approval of the Plan by authorities having jurisdiction.
 3. Obtain the approval of the Plan by the Owner
- B. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.01 MATERIALS

- A. As detailed on the drawings.
- B. Mulch: Use one of the following:
 1. Straw or hay.
 2. Wood waste, chips, or bark.
 3. Erosion control matting or netting.
 4. Cutback asphalt.
- C. Bales: Air dry, rectangular straw bales.
 1. Cross Section: 14 by 18 inches, minimum.
 2. Bindings: Wire or string, around long dimension.

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EROSION AND SEDIMENT CONTROLS

- D. Bale Stakes: One of the following, minimum 3 feet long:
 - 1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.
 - 2. Wood, 2 by 2 inches in cross section.
- E. Silt Fence:
 - 1. Type II material per current edition of the Mississippi Standard Specifications for State Aid Road and Bridge Construction

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 - 1. Width: As required; 20 feet, minimum.
 - 2. Length: 50 feet, minimum.
 - 3. Provide at each construction entrance from public right-of-way.
 - 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers:
 - 1. Provide linear sediment barriers:
 - 2. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - 3. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - 4. Along the toe of cut slopes and fill slopes.
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
 - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet. *As an option, #57 stone can be submitted for the concrete blocks*
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
- H. Temporary Seeding: Use where temporary vegetated cover is required.

EROSION AND SEDIMENT CONTROLS

3.04 INSTALLATION

- A. Traffic-Bearing Aggregate Surface: 1. Excavate minimum of as detailed on the drawings inches.
- B. Silt Fences:
 - 1. Store and handle fabric in accordance with ASTM D 4873.
 - 2. Install with top of fabric at nominal height and embedment indicated on drawings.
 - 3. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 - 4. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- C. Straw Bale Rows:
 - 1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
 - 2. Install bales so that bindings are not in contact with the ground.
 - 3. Embed bales at least 4 inches in the ground.
 - 4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
 - 5. Fill gaps between ends of bales with loose straw wedged tightly.
 - 6. Place soil excavated for trench against bales on the upslope side of the row, compacted.
- D. Mulching:
 - 1. Apply two (2) tons per acre hay mulch.
- E. Temporary Seeding:
 - 1. When hydraulic seeder is used, seedbed preparation is not required.
 - 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 - 3. Use seed mixture appropriate to the time of year seeding is performed. Seed mixture shall be per Section S-214.03 of the current edition of the Mississippi Standard Specifications for State Aid Road and Bridge Construction
 - 4. Apply agricultural lime at a rate of two (2) tons per acre.
 - 5. Apply Ammonium Nitrate at a rate of 0.15 tons per acre
 - 6. Apply commercial fertilizer (13-13-13) at a rate of half (0.5) ton per acre.
 - 7. Incorporate fertilizer into soil before seeding.
 - 8. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep deep.
 - 9. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
 - 10. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. Inspect preventive measures as required by permits, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 - 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 - 2. Remove silt deposits that exceed one-third of the height of the fence.
 - 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

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- D. Straw Bale Rows:
 - 1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
 - 2. Remove silt deposits that exceed one-half of the height of the bales.
 - 3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- E. Clean out temporary sediment control structures as required by permits and relocate soil on site.
- F. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Precision Engineering Corporation.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 31 31 16

TERMITE CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water emulsion chemical treatment of soil under slabs-on-grade, at foundation walls and slab penetrations.

1.2 QUALITY ASSURANCE

- A. Conform to applicable Federal, State, and local environmental regulations.
- B. Applicator: Company with not less than 5 years experience specializing in soil treatment for termite control.

1.3 WARRANTY

- A. Warranty Conditions:
 - 1. Duration: 5 years.
 - 2. State that soil has been treated and treatment, concentration, rate, method and location comply with this Section.
 - 3. When subterranean termite infestation occurs in treated building within warranty period; without additional cost to Owner:
 - a. Retreat soil in substantial conformance with this Section, and;
 - b. Repair damage caused by subterranean termites.

PART 2 – PRODUCTS

2.1 CHEMICALS & CONCENTRATIONS

- A. DemonMax or Baseline Pretreat Termiticide in water emulsion.
- B. Apply the chemical in water emulsion at required concentration

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that soil is in friable condition with moisture content low enough to permit absorption of termiticide solution.
- B. Do not begin work until earthwork for slab placement has been completed.

3.2 APPLICATION, GENERAL

- A. Apply termiticide uniformly at specified rates in accordance with manufacturer's printed instructions.
- B. Increase application rates as required by local authorities to suit soil conditions and as required treatment for Formosan Termites.
- C. Do not apply chemical when soil is frozen, excessively wet or prior to backfilling.

3.3 APPLICATION UNDER SLABS-ON-GRADE

- A. Four gallons per 10 lineal ft. along inside perimeter of exterior foundation walls and along both sides of interior foundation walls.
- B. One gallon per 10 sq. ft. to areas under slabs, pavement, and under walks within 5 feet of building.

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TERMITE CONTROL

- C. Four gallons per 10 lineal ft. of trench, for each foot of depth, grade to footing, along outside edge of building.
- D. Dig trench 6" to 8" wide along outside of foundation to depth of 12" minimum. Punch holes to top of footing at 12" o.c. minimum and apply termiticide. Mix termiticide with soil as it is being replaced.
- E. Four gallons per 10 lineal ft. at expansion joints, control joints, and other areas where slabs will be penetrated.

3.4 PROTECTION OF TREATED SURFACES

- A. Post warning signs in areas of application. Protect treated surfaces from disturbance and person or animal contact.
- B. Reapply termiticide in areas disturbed by subsequent excavation, landscape grading, or other construction activity.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Section 00 7200 - General Requirements.
- B. Section 01 1000 - Summary and Scope of Work.
- C. Section 01 3000 - Administrative Requirements.
- D. Section 31 2200 - Grading: Preparation of site for base course.
- E. Section 31 2323 - Fill: Compacted fill under base course.
- F. Section 31 2316.13 - Trenching: Compacted fill over utility trenches under base course.
- G. Section 31 2323 - Fill: Fill at areas adjacent to aggregate base course.
- H. Section 32 1216 - Asphalt Paving: Binder and finish asphalt courses.
- I. Section 32 1313 - Concrete Paving: Finish concrete surface course.
- J. Section 32 1713 - Parking Bumpers: Concrete bumpers.
- K. Section 33 0513 - Manholes and Structures: Manholes including frames.

1.03 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; American Association of State Highway and Transportation Officials; 1965 (2004).
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010.
- C. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2007.
- E. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand- Cone Method; 2007.
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2009.
- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2010.
- H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.
- I. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- J. Tennessee Department of Transportation (TDOT) Standard Specifications.
- K. Unified Soils Classification System.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Samples: 10 - 50 lb sample of each type of aggregate; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

SECTION 32 11 23

AGGREGATE BASE COURSES

1.05 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When aggregate materials need to be stored on site, locate stockpiles where designated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. See Section 31 2323 Fill.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 4000 Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.
- E. Limerock Base Requirements
 - 1. Type: Use limerock base, subbase, or shoulder course material of uniform quality.
 - a. To ensure uniform quality, the Department may restrict approved sources to specific mining areas, mining processes at a specific mining site, or both.
 - b. Use a limerock base that yields a mixture to meet these Specifications.
 - c. Use material that is crushed or processed as a part of the mining operations, or mix two grades of material so that when combined in the central mix plant the mixture meets the specifications.
 - d. Use limerock base, subbase, or shoulder material that has the following characteristics:

Limerock bearing ratio	At least 100.
Deleterious substances	Do not allow chert or other extremely hard pieces that will not pass the 2 in (50 mm) sieve. Do not allow clay, sand, organics, or other materials in quantities that may damage bonding, finishing, or strength. All material passing the No. 4 (425 µm) sieve shall be nonplastic
Carbonate content (magnesium or calcium)	At least 90%

- 2. Gradation: Grade the limerock base so at least 97 percent by weight passes the 3-1/2 in (90 mm) sieve.
 - a. Grade the material uniformly to dust. The fine portion passing the No. 10 (2 mm) sieve shall all be dust of fracture.
 - b. Crush or break the limerock base, if necessary to meet size requirements before placing the material on the road.
 - c. Ensure that materials having soundness losses of 20% or less, comply with the following gradation requirements:

SECTION 32 11 23

AGGREGATE BASE COURSES

GRADATION REQUIREMENTS

SIEVE SIZE	PERCENT PASSING BY WEIGHT
2" (50 Mmm)	100
1-1/2" (37.5 mm)	97-100
3/4" (19 mm)	60-95
No. 10 (2.00 mm)	24-45
No. 60 (250 µm)	10-30
No. 200 (75 µm)	7-20

3. Acceptance – Test as follows:

Test	Method
Gradation	AASHTO T 27
Limerock bearing ratio	FL DOT Method FM5-515
Petrographic analysis	ASTM C 295
Total carbonates (insoluble residue)	ASTM D 3042

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Spread aggregate over prepared substrate to a total compacted thickness of dimensions indicated. Where not indicated, compacted thickness shall be 6 inches.
- B. Place aggregate in maximum 4 inch layers and roller compact to specified density or as detailed in Tennessee Department of Transportation Standards.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

SECTION 32 11 23

AGGREGATE BASE COURSES

- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From Design Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control inspections and tests, as specified in Section 01 4000.
- B. See Section 31 2323 Fill for testing requirements by independent testing agency.
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade and paving.

3.06 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

FLEXIBLE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work includes sub-grade preparation, aggregate base course(s), prime and tack coats, bituminous concrete base and surface courses, pavement marking and wheel stops.
 - 1. Work includes patching or overlay of existing pavements, if indicated.
- B. Refer to geotechnical report for specific materials to be furnished.
- C. Provide hot-mix asphalt paving according to standard specifications of the local state DOT or other acceptable specifying authority.
- D. The paving contractor shall provide a written guarantee for a period of eighteen (18) months from date of substantial completion, that all new materials and labor furnished and all work performed are in accordance with the contract documents, and any imperfect workmanship and/or materials will be replaced and/or repaired at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix aggregate-asphalt plant mixes complying with the composition, grading, and tolerance requirements of ASTM D3515, and with a history of satisfactory performance in geographical area where Project is located, for the following nominal, maximum aggregate sizes:
 - 1. Base Course: 12.5mm
 - 2. Surface Course: 9.5mm
- B. Prime Coat: ASTM D2027, medium-curing cutback asphalt or asphalt-emulsion prime complying with state DOT requirements.
- C. Tack Coat: ASTM D977, emulsified asphalt or ASTM D2397, cationic-emulsified asphalt, slow setting tack complying with state DOT requirements.
- D. Aggregate Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90 percent passing a 1-1/2 inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Herbicide: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA). Provide granular, liquid, or wet-able powder form.
- F. Pavement-Marking Paint: FS TT-P-115, Type I, or AASHTO M-248, Type N, alkyd-resin type, fast drying, non-bleeding; color to be white or as required by authorities having jurisdiction.
 - 1. Accessible symbols shall be painted blue.
 - 2. Where reflective paints are required, provide glass beads meeting AASHTO M-247.
- G. Wheel Stops: Pre-cast, air-entrained concrete, 2500-psi minimum compressive strength, 6 inches high, 9 inches wide, and 84 inches long.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. The sub-grade in areas to be paved, shall be true to line and grade, free from all loose rock and foreign materials, and shall have a dry and properly prepared surface compacted with a mechanical tamper or proof rolled with heavy loaded pneumatic-tired equipment immediately prior to placing the dense graded aggregate base course. Soft or unstable zones detected thereby shall be undercut to firm soil and backfilled with engineered fill and compacted. The sub-grade for all pavements shall be uniformly stable before aggregate base is installed.

FLEXIBLE PAVEMENT

- B. Establish and maintain required lines and elevations.

3.2 PAVING

- A. Apply prime and tack coats only when ambient temperature is above 50 degrees F, and when temperature has not been below 35 degrees F for 12 hours immediately prior to application. Do not apply when base surface is wet or contains an excess of moisture.
- B. Place asphaltic concrete courses only when atmospheric temperature is above 40 deg. F and rising and when the underlying base surface is dry.
- C. Place aggregate base course in one or more layers, not exceeding 6-inches per layer. Compact to 100 percent of maximum density, ASTM D698.
- D. Prime coat compacted-aggregate base at rate of 0.35 gal. per sq. yd. Apply prime coat material to penetrate and seal, but not flood, surface. Allow to cure and dry as long as necessary to attain penetration and evaporation of volatile, but in no case less than 24 hours.
- E. Tack coat existing asphalt or concrete surfaces at rate of 0.20 gal. per sq. yd. and allow tack coat to cure undisturbed.
- F. Place hot-mix asphalt to required grade, cross-section, and thickness. Promptly correct surface irregularities in paving course.
- G. Compact each hot-mix asphalt course to an average density of 96 percent of reference laboratory density according to ASTM D1188, within thickness and surface tolerances recommended in AI's "The Asphalt Handbook."
1. Compact each asphaltic concrete paving course with self-propelled rolling equipment. Start compaction as soon as paving will bear equipment without checking or undue displacement.
 2. Carry out compaction in three operations (breakdown or initial rolling, second rolling and finish rolling) in pass sequence to produce smooth surfaces of uniform texture, free from depressions ("bird baths") and roller marks.
 3. Compact with hand tampers in areas not accessible to rolling equipment.
- H. Remove and restore paved areas that are defective or contaminated. Do not allow vehicular traffic on newly paved areas until surface has cooled to atmospheric temperature.
- I. Apply pavement-marking paint with mechanical equipment to a minimum wet film thickness of 15 mils. Allow new asphalt pavements to age at least 14 days prior to marking.
1. For reflective paints, broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal.
- J. Securely attach wheel stops into pavement with two (2) driven, galvanized steel dowels.

3.3 PAVING TOLERANCES

- A. Elevation: Plus or minus 1/2 inch of required elevations except that no difference in elevation will be permitted at joints with other surfaces intended to be at same elevation as asphaltic concrete paving.
- B. Thicknesses indicated are minimum in-place compacted thicknesses for each base and paving course.
- C. Surface Smoothness: Within 3/16 inches deviation when checked with 10 foot straightedge.

3.4 PAVEMENT SECTION (GENERAL NOTE)

- A. Pavement sections as indicated in construction drawings are for illustrated purposes only. These sections are provided only as a design tool for the civil engineer and shall be modified as required based upon a site specific Geotechnical Report for the required application.

END OF SECTION

SECTION 32 12 16

FLEXIBLE PAVEMENT

SECTION 32 13 00

RIGID PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work includes concrete pavements, curbs, combination curb and gutter, and surface finishes.
- B. Submit design mixes for concrete.
- C. Comply with ACI 301, "Specification for Structural Concrete."
- D. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- E. Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
 - 1. Producer shall be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- F. Testing Agency Qualifications: An independent testing agency, acceptable to Owner to conduct the testing indicated.
 - 1. The owner shall engage a qualified independent testing agency to perform material evaluation tests.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Formwork: 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 curves of a radius 100 feet or less.
- B. Deformed Reinforcing Bars: ASTM A615, Grade 60, reasonably free of rust.
- C. Welded Steel Wire Fabric: ASTM A185, flat sheets; not rolls.
- D. Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
 - 1. Air-Entraining Admixture: ASTM C260.
 - 2. Chemical Admixtures: ASTM C494. Calcium chloride shall not be used.
- E. Liquid Membrane-Forming Curing Compound: ASTM C 309, clear, Type I, Class B, waterborne (VOC compliant).
- F. Hardener - Sealer: Sonneborn "Lapidolith" or approved equal.
- G. Pavement-Marking Paint: FS TT-P-115, Type I, or AASHTO M-248, Type N, alkyd-resin type fast drying, non-bleeding; color to be white or as required by authorities having jurisdiction. Contractor shall verify with local, state and federal requirements for handicap blue paint striping requirements as required for accessible markings on site.
- H. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 6 inches high, 9 inches wide, and 84 inches long.
- I. Aggregate Base: Dense graded crushed stone conforming to current MDOT Specifications Section 703, compacted to 98% maximum density according to ASTM D698.
- J. Contraction and Isolation Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752, cork or self-expanding cork.
- K. Integral Colorant: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

SECTION 32 13 00

RIGID PAVEMENT

2.2 MIXES

- A. Proportion normal-weight concrete mixes to provide the following properties:
 - 1. Compressive Strength: 4000 psi at 28 days.
 - 2. Portland Cement: ASTM C150
 - 3. Aggregate: ASTM C33; 3/4-inch maximum size.
 - 4. Water: Potable.
 - a) Slump Limit: maximum of 5 inches at point of placement.
 - b) W/C Ratio: 0.45 maximum at point of placement.
 - c) Air Content: 5.5 to 7.0 percent.
- B. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- C. Add coloring agent, per manufacturer's recommendations, where integrally colored concrete is indicated

PART 3 – EXECUTION

- A. 3.1 PREPARATION
- B. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Soft or unstable zones detected thereby shall be undercut to
- C. firm soil and backfilled with engineered fill and compacted. The subgrade for all pavements shall be uniformly stable before aggregate base is installed.
- D. Remove loose material from compacted subbase surface immediately before placing aggregate base course.
- E. Place aggregate base course in one or more layers, not exceeding 6-inches per layer. Compact to 98 percent of maximum density, ASTM D698.
- F. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

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. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

3.3 PAVING

- A. Accurately position and support reinforcement, and secure against displacement.
- B. Locate and install contraction, construction, isolation, and expansion joints as indicated.
- C. Place concrete in a continuous operation within planned joints or sections. Do not add water to adjust slump once discharge of truck has started.
- D. The maximum concrete temperature shall be 90oF. Concrete with a temperature more than the maximum allowable temperature shall be rejected.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

RIGID PAVEMENT

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. 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 mix designs.
- F. F Hot-Weather Placement: Place concrete according to recommendations in ACI 305R 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 to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
- G. Float surfaces to true planes within a tolerance of 1/4 inch in 10 feet (1:480). Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
1. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the 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.
 2. Broom Finish: After the concrete has been placed, the surface shall be brought to the established grade with a straight edge and bull floated to "smooth out" the surface. When the water sheen has disappeared, surface shall be floated with power and/or wood floats, and surface shall be broomed with fine hair broom perpendicular to line of traffic to achieve a surface texture approved by the Owner's representative.
 3. Rubbed Finish: After removal of forms the rubbing of concrete shall be started as soon as its condition will permit. The initial rub shall be completed within 48 hours of form removal. Immediately before starting this work the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using water but no mortar on its face. Rubbing shall be continued until all form marks, projections, and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place. After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color. Surface shall be left free from all unsound patches, paste and objectionable marks.
- H. Tool edges and joints to a radius of 3/8 inch unless otherwise detailed.

SECTION 32 13 00

RIGID PAVEMENT

- I. Unless otherwise indicated, provide control joints in concrete slabs at 10-feet on center each way. Provide joint filler material at isolation joints and all formed contraction joints.
 - 1. Concrete curbs shall have formed contraction joints provided at 10-feet on center.
- J. Begin curing after finishing concrete. Keep concrete continuously moist for at least 7 days. Apply membrane-forming curing compound to concrete where indicated or scheduled.
 - 1. Exterior, exposed, non-vehicle slabs shall receive a liquid hardener - sealer.
- K. Apply traffic paint with mechanical equipment to a minimum wet film thickness of 15 mils.
- L. Remove and replace concrete paving that is broken, damaged, or defective. Exclude traffic from paving for at least 14 days.
- M. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in drilled holes concrete pavements. Firmly bond each dowel to wheel stop and to pavement with grout.

3.4 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Industry standard FF & FS.
 - 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 - 5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
 - 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
- B. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge. Length of dowel X 1/4 inch per 12 inches.
 - 1. Joint Spacing: 3 inches.
 - 2. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 3. Joint Width: Plus 1/8 inch, no minus.

3.5 TESTING

- A. Frequency: A composite sample shall be taken once every 100 cubic yards or fraction thereof.
- B. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
- C. Air Content: ASTM C231, pressure method, for normal-weight concrete; ASTM C173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
- D. Temperature: ASTM C1064, test the temperature of fresh concrete for each composite sample.
- E. Compression Test Specimens: ASTM C31; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
- F. Compressive-Strength Tests: ASTM C39; test one laboratory-cured specimen at 7 days, two at 28 days and one hold cylinder. Report results of tests to Owner within 48 hours.
 - 1. Test one laboratory specimens at 7 days and two at 28 days.
 - 2. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
 - 3. Project Manager shall be provided a copy of all test reports.

END OF SECTION

SECTION 32 16 00

RIGID PAVEMENT

PART 1 GENERAL

1.1 SCOPE

- A. Work under this section shall consist of constructing Portland cement concrete sidewalk on a prepared subgrade in accordance with the Contract Drawings and these specifications. Lines and grades shall be as shown on the plans or established. "Subgrade" in this section shall mean the prepared foundation on which the sidewalk is constructed.
- B. Work under this section shall also consist of furnishing and installing detectable warning "panels" in concrete sidewalk on all curb-cut ramps as shown on the Contract Drawings.
- C. Submit design mixes for concrete.
- D. Comply with ACI 301, "Specification for Structural Concrete."
- E. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- F. Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
 - 1. Producer shall be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- G. Testing Agency Qualifications: Owner will engage a qualified testing agency to perform test and inspections.
 - 1. Additional testing and inspection, at contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

1.2 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F. or surface is wet or frozen.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Formwork: 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 curves of a radius 100 feet or less.
- B. Welded Steel Wire Fabric: ASTM A185, flat sheets; not rolls.
- C. Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
 - 1. Air-Entraining Admixture: ASTM C260.
 - 2. Chemical Admixtures: ASTM C494. Calcium chloride shall not be used.
- D. Liquid Membrane-Forming Curing Compound: ASTM C309, clear, Type I, Class B, waterborne (VOC compliant).
- E. Hardener - Sealer: Sonneborn "Lapidolith" or approved equal.
- F. Aggregate Base: Dense graded crushed stone conforming to current MDOT Specifications Section 703, compacted to 98% maximum density according to ASTM D698.
- G. Contraction and Isolation Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752, cork or self-expanding cork.
- H. Integral Colorant: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

SECTION 32 16 00

RIGID PAVEMENT

2.2 CONCRETE MATERIALS

- I. Concrete Materials: As specified in Section 03 30 00.
- J. ACCESSORIES
 - 1. Curing Compound: ASTM C308, Type 1, Class A
- K. CONCRETE MIX
 - 1. Mix and deliver concrete in accordance with ASTM C94, Alternative No. 2. Select proportions for normal weight concrete in accordance with ACI 301 Method 1 or Method 2.
 - 2. The Contractor's concrete supplier shall submit to the Engineer a copy of a concrete mix design. Proportion normal-weight concrete mixes to provide the following properties:
 - a. Compressive Strength: 3500 psi at 28 days.
 - b. Portland Cement: ASTM C150
 - c. Aggregate: ASTM C33; 3/4-inch maximum size crushed limestone or #8 pea gravel.
 - d. Water: Potable.
 - e. Slump Limit: maximum of 5 inches at point of placement.
 - f. W/C Ratio: 0.45 maximum at point of placement.
 - g. Air Content: 6.0 percent \pm 1.5.
 - 1. Use accelerating or retarding admixtures only when approved by Architect/Engineer. Use of admixtures will not relax cold or hot weather placement requirements.
 - 2. Do not use calcium chloride.
- L. Add coloring agent, per manufacturer's recommendations, where integrally colored concrete is indicated.

2.3 DETECTABLE WARNING PANELS

- A. The detectable warning panels shall be In-line Dome Paver Tile by ADA Solutions, Inc., or an approved equal. The size shall be as shown on the Contract Drawings. The panels shall be made of a color impregnated composite which is colorfast and UV stable. It shall also meet the following:

Characteristic Requirement Test Method
Compressive Strength 23,800 psi ASTM D 695
Flexural Strength 24,600 psi ASTM D 790
Tensile Strength 12,100 psi ASTM D 638
Water Absorption 0.13% - 2 weeks ASTM D 570
Slip Resistance Exceeds 0.80 wet/dry ASTM C 1028
Flame Spread Index 15 ASTM E 84
Smoke Developed 145 ASTM E 84
Salt Spray No Change (120 hours) ASTM B 117
Chemical/Stain Resistance No Deterioration ASTM D 1308
Accelerated Weathering No Change (3,000 hours) ASTM G 26
Abrasion Resistance 564 ASTM C 501
Rockwell Hardness 122 ASTM D 785
Freeze/Thaw/Heat No Disintegration ASTM C 1026

PART 3 CONSTRUCTION REQUIREMENTS

3.1 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads. Verify gradients and elevations of base are correct.

3.2 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete. Coat surfaces of manholes and catch basin frames with oil to prevent bond with concrete pavement. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.

SECTION 32 16 00

RIGID PAVEMENT

3.3 FORMING

- A. Place and secure forms to correct location dimension and profile. Assemble formwork to permit easy stripping and dismantling without damaging concrete. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.
- B. The Contractor may use forms or, if requested in writing and approved by the Engineer, an approved automatic extrusion type paving machine. Forms shall be wood or metal. If wood forms are used, they shall be straight and level on top. If metal, they shall be of approved section and have a flat surface on top. The depth of the forms shall be equal to the depth of the sidewalk or driveway. Adequate means shall be provided for securely fastening the ends of forms together.
- C. Prior to use, an automatic extrusion machine must be demonstrated to produce a consolidated concrete section conforming to the dimensions, cross section, line, and grades shown on the Contract Drawings or established.

3.4 EXCAVATION AND GRADE PREPARATION

- A. Excavation shall be made to the required depth and to a width that will permit the installation and bracing of forms. The foundation shall be shaped and compacted at the proper moisture content to a firm even surface conforming to the lines, grades, and sections shown on the Contract Drawings or established. All soft, spongy, or other unsuitable materials encountered shall be removed and replaced with acceptable material.

3.5 SETTING FORMS

- A. Forms shall be set to the required line and grade and rigidly held in place by stakes or braces. Ends of adjoining form sections shall be flush. Forms and division plates shall be cleaned and oiled before placing concrete against them.

3.6 PLACING CONCRETE

- A. The subgrade shall be moist and free of debris and foreign material before concrete is deposited upon it. The concrete mixture shall be placed on the prepared subgrade to the depth required to complete the sidewalk or driveway in one course. It shall then be vibrated and/or tamped and struck off with an approved straightedge resting upon the side forms and drawn forward with a sawing motion.
- B. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- C. After the concrete has been deposited in place, it shall be consolidated and the surface shall be struck off by means of a strike board and floated with a wooden or cork float. An edging tool shall be used on edges and expansion joints. The surface shall not vary more than 1/8 inch under a 10-foot straightedge. The surface shall have a granular or matte texture, which will not be slick when wet.
- D. The edges of sidewalk shall be rounded with an edging tool having a radius of 1/2 inch.
- E. Control joints shall be edged with an edger having a radius of 1/4 inch.

3.7 COLD WEATHER CONCRETING

- A. No Portland cement concrete, mortar, or grout shall be placed when the atmospheric temperature is below 35°F without written permission of the Engineer. If the Contractor proposed to place concrete during seasons when there is a probability of temperatures lower than 40°F, he shall have available on the project approved facilities necessary to enclose the

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concrete and to keep the temperature of the air inside the enclosure within the range of 50°F - 100°F for at least four days after placement.

- B. The Contractor shall assume all risk and added cost connected with the placing and protecting of concrete during cold weather. Permission given by the Engineer to place concrete during such time will in no way relieve the Contractor of responsibility for unsatisfactory results. Concrete placed during this time that is deemed unsatisfactory shall be removed and replaced at the Contractor's expense.

3.8 HOT WEATHER CONCRETING

- A. The manufacture, placement, and protection of concrete during hot weather requires special attention to ensure that uniform slump ranges and satisfactory placement qualities are maintained, that surface cracking is held to a minimum, and that design strengths are produced.
- B. During periods of hot weather or arid atmospheric conditions, the Contractor shall use such controls, as deemed necessary by the Engineer, to produce and place concrete going into the forms which will not exceed 90°F.
- C. In order to minimize the number and extent of precautions required for hot weather concreting, the Contractor may use, when approved by Engineer, chemical admixtures for set-retarding purposes. The furnishing and use of additives or admixtures and the other precautions necessary to provide satisfactory concrete shall be considered subsidiary to the furnishing and placement of the concrete, and all additional costs related thereto and risks resulting there from shall be borne by the Contractor.

3.9 JOINTS

- A. Construction joints shall be of the dimensions specified and shall be filled with the type of premolded expansion joint filler specified. Sidewalks shall be divided into sections by control joints formed by a jointing tool or other acceptable means. These control joints shall extend into the concrete for at least one inch and shall be approximately 1/8 inch wide. Joints shall match as nearly as possible adjacent joints in curb or pavements. Control joints may be sawed in lieu of forming with a jointing tool.
- B. Isolation joints shall be formed around all appurtenances such as manholes, utility poles, etc. extending into and through the sidewalk. Premolded expansion joint filler ¼ inch thick shall be installed in these joints. Expansion joint filler of the thickness indicated shall be installed between concrete sidewalks and fixed structure such as a building or bridge. This isolation joint material shall extend for the full depth of the walk.

3.10 FINISHING

- A. Broom Finish: After the concrete has been placed, the surface shall be brought to the established grade with a straight edge and bull floated to "smooth out" the surface. When the water sheen has disappeared, surface shall be floated with power and/or wood floats, and surface shall be broomed with fine hair broom perpendicular to line of traffic to achieve a surface texture approved by the Owner's representative.

3.11 PROTECTION AND CURING

- A. Concrete surfaces shall be protected from premature drying by covering as soon as possible with satisfactory curing material. The Contractor may use wetted burlap or curing compound. Curing by wetted burlap shall continue for a period of seven days after placement of concrete. If curing compound is used, it shall be placed in two applications. The first shall be immediately after finishing. The concrete shall be thoroughly wetted with water and the curing compound

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applied just as the surface film of water disappears. The second application of curing compound shall be applied after the first application has set.

- B. Any cracking in the concrete due to improper curing shall be removed and replaced at the Contractor's expense.

3.12 BACKFILLING AND CLEANING UP

- A. When the concrete has set sufficiently, all forms, bracing, etc., shall be removed and the sides of the walk or driveway shall be backfilled and compacted to the required elevation with
- B. suitable material. All surplus material shall be disposed of as directed, and the completed work and the site shall be left in a neat and presentable condition.

3.13 FIELD QUALITY CONTROL

- A. Three concrete test cylinders will be taken for every 50 or less cu yds or each class of concrete placed each day or at the engineer's discretion.
- B. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents.
 - 1. One slump test will be taken for each set of test cylinders taken.
 - 2. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

END OF SECTION