Anchor Bay Schools

Anchor Bay High School
Boiler Replacement

2021-013

02-23-2021

specifications manual

specifications manual
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specifications manual

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FILE TRANSFER AGREEMENT

PROJECT: **Anchor Bay Schools**
Anchor Bay High School Boiler Replacement
February 2021

FIRM:

TYPE OF WORK:

AGREEMENT FOR THE TRANSFER OF INSTRUMENTS OF SERVICE

As per your request, and upon approval by our client, we will provide electronic files for your convenience and use in preparing for your specific work related to the above referenced project, subject to the following terms and conditions:

Hard Copy Instruments
These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by us and the electronic files, the signed or sealed hard-copy construction documents shall govern. You are responsible for determining if any conflicts exist. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.

Electronic Data Transfer
Our electronic files are compatible with: *AutoCAD 2018.* We make no representation as to the compatibility of these files with your hardware or your software beyond the specified release of the referenced specifications. Other software programs may have been used in the development of the drawings and design of the project. French Associates, Inc. (FA) will not release any of this associated software for use with the electronic files.

Because information presented on the electronic files can be modified, unintentionally or otherwise, we reserve the right to remove all indicia of ownership and / or involvement from each electronic display.

Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving these data through or from you for any purpose other than as a convenience in preparing your work for the above referenced project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to us. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents or sub-consultants that may arise out of or in connection with your use of the electronic files.

Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files.

Computer Viruses
Computer viruses are a real and serious threat to all computer users. FA takes steps to detect and eliminate computer viruses from our system and the diskettes that are made available to our clients and colleagues. Since computer viruses can attach at any time, FA strongly urges its clients and colleagues to back-up their important data frequently and to take steps to detect viruses from any files that we make available. Even though FA takes prudent steps to prevent the attachment of computer viruses to its electronic media, we cannot guarantee this.

FILE TRANSFER AGREEMENT

If an electronic file is requested and provided by FA, it is specifically understood and agreed that use of electronic media provided by FA is done so at the sole risk of the user and the user is responsible for testing for and eliminating computer viruses from any files provided by FA.

Service Fee
A service fee of $200 **per building** shall be remitted to us prior to delivery of the electronic files.

This file transfer agreement applies to Architectural drawings only. Structural, electrical, mechanical, civil and landscape drawings are the property of our consultants. Arrangements to obtain electronic files of these drawings must be made with them. French Associates makes no commitment that our consultants will make these files available.

Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by us, and we make no warranties, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall we be liable for any loss of profit or any consequential damages as a result of your use or reuse of these electronic files.

Architect:
French Associates, Inc.

_____
Signature

_____
Print Name

_____
Title

Date: _____

Agreed by:
(signing below indicates that we have read and agree to both pages of this agreement)

_____
Signature

_____
Print Name

_____
Title

Date: _____

SECTION 01 0400 - COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:

1. Generals project coordination procedures.
2. Administrative and supervisory personnel.
3. Coordination Drawings.
4. General installation provisions.
5. Cleaning and protection.
6. Coordination program.

B. Related Section: The following Sections contain requirements that relate to this Section:

1. Division 01 6000 Section “Product Requirements” for coordinating materials and equipment for general installation.
2. Division 01 7300 Section “Execution Requirements” for Layout and Measurements, specifies procedures for field engineering services, including establishment of benchmarks and control points.

1.3 COORDINATION

A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend upon each other for proper installation, connection, and operation.

1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
3. Make adequate provisions to accommodate items schedule for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.
2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project closeout activities.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare coordination drawings for above ceiling work, equipment rooms and other areas where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the relationship of components on separate Shop Drawings.
2. Indicate required installation sequence.

B. Staff Names: Within fifteen (15) calendar days of "Notice to Proceed," submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities. List their addresses and telephone numbers.

1. Post copies of the list in the Project meeting room, the temporary field office, and each temporary telephone.

C. Other Project names, addresses and information:

1. Lists of sub-contractors and erectors.
2. List of suppliers and manufacturers.

PART 2 – PRODUCTS (Not applicable)

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require the Installer of each component to inspect both the substrate and conditions under which Work is to be performed. Proceed when unsatisfactory conditions have been corrected.

B. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction.

3.2 COORDINATION PROGRAM

A. It shall be the responsibility of the Construction Manager/General Contractor to coordinate the equipment room requirements and the above ceiling space requirements of the various subcontractors and to determine that adequate clearance is allowed with respect to their equipment and the building.

B. The Coordination Program shall consist of a series of meetings with all trades involved and the preparation of installation drawings prepared from base drawings produced by the Sheet Metal Subcontractor. The Mechanical, Electrical and Fire Protection Subcontractors shall use the base drawings for producing their individual installation drawing overlays for coordination with other trades.

C. The following sequence shall be followed:

1. After the award of contract and prior to construction the Construction Manager/General Contractor will schedule a meeting to introduce the Coordination Program and determine its implication to the progress schedule. Attendees shall include the Construction Manager/General Contractor, Owner's Representative, Architect/Engineer and all subcontractors responsible for work in equipment rooms and in or above the ceilings which includes (but is not limited to) those items below:

    a. Recessed lighting fixtures.
    b. Plumbing waste, vent and roof drainage.
    c. Steam, condensate and all other pitched services.
    d. Ductwork and appurtenances.
    e. Fire protection (sprinkler system).
    f. HVAC piping.
    g. Plumbing, supply and service piping.
    h. Cable tray.
    i. Electrical conduit.

        (1) The above list, in descending order, is the precedence for space priority. Recessed light fixtures and space for their installation have first priority, plumbing waste, vent and roof drainage has second priority, etc.

2. The Construction Manager/General Contractor shall confirm that the following have been provided to the Sheet Metal Subcontractor prior to commencing the base drawings:

    a. Approved structural steel drawings.
    b. Clearance requirements for plumbing, piping, etc. from the Mechanical Subcontractor.
    c. Clearance requirements for recessed lighting, cable trays, etc. from the Electrical Subcontractor.
    d. Clearance requirements for piping from the Fire Protection Subcontractor.

3. The Sheet Metal Subcontractor shall prepare and provide the Mechanical, Electrical and Fire Protection Subcontractors with reproducible transparent drawings which shall serve as the base drawings. The base drawings shall show column center lines, interior partition locations, and ceiling heights.

4. The Sheet Metal Subcontractor, with reference and consideration to the structural, mechanical, electrical, fire protection, and plumbing requirements provided and the reflected ceiling plans, shall draw, to scale (minimum ¼" scale), the proposed ductwork installation showing duct sizes, equipment layouts, and dimensions from column lines and distance from finished floors to bottom of ducts and equipment. In congested areas, the Sheet Metal Subcontractor shall, in addition, prepare drawings in Section view.

5. The base drawings with ductwork layouts shall be produced in sequence as mandated by the project schedule. The earliest area indicated in the schedule will receive the first effort, etc.

6. When the base drawings for the earliest scheduled area have been completed (time limitation as determined in the initial coordination meeting), the Sheet Metal Subcontractor shall provide the Construction Manager/General Contractor with one set of mylars for each participant in the effort. Upon receipt of the base drawings from the Construction Manager/General Contractor each participant shall incorporate on the drawings, their proposed installation. Each of the subcontractors proposed installation drawings shall indicate to scale, size, equipment layout, equipment clearance requirements, dimensions from column centerlines and distance from the finish floor to bottom of equipment, piping, conduits, etc. The Contract Drawings shall be followed as a general guide for the proposed installation drawings.

7. The major components to be indicated include (but are not limited to):

    a. Roof drain leaders.
    b. Waste and vent piping.
    c. Fire protection piping.
    d. Plumbing and lab service piping.
    e. HVAC and Mechanical ductwork routing.
    f. Electrical conduit and Cable tray runs.
    g. Contract ceiling heights and Soffit locations.
    h. Access points for access to valves and Dampers.
    i. Firewall penetrations.

8. Prior to fabrication of ductwork and within a period of not to exceed two (2) calendar weeks after distribution of the mylars to the individual participants, the Construction Manager/General Contractor will schedule a meeting with the Owner's Representative, the Architect/Engineers and participating Subcontractors at which time areas of conflict shall be resolved through the following process:

    a. The transparent tracings shall be overlaid on a light table to identify areas of conflict. All parties shall then cooperate in resolving the conflicts.

    b. The Owner's Representative and the Architect/Engineer reserve the right to determine space priority of the Subcontractors in the event of interference between piping, conduits, ducts and equipment of the various Subcontractors.

    c. Records of the areas of conflict and the names of the subcontractor who is to make modifications to their drawings shall be kept by the Construction Manager/General Contractor. This record shall be updated on a weekly basis and shall be incorporated into the coordination meeting minutes.

    d. Once all areas of conflict are resolved, each participant shall revise their drawings and shall submit for review. After review, ductwork can be fabricated, and installation of work can begin. A permanent record of the agreement shall be entered on each Subcontractors' installation drawings, acknowledged by all participants' by signature in a space provided for this purpose. The Construction Manager/General Contractor shall provide and distribute two graphic copies of each subcontractor's signed installation drawings to all parties involved. Revisions of drawings as a result of the coordination process shall not be considered an extra and will not result in a change to the contract.

    e. The above drawings, review and coordination process will be repeated until all areas on the Project have been coordinated.

9. Shop drawings shall be modified through the coordination process to reflect the final resolved locations of equipment prior to submittal for review.

10. In the event a Subcontractor fails to cooperate in the Coordination Program, he shall be held responsible for all costs incurred for adjustments to the work of others made necessary to accommodate the uncooperative Subcontractor's installations.
11. When a Change Order request is issued, the affected Subcontractors shall review the Coordination Drawings and bring to the attention of the Construction Manager/General Contractor any revisions necessary to the work of others affected by the Change Order.

D. At the completion of the project, each subcontractor shall provide the Construction Manager/General Contractor with a reproducible transparent drawing of the installation drawings to be forwarded to the Owner.

3.3 CLEANING AND PROTECTION

A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Radiation.
11. Puncture.
12. Abrasion.
13. Heavy traffic.
14. Soiling, staining and corrosion.
15. Bacteria.
16. Rodent and insect infestation.
17. Electrical current.
18. Improper lubrication.
19. Unusual wear or other misuse.
20. Contact between incompatible materials.
21. Misalignment.
22. Excessive weathering.
23. Unprotected storage.
24. Improper shipping or handling.
25. Theft.
26. Vandalism.

END OF SECTION 01 0400

SECTION 01 2300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates as proposed by the Architect.

1. Voluntary Alternates or Substitutions proposed by Bidders will not form the Base Bid Proposal Price.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

B. Voluntary Alternates: Bidders proposed voluntary alternates and substitutions will not be recognized as part of the Base Bid Price opening. Owner may review voluntary proposals with the successful Bidder.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - EXECUTION

2.1 SCHEDULE OF ALTERNATES

A. Alternate M1:

1. Description of Alternate: Add the removal and replacement of the main heating hot water pumps P-1 and P-2, including piping specialties, VFDs, electrical work associated with the pumps.
2. References: Mechanical and Electrical Drawings.
3. Price: ADD/SUBTRACT_____Dollars $ _____

B. Alternate M2:

1. Description of Alternate: Add the removal and replacement of domestic hot water heater DWH-6, including flue, misc. piping accessories and associated electrical work.
2. References: Mechanical and Electrical Drawings.
3. Price: ADD/SUBTRACT _____Dollars $ _____

END OF SECTION 01 2300

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

1. Shop drawings and Samples
2. Product data submittal procedures.
3. Shop Drawing and Samples Transmittal Form.
4. Contract Close-out Deliverables Form.

B. Related Sections include the following:
1. Divisions 02 0000 through 33 0000 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals (Shop Drawings, Samples, Product Data, Catalog Cuts, etc.): Written and graphic information that requires Architect's **and Construction Manager's** responsive action.

B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings may be provided at Architect’s discretion and at extra cost to Contractor for use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

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 submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. **Architect reserves** the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on **Architect's** receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow twenty (20) calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. **Architect** will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow eighteen (18) calendar days for review of each resubmittal.
3. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow twenty (20) calendar days for initial review of each submittal.
4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow twenty (20) calendar days for review of each submittal.

D. Shop Drawing Submittal Procedures: The procedures and quantity of drawings, catalog cuts, samples and other information for submittal are minimum. The Contractor and Architect will finalize format at the Project Kick-Off Meeting.

1. Contractor to Construction Manager and then to Architect
   a. All submittals shall be sent as pdf files via email.
   b. Each submittal shall include one pdf that includes the Submittal Transmittal as provided in this specification (completely filled out) and all other 8.5 x 11 documents as a single pdf file.
   c. Submittal documents that are not 8.5 x 11 shall be submitted as a separate pdf file for each size documents. For instance, 24" x 36" sheets shall be sent as a separate pdf. Always include the separate pdf file with the filled out transmittal with each submittal pdf.
2. Architect to CM to Contractor
   a. A pdf file of each reviewed submittal will be sent via email.

E. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 4 x 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:

   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Name and email address of subcontractor.
   f. Name and email address of supplier.
   g. Name and website address of manufacturer.
   h. Contractors Submittal number
   i. Number and title of appropriate Specification Section.
   j. Drawing number and detail references, as appropriate.
   k. Other necessary identification.

F. Deviations: **Highlight and encircle**, or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Transmittal: Package each submittal item individually and appropriately for transmittal and handling. Do not group submittals related to different specification sections. Transmit each submittal using the official transmittal form. Architect received submittals from sources other than General Contractor will be discarded without review.

1. Transmittal Form: Use **submittal form included at the end of Specification.**
2. Form:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Specification Section number and title.
i. Drawing number and detail references, as appropriate.
j. Transmittal number**, numbered consecutively**.
k. Submittal and transmittal distribution record.
l. Remarks.
m. Signature of transmitter.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2 Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with Architect's "REVIEWED FOR CONSTRUCTION" or Architect's "REVIEWED AS NOTED" stamp

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Use only final submittals with mark indicating Architect's "REVIEWED FOR CONSTRUCTION" or "REVIEWED AS NOTED" stamp and Construction Manager's or General Contractor's release for construction stamp.

1. DO NOT USE Shop Drawings noted "XRR = RETURNED FOR CORRECTIONS" for construction or fabrication.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Submit electronic submittals directly to extranet specifically established for Project.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's written recommendations.
    b. Manufacturer's product specifications.
    c. Manufacturer's installation instructions.
    d. Standard color charts.
    e. Manufacturer's catalog cuts.
    f. Wiring diagrams showing factory-installed wiring.
    g. Printed performance curves.
    h. Operational range diagrams.
    i. Mill reports.
    j. Standard product operating and maintenance manuals.
    k. Compliance with specified referenced standards.
    l. Testing by recognized testing agency.
    m. Application of testing agency labels and seals.
    n. Notation of coordination requirements.

4. Submit Product Data concurrent with Samples.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Dimensions.
    b. Identification of products.
    c. Fabrication and installation drawings.
    d. Roughing-in and setting diagrams.
    e. Wiring diagrams showing field-installed wiring, power, signal, and control wiring.
    f. Shop work manufacturing instructions.
    g. Templates and patterns.
    h. Schedules.
    i. Design calculations.
    j. Compliance with specified standards.
    k. Notation of coordination requirements.
    l. Notation of dimensions established by field measurement.
    m. Relationship to adjoining construction clearly indicated.
    n. Seal and signature of professional engineer if specified.
    o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 24 by 36 inches (750 by 1000 mm).

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    p. Generic description of Sample.

q. Product name and name of manufacturer.
r. Sample source.
s. Number and title of appropriate Specification Section.

2. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

3. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one (1) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, **through Construction Manager**, will return submittal with options selected.

4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit number of samples as indicated in Part 1.4 "Submittal Procedures".

1. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Room name, room number, space and location.

F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.

G. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

H. Application for Payment: Comply with requirements specified in Division 01 Section “Payment Procedures.”

J. Schedule of Values: Comply with requirements specified in Division 01 Section “Payment Procedures.”

K. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Number of Copies: Submit two (2) copies of subcontractor list, unless otherwise indicated.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two (2) copies of each submittal, unless otherwise indicated. Architect will not return copies.
2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements in Division 01 4000 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 01 3100 Section “Project Management and Coordination.”

C. Contractor's Construction Schedule: Comply with requirements in Division 01 3200 Section "Construction Progress Documentation."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 4000 Section "Quality Requirements."

N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 7700 Section "Closeout Procedures" for Operation and Maintenance Data."

R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product

or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles and term of the coverage.

V. Material Safety Data Sheets (MSDSs): Submit information directly to Construction Manager; do not submit to Architect, **except as required in "Action Submittals´ Article**."

1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.3 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three (3) copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with Contractor's review approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

A. General: Architect will not review submittals that do not bear Construction Manager's or General Contractor's review approval stamp and will return them without action.

B. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action to be taken.

C. Informational Submittals: Architect will review each submittal and will return it to the Construction Manager or General Contractor with review comments for their review.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

3.3 ARCHITECT'S FORMS

A. Shop Drawings and Samples Transmittal form, attached at end of Section.

B. Contract Close-out Deliverables form, attached at end of Section.

END OF SECTION 01 3300

SHOP DRAWING AND SAMPLES TRANSMITTAL

FRENCH associates
architects planners interiors

FA Submittal No.

Consultant Submittal No.

Project Name:	Architect's Project No.:	Submittal Date: Resubmittal	Contr. Submittal No. Refer. Submittal No.
CM / Contr. Name: CM / Contr. Address:	Contr. Proj. No.	Sub-Contr, Supplier, Etc. Name: Sub-Contr, Supplier, Etc. Submittal No:	

Spec Section (not Bid Ctgy.)	No. of Prints	No. of Tracing	No. of Cat/etc.	No. of Sample	Sub-Contractor, Suppler, Manufacturer, Misc.	* List Each * Draw ing No.	Draw ing Title, Item Description	**Architect Review Code**	Copies Returned to Contractor

Contractor(s) certifies that the above submitted information has been review ed in detail and comply w ith the Contract Documents, except as indicated, and is submitted to the Architect, " FOR REVIEW AND COMMENTS ONLY." The Architect's and Engineer's critique w ill not relieve the Contractor(s) from compliance w ith requirements of the Contract Documents. Contractor(s) assumes responsibility for all information and comments indicated in Shop Draw ings.

Contractor / Const. Manager Comments

Priority High Normal Low

Signature

Consultant's Comments

Signature

Architect's Comments

Signature

Date: Copies: Attn:

CONTRACTOR TRANSMITTED TO:
- Structural
- Mechanical
- Electrical
- Architect
- Other

CONSULTANT TRANSMITTED TO:
- Architect
- Other Consul.
- Other

ARCHITECT TRANSMITTED TO:
- Contr./Mgr.
- Consultant
- Other

Architect Review Code Legend

RC = Reviewed for Construction
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

RN = Reviewed 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 of the Contract Documents; final acceptance will depend on that compliance.

XRR = Returned for Corrections
Do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a "Reviewed for Construction" or "Reviewed as Noted" action mark.

Contractor / Const. Manager - Record Copy Sent To:

Date:

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.

C. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements.

1.5 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

G. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.6 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, **and the Contract Sum will be adjusted by Change Order**.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least forty-eight (48) hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 3300 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractors in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Construction Manager, and Contractors promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel.

1. Incidental labor and facilities necessary to facilitate tests and inspections.
2. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
3. Facilities for storage and field curing of test samples.
4. Delivery of samples to testing agencies.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTABLE TESTING AGENCIES

A. Construction Manager will select testing agency before construction begins.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 01 7329 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(888) 293-6498 (202) 512-1530
CRD	Handbook for Concrete and Cement Available from Army Corps of Engineers Waterways Experiment Station www.wes.army.mil	(601) 634-2355
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point www.dodssp.daps.mil	(215) 697-6257
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point www.dodssp.daps.mil	(215) 697-6257
	Available from General Services Administration www.fss.gsa.gov	(202) 501-1021
	Available from National Institute of Building Sciences www.nibs.org	(202) 289-7800
FTMS	Federal Test Method Standard (See FS)	
UFAS	Uniform Federal Accessibility Standards	(800) 872-2253

	Available from Access Board www.access-board.gov	(202) 272-0080

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(202) 862-5100
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400

AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America www.alca.org	(800) 395-2522 (703) 736-9666
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (212) 591-7722
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association www.awpa.com	(334) 874-9800
AWS	American Welding Society	(800) 443-9353

	www.aws.org	(305) 443-9353
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
FM	Factory Mutual System (Now FMG)	
FMG	FM Global (Formerly: FM - Factory Mutual System) www.fmglobal.com	(401) 275-3000
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
LPI	Lightning Protection Institute	(800) 488-6864

	www.lightning.org	(847) 577-7200
MFMA	Maple Flooring Manufacturers Association www.maplefloor.org	(847) 480-9138
MFMA	Metal Framing Manufacturers Association www.metalframingmfg.org	(312) 644-6610
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NAGWS	National Association for Girls and Women in Sport www.aahperd.org/nagws/	(800) 213-7193 ext. 453
NAIMA	North American Insulation Manufacturers Association (The) www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NGA	National Glass Association www.glass.org	(703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818

NOFMA	National Oak Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
SAE	SAE International www.sae.org	(724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 462-1930
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEI	Structural Engineering Institute www.seinstitute.com	(800) 548-2723 (703) 295-6195
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980

SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
UL	Underwriters Laboratories Inc. www.ul.com	(800) 285-4476 (847) 272-8800
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WIC	Woodwork Institute of California (Now WI)	

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

BOCA	BOCA International, Inc. (See ICC)	
CABO	Council of American Building Officials (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials	

(See ICC)

ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council (Formerly: CABO - Council of American Building Officials) www.iccsafe.org	(703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
NES	National Evaluation Service (See ICC-ES)	
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-6816
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense www.dodssp.daps.mil	(215) 697-6257
DOE	Department of Energy www.eren.doe.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(202) 366-4000
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111 (202) 501-1888
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112

LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
MBC	Michigan Building Code	?????
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Building Service (See GSA)	
PHS	Office of Public Health and Science http://phs.os.dhhs.gov	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

MDH	Michigan Department of Health	?????

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 6000 - PRODUCT REQUIREMENTS - OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

1. Substitutions Request Procedures.
2. Product Substitutions and Options.
3. Substitution Request Form. (included at end of this Specification Section)

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility**, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise**. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions (after selection of successful bidder): Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 SUBMITTALS

A. Substitution Requests Procedures: Submit three (3) copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request must be proposed and submitted only to the Construction Manager or General Contractor. Substitution Requests must not be sent directly to the Architect.
2. Substitution Request Form: Use form provided at end of Section.
3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and other separate Contractors, that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    i. Cost information, including a proposal of change, if any, in the Contract Sum.
    j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    k. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

4. Architect/Engineer shall have right to reject proposed substitution without explanation.
5. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within Seven (7) calendar days of receipt of a request for substitution. Architect will notify General Contractor of acceptance or rejection of proposed substitution within Ten (10) calendar days of receipt of request, or Seven (7) calendar days of receipt of additional information or documentation, whichever is later.

    a. **Should the Architect not respond within Twelve (12) calendar days of the dated date of Request, the proposed substitution is considered REJECTED.**
    b. Form of Acceptance: Construction Change Directive (CCD).
    c. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
    d. Owner or Architect does not have to give any reason for rejection of substitutions.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 3300 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
2. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
4. Store products to allow for inspection and measurement of quantity or counting of units.
5. Store materials in a manner that will not endanger Project structure.
6. Store products that are subject to damage by the elements, under cover in a weather-tight enclosure above ground, with ventilation adequate to prevent condensation.
7. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
8. Protect stored products from damage.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
3. Refer to Divisions 02 0000 through Divisions 33 0000 Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS and SUBSTITUTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product acceptable to the Architect.

B. Product Selection Procedures: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.

    a. The product is a single source item.
    Substitutions will not be considered.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.

    a. Substitutions may be considered.

3. Manufacturer’s Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

    a. Substitutions will not be considered.

4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.

    a. Substitutions by non-listed manufacturers will not be considered.

5. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by a specified manufacturer. Comply with provisions in "Product Substitutions" Article.

6. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, design profiles, dimensions, and other characteristics that are based on the product named.

   a. Provide Basis-of Design product or by one of the listed manufacturers.
   b. Substitutions of other products will not be considered.

7. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.

   a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.

8. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.

   a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
   b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS CRITERIA

A. Timing: Architect may consider requests for substitution if received within thirty (30) calendar days after the “Notice to Proceed” or before the first (1st) “Application for Payment.” Requests received after that time may be considered or rejected at discretion of Architect without explanation.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action or reason, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not affect work of other Trades Contractor's construction time schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.

9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

3.1 Architect's "Substitution Request" form included at end of this Specification Section.

END OF SECTION 01 6000

FRENCH associates

architects planners interiors

SUBSTITUTION REQUEST

Project: _____

_____

To: _____

_____

Re: _____

Substitution Request Number: _____

From: _____

Date: _____

A/E Project Number: _____

Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached - < REQUIRED BY A/E >

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution (if applicable): _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports
< REQUIRED BY A/E >

SUBSTITUTION REQUEST (CONT'D)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E's REVIEW AND ACTION

Note: Should the Architect not respond within Twelve (12) calendar days of the dated date of Request, the proposed substitution is considered rejected.

☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Printed name: _____ Title: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E

_____

_____

_____

_____

_____

_____

cc: Technical Specifications Committee

SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. General installation of products.
   2. Starting and adjusting.
   3. Protection of installed construction.
   4. Correction of the Work.

B. Related Sections include the following:
   1. Division 01 3300 Section "Submittal Procedures" for submitting surveys.
   2. Division 01 7329 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

   1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility, Owner and Architect that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Existing Utility Interruptions: 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 and Architect not less than seven (7) calendar days in advance of proposed utility interruptions. Provide information on length of interruptions.
2. Do not proceed with utility interruptions without Owner’s and Architect’s written permission.

D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

4. Maintain minimum headroom clearance of 8 feet (2.4 m) in spaces without a suspended ceiling.

B. Building Envelope Integrity: The completed project must provide a building enclosure that does not allow water to penetrate the building envelope. Outside air infiltration into the building must be minimized unless controlled or part of hvac system operation. Outside air infiltration is not allowable in a quantity that can allow freezing or negatively impact piping (plumbing, fire protection, hvac), hvac systems, electrical systems or any other building system.

C. Structural Integrity: All walls, ceilings, soffits and other components must be adequately supported to remain plumb and square. Provide bracing as required to prevent sway, cracking or collapse.

D. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

E. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

F. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

G. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

H. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

I. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

J. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

K. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than seven (7) calendar days during normal weather or three (3) calendar days if the temperature is expected to rise above 80 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.5 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 4000 Section "Quality Requirements."

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.7 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 7329 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 7300

SECTION 01 7329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching of items indicated but not limited to the following:

1. Architectural work.
2. Structural work.
3. Mechanical work.
4. Electrical work.
5. Partial Demolition work.

B. Related Sections include the following:
1. Divisions 02 0000 through Divisions 33 0000 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
2. Division 07 8413 Section "Penetration Fire-stopping" for patching fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

1. Consult with Architect and Structural Engineer before beginning work.

a. Provide work program for removal and shoring of the existing structural members and framing conditions of the building.

2. Comply with all requirements of governmental, local and agencies having jurisdiction.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or results that increase

maintenance or decreased operational life or safety. Operating elements include, but not limited to, the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Electrical wiring systems.
8. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include, but not limited to, the following:]

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Divisions 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

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

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.

4. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

5. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather-tight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 7329

SECTION 22 0005 - BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. This section applies to all sections of Division 22.

B. Drawings and general provisions of the contract, including Division 00 and Division 01 specification sections, apply to work of this section.

C. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

D. The items in this section are supplementary to the requirements set forth in other portions of the specifications as indicated under item "A" above.

1.2 APPLICATION

A. This section applies to all plumbing work. The contractors involved shall check all sections of the specifications in addition to the particular section covering their specific trade. Each distinct section of the specifications aimed for one trade may have detailed information with regards to other trades, therefore, it is imperative that all sections be reviewed to get a complete picture of all other trades' functions and work required.

B. The plumbing contractor is responsible for the installation and operation of the plumbing systems.

C. The plumbing contractor is responsible for receiving, unloading and placement of all of the owner provided equipment.

1.3 INSPECTION OF SITE

A. Each Contractor shall visit the site prior to bid submission to determine all existing conditions that may affect his work and shall make appropriate allowances for such conditions in his bid. Failure to visit the site shall not be cause for a request for additional compensation later in the project during construction.

B. The submitting of a proposal implies that the contractor has visited the site and understands the conditions under which the work must be conducted.

C. Install Work in locations shown on Drawings, unless prevented by Project conditions.

D. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner before proceeding.

1.4 ALTERNATES AND SUBSTITUTIONS

A. Refer to Division 01 - General Requirements for procedures to submit products by a Manufacturer that is not listed as approved equal in the Specifications.

1.5 **DEVIATIONS FROM BASIS OF DESIGN MANUFACTURER**

A. Products identified wiithin the schedules and details are used as the basis of design for laying out and coordinating with other trades such as structural, architectural, and electrical.

Should Division 22 Contractor submit products by a manufacturer other than that indicated as Basis of Design in the Drawings, Contractor shall then be responsible for evaluating the impacts of the proposed Manufacturer's equipment, even if the Manufacturer is listed in the specifications as an approved equal. This includes the proposed Manufacturer's electrical, architectural and structural requirements and their subsequent impacts on the current design and coordination of any differing dimensions and clearances with all other trades. This evaluation shall be included as part of the proposed product submittal.

1.6 MATERIALS

A. Plumbing equipment is to be furnished with motors, electrical controls and protective devices, and integral operating devices which are normally included by the manufacturer or required by the Contract Documents.

B. The Plumbing trades shall provide all control wiring, 120 volts and less, for the equipment and devices furnished under Division 22 of these specifications, including all wiring devices, transformers, conduit, etc. Any conduits used for control wiring shall meet the specifications as indicated in Division 26.

C. Power wiring 120 volts and greater shall be by the Electrical Trades.

1.7 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for plumbing work shall be secured and paid for by the contractor. All work shall conform to all applicable codes, rules and regulations. Applicable publications listed in all sections of Division 22 shall be the latest issue, unless otherwise noted.

B. Rules of local utility companies and municipalities shall be complied with. Check with the utility company and/or municipality supplying service to the installation and determine all devices including, but not limited to: meters, regulators, valves which will be required and include the cost of all such items in the proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

1.8 MAINTENANCE

A. Provide 8 hours of instruction to the owner's designated personnel in the maintenance and operation of equipment and systems.

B. Provide complete maintenance and operating instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manuals shall be submitted in electronic format for review. When approved, four (4) bound hard copies and an indexed electronic PDF shall be provided to the owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

1.9 UTILITY COMPANY REBATES

A. The contractor shall apply for all applicable utility company rebates in the name of the owner. In a timely manner after award of contract, the contractor shall complete pre-

application notifications for the applicable rebates for each school or building. At the completion of the project, the contractor shall furnish and submit all additional information required and requested of the utility company for the final application and submit the final application. The contractor shall act as the technical contact for communication in securing the rebates. The rebates shall be forwarded directly from the utility company to the owner, in the owner name. The contractor shall not claim any of the rebates for themselves.

1.10 WARRANTY AND GUARANTEE

A. Contractor shall guarantee all work installed by him or his subcontractors to be free from defect in material and workmanship for a period of one year from date of final acceptance of the work, unless a longer period is stipulated under specific headings. Contractor shall repair or replace at no additional cost to the owner, any material or equipment developing defects and shall also make good any damage caused by such defects or the correction of defects. Repairs or replacements shall bear additional guarantee, as originally called for, dated from the final acceptance of the repair or replacement. This requirement shall be binding even though it will exceed product guarantees normally furnished by some manufacturers. Contractor shall submit his own and each equipment manufacturers written certificates, warranting that each item of equipment furnished complies with all requirements of the drawings and specifications. Note that guarantee shall run from date of final acceptance of the work, not from date of installation of a device or piece of equipment.

1.11 SUBMITTALS

A. Shop drawings and samples shall be submitted in compliance with the Conditions of the Contract and Division 1 General Requirements.

B. Contractor shall provide submittals where items are referred to by symbolic designation on the drawings. All submittals shall bear the same designation (plumbing piping, plumbing fixtures, etc.). Refer to other sections of the electrical specifications for additional requirements.

C. Shop Drawings: Each piece of equipment shall be identified by the number shown in the schedules and by specification article number pertaining to the item. Shop drawings shall as a minimum be ¼" equals 1' 0" scale, and shall be newly prepared by the Contractor and not reproduced from the Architect's drawings. Layouts shall be made for all floor plans including all ductwork, piping, electrical distribution and other mechanical equipment. Layouts shall show clearances of piping, ducts, etc., above floor.

D. Contractor shall obtain Engineer's approval on all the work before any equipment is purchased, or any work installed. Contractor shall also secure approval of the Governmental Authorities having jurisdiction on all equipment and on the layout of the complete system.

E. The Engineer's review and approval of shop drawings is a gratuitous assistance and in no way does it relieve the Contractor from responsibility for errors or omissions which may exist on the shop drawings. Where such errors or omissions are discovered later, they must be made good by the Contractor, without any additional cost to the Owner, irrespective of any approval by the Engineer.

1. The Contractor shall incorporate with his shop drawings, a letter indicating all deviations from the plans and/or specifications. If in the opinion of the Architect, the deviations are not equal, the Contractor will be required to furnish the item as specified and as indicated on the drawings.

2. Record documents shall be submitted in compliance with the requirements of the Specifications.

F. Engineer WILL NOT REVIEW:

1. Submittals not specified.

2. Submittals not reviewed by Contractor; including Contractor stamp with signature comments.

3. Submittals made after work is delivered to site and/or installed.

4. Submittal resubmissions unless resubmission is required by Architect/Engineer.

G. Installation of any item that requires submittal approval by the engineer shall be installed at the contractors risk. The contractor, at his cost, shall remove all work installed prior to approval of the submittal.

H. The engineer will not be responsible for errors in quantities, or dimensions required to fit the job condition, details of fabrication to insure proper assembly at the job, or for errors resulting from errors in submittals.

I. For underground piping, record dimensions and invert elevations of all piping, including all offsets, fittings, cathodic protection and accessories. Locate dimensions from benchmarks that will be preserved after construction is complete.

1.12 RECORD DRAWINGS

A. Refer to Division 01 - General Requirements for procedures. All literature shall be furnished in accordance with requirements listed in Division 01.

B. Contractor shall provide the following record drawings as part of the Project closeout document process:

1. Contract Documents, specifications and submittals, indicating "As-Built" conditions and actual products selected for use.

2. Product and Maintenance manuals for all equipment listed within this specification manual and in Contract Documents. Provide with parts lists as applicable.

1.13 QUALITY ASSURANCE

A. Other referenced standards:

1. Comply with referenced standards, guidelines, data sheets from various associations, including NFPA, ANSI, ASTM, ASME, ASHRAE.

PART 2 PRODUCTS

2.1 SLEEVES AND ESCUTCHEONS

A. Provide sleeves wherever pipes pass through exterior wall and floors. Sleeves shall be schedule 40 steel pipe cut to length. Sleeves shall terminate flush with walls, partitions and ceilings in finished areas. All sleeves through floor shall extend 2" above floor. Provide cast brass nickel-plated escutcheons with positive catches on each visible sleeve penetration. Sleves are to be sealed at each installation with a 3M approved sealant. The space between the inside of the sleeve and the outside of the pipe or conduit with in the sleeve

shall be sealed at each installation with a 3M approved sealant.

2.2 DIELECTRIC UNIONS

A. Dielectric unions shall be used to connect dissimilar metals (such as steel and copper) to prevent electrolytic action.

B. Dielectric waterway fittings shall be a copper-silicon casting conforming to UNS C87850, and UL classified in accordance with ANSI / NSF-61 for potable water service.

2.3 BUILDING ATTACHMENTS FOR PLUMBING WORK SUPPORTS

A. General Requirements:

1. Provide building attachments required for supporting plumbing work, suitably selected and installed for the loads applied with a minimum additional safety factor of 3.

2. Where specified attachments are not suitable for conditions, submit to Engineer for approval, proposal for alternate building attachments.

3. If specially designed building attachments are required, retain the services of a licenced structural engineer to design such building attachments.

4. Approved Manufacturers: Grinnell, or equivalent products by Michigan Hanger and B-Line.

5. Provide supplemental trapeze supports where necessary. Design trapeze to support all trades. Coordinate loads, and supports with all trades. Size trapeze for maximum deflection of 1/64 of the span.

B. Attachments to Structural Steel:

1. Support plumbing work from building structural steel where possible and approved. No welding or bolting to structural steel is permitted unless authorized by Architect. C-clamps are not permitted.

a. Center beam clamp - for loads over 120 lb.: Malleable center hung Grinnell Fig. 228.

b. Side beam clamp with retaining clips - for loads up to 120 lb.

C. Cast in Place Concrete Inserts:

1. Provide inserts selected for applied load of present load plus 100% for future, and coordinated with concrete work. Except as detailed on drawings, inserts shall be Unistrut or Grinnell. Plan, lay out and coordinate setting of inserts prior to concrete pour. Use Grinnell Fig. 285 lightweight concrete insert for loads up to 400# or Grinnell Fig. 281 Wedge Type concrete insert for loads up to 1200#

D. Drilled Insert Anchors:

1. Where plumbing work cannot be supported from structural steel, or cast in place concrete inserts, provide drilled concrete insert anchors. Submit for approval, project specific installation drawings for all loads over 100 lbs. Install inserts in web of beam if possible and approved. Insert depth shall not exceed two thirds the thickness of the concrete. Where existing concrete appears to be deteriorating, or where applied load at insert exceeds 1000 lbs., conduct test of concrete to determine derated capacity of

insert. Anchors may be adhesive or expansion type up to 1000 lbs., and shall be adhesive type for loads over 1000 lbs.

PART 3 EXECUTION

3.1 GENERAL

A. Existing piping: when encountered during the course of work, protect, brace and support existing piping where required for proper execution of the work.

B. Interruption of existing active piping: when the course of work makes shut-down of services unavoidable, the plumbing contractor shall schedule the shut-down at such time as approved by the owners representative, which will cause least interference with established operating routine.

C. Arrange work accordingly, providing such fittings as duct transitions traps, valves and accessories necessary to complete all construction in an orderiy fashion.

D. Install all equipment in strict accordance all directions and recommendations furnished by the manufacturer.

3.2 INTERPRETATION OF CONTRACT DOCUMENTS

A. Should there be discrepancy or a question of intent, refer matter to Architect/Engineer for decision before ordering any equipment or materials or before starting any related work.

B. Drawings and Specifications are to be taken together. Work specified and not shown or work shown and not specified shall be performed or furnished as though mentioned in both Specifications and Drawings. If there is discrepancy between Drawings and Specifications as to quantity or quality to be provided, the greater quantity or better quality shall be provided.

C. Minor items and accessories or devices reasonably inferable as necessary to complete and proper installation and operation of any system shall be provided by Contractor for such system whether or not specifically called for by Specifications or Drawings.

D. Architect/Engineer may change location of any equipment 5’ and any piping, ductwork, conduit, etc. 10’ in any direction without extra charge, provided such changes are made before installation.

E. Locations of items not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to review and approval by Architect/Engineer.

F. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.

1. Where headroom or space conditions appear inadequate, notify Architect or Owner’s field representative before proceeding with installation.

2. Pipe/duct rerouting and size changes shall be made at no additional cost to the Owner.

G. Furnish advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, and also furnish information and shop drawings necessary to permit installation of other work without delay.

H. Where there is evidence that parts of the Work specified in Divisions 21, 22, and 23 will interfere with other work, assist in working out space conditions to make satisfactory adjustments, revise and submit coordinated shop drawings.

I. After review and without additional cost to the Owner, make minor modifications in the work as required by structural interferences, by interferences with work of other sections or for proper execution of the work.

J. Work installed before coordinating with other work so as to cause interference with other work shall be changed and corrected without additional cost to the Owner.

K. Drawings are diagrammatic in nature and are a graphic representation of requirements and shall be followed as closely as actual building construction will permit. All changes from the plans necessary to make the work conform to the building as constructed and to fit the work of other trades or to conform to rules of the Governmental Authorities having jurisdiction, NFPA, OSHA and the Owner's Insurance Underwriters, shall be made by the Contractor without extra cost to the Owner.

L. The layout of the piping, ductwork, equipment, etc., as shown on the drawings shall be checked and exact locations shall be determined by the dimensions of the equipment approved and the Contractor shall obtain approval for the revised layout before the apparatus is installed. The Contractor shall field measure or consult existing record Architectural and Structural Drawings if available for all dimensions, locations of partitions, locations and sizes of structural supports, foundations, etc.

M. Omission in the Drawings and/or Specifications of any items necessary for the proper completion or operation of the work outlined in this specification shall not relieve the Contractor from furnishing same without additional cost to the Owner.

N. The Equipment Shop Drawings should be furnished to the installing Contractor by the purchasing Contractor before roughing in. Contractor shall not install any piping or ductwork for said equipment until he has received approved shop drawings for same.

3.3 ALTERATIONS IN PRESENT BUILDING AND SYSTEMS

A. Contractor shall take particular note of the revisions and alterations to the existing systems, facilities and equipment due to the new construction as indicated on the Drawings and/or in Specification. Contractor shall remove, reroute or alter all services, ductwork, etc., as required or as indicated on the drawings.

B. The Contractor shall maintain all services in the existing building. In case, where new service connections are to be made to existing services and service interruptions can in no way be avoided, the service interruptions shall be with the minimum of inconvenience to the Owner and the work shall be done at such time of any day, Saturday and Sunday included, and only as directed by the Owner or the Architect.

3.4 ACCESSIBILITY

A. Do not locate traps, valves, controls, unions, cleanouts, etc. in any system at a location that will be inaccessible after construction is completed. Maintain accessibility for all components in plumbing systems.

3.5 ACCESS PANELS:

A. Refer to Division 08 - Openings; Provide access doors in locations as required by applicable codes and as indicated below. Coordinate locations with architectural trades.

B. Submit shop drawings for review before ordering panels. Where fire rating is required, furnish label doors compatible with fire rating of assembly.

C. Contractor shall confer with other trades with respect to access panel locations, and shall wherever practical group valves, traps, dampers, etc. in such way as to be accessible from single panel and eliminate as many access panels as possible.

D. Furnish access panels to access valves, traps, control valves or devices, dampers, damper motors, etc. Access panels shall be sized as necessary for ample access, or as indicated on drawings, but no smaller than 12" x 12" where devices are within easy reach of operator, and at least 24"x24" when operator must pass through opening in order to reach the devices. Architectural Trades shall install access panels coordinated with Mechanical Trades.

E. Access panels in fire rated walls or ceiling must be U.L. labeled for intended use. Unless otherwise indicated on plans, access doors shall be hinged flush type steel framed panel, 14 gauge minimum for frame, and with anchor straps. Only narrow border shall be exposed. Hinges shall be concealed type. Locking device shall be flush type and screw driver operated. Metal surfaces shall be prime coated with rust-inhibitive paint. Panels shall be compatible with architectural adjacent materials.

3.6 PROTECTION OF ELECTRICAL EQUIPMENT

A. Contractor shall furnish and install sheet metal drain pans beneath piping that is routed above electrical equipment and/or above the 3’ access space in front of such equipment. Electrical equipment, for the purpose of addressing drain pan requirements, shall be defined as free-standing or wall-mounted switchgear, transformers, distribution boards or motor control centers.

1. Drain pans shall be 20 gauge galvanized sheet metal with a minimum 4” high turned up edge. Bottom of drain pan shall slope to a single drainage point at ⅛” per foot. A 1” diameter clear plastic tube shall allow collected fluid to drain to the nearest open site floor drain. Secure plastic tubing to building structure only.

2. Drain pan shall be hung from building structure with angle iron trapeze hangers (no hanger shall penetrate the drain pan). Consider drain pan to be full of water for hanger load calculations.

3. Drain pans shall include liquid detectors with alarms only if noted on the drawings. Liquid detectors shall be specified in Section 22 10 06 Plumbing Piping Specialties.

B. Contractor shall include provisions to adjust the local lighting layout, at no extra cost to Owner, in order to accommodate any detrimental effect the drain pan has on the illumination of the electrical equipment and access space.

3.7 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

A. Refer to Division 01 - General Requirements.

B. All cutting required shall be done by the contractor whose work is involved, without extra cost the owner. All patching and restoration including the furnishing and installation of access panels in ceiling, walls; etc. Within the building lines shall be done by the respective, responsible contractor. No cutting of structural steel, concrete, or wood shall be done without prior approval and explicit directions of the architect patched by the respective, responsible contractor.

C. The contractor, under whose jurisdiction the work may fall, shall provide labor, material, and tools required to cut, repair, protect, cap, or relocate existing pipes, conduits, or utilities interfering with or uncovered during work, per regulations of the authorities having jurisdiction.

3.8 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling, removal of materials, de-watering and backfilling required for the proper laying of pipes and plumbing work. Coordinate the work with other excavating and backfilling in same area.

3.9 ROUGH-IN FOR CONNECTION TO EQUIPMENT

A. It shall be the responsibility of each contractor to study the architectural, structural, electrical, and mechanical drawings, conferring with the various trades involved and checking with the supplier of equipment in order to properly rough-in for all equipment.

3.10 MATERIAL AND EQUIPMENT

A. All material and equipment shall be new and of the best quality used for the purpose in good commercial practice, and shall be the standard product of reputable manufacturers. The material and equipment must meet approval of state and local codes in the area it is being used. Roof decks shall not be used to support piping, conduit, equipment, devices, etc.

3.11 SEAL PENETRATIONS

A. Seal the space around pipes in sleeves and around duct openings through walls, floors and ceilings. Provide adequate clearance to allow for proper sealing.

3.12 SOUND CONTROL

A. Penetrations shall be maintained airtight to pevent sound transfer.

B. Piping shall pass through sleeves. Pack sleeves tight with glass fiber or oakum and caulked on both sides with non-hardening acoustical sealant.

3.13 FIRESTOPPING

A. Refer to Division 07 - Thermal and Moisture Protection for more information.

B. Provide UL classified firestopping system for plumbing penetrations through rated walls and floors to maintain the fire rating.

3.14 CONTROL WIRING

A. All control wiring for plumbing and electrical equipment, including motor starters, shall be 120 volt maximum and wired with one side of the coil grounded and the operating contacts in the north side of the circuit. All control wiring shall be installed in conduit.

3.15 CLEANING, FLUSHING, AND INSPECTING

A. Refer to Division 01 - General Requirements; all plumbing equipment and components shall be cleaned as frequently as necessary through the construction process and again prior to project completion.

B. Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

C. Sufficient flushing water shall be introduced into the mains to produce a velocity of not less than 4’ per second and this flow rate shall be continued until the discharge is clean and clear and does not show evidences of silt or foreign matter when a sample is visually inspected.

D. Inspect pressure piping in accordance with procedures of ASME B31.

3.16 DELIVERY, STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

A. Refer to Division 01 - General Requirements; all equipment and materials shall be delivered, stored and secured per manufacturer's recommendations.

B. On-site storage shall be coordinated with Construction Manager/General Contractor and be performed in a manner as to avoid damage, deterioration and loss.

C. Contractor shall provide temporary protection for installed equipment prior to project completion.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. All equipment shall be inspected prior to installation to assure that equipment is free from defect and damage.

F. Protect plumbing fixtures and piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.17 PIPING TESTS

A. Test pressure piping in accordance with ASME B31.

B. General: Provide temporary equipment for testing, including pump and gauges. Test piping systems before insulation is installed wherever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

1. Test each piping system at 150% of operating pressure, or other pressure as required by Authority Having Jurisdiction, whichever is greater.

    a. Domestic water systems and equipment vents shall be tested hydrostatically for minimum of four hours at 1½ times design pressure for that system, or 100 psig minimum, whichever is greater, unless otherwise specified.

    b. Storm, soil, waste and vent piping shall be tested with water for minimum of 24 hours at 10 feet head.

    c. Acid resistant waste and vent systems shall be tested as per manufacturer’s recommendations.

2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

C. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics or other temporary repair methods.

D. Drain test water from piping systems after testing and repair work has been completed.

END OF SECTION

SECTION 22 0505 - SELECTIVE DEMOLITION FOR PLUMBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Demolition and extension of existing plumbing work.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Division 02 - Existing Conditions: Demolition, cleaning and disposal requirements, cutting and patching requirements, repairs.

1.3 SUMMARY

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of minor electrical demolition as described in this specification.

B. The demolition documents plans and specification have been prepared from existing non-as built documents and cursory non-invasive field investigation.

C. It is the contractors obligation to become familiar with the extent of demolition and the existing condition before submitting their bid.

D. During demolition if the contractor discovers unforeseen significant non-code compliance conditions of the existing installation they shall notify the Architect and Engineer immediately in writing.

E. The contractor shall become familiar with the drawings and scope of work of other trades as the work scope of those trades relates to mechanical equipment and connection requirements.

F. During demolition the contractor shall record on site as-builts all plumbing sanitary, waste and domestic hot, cold and hot water recirculation capped branches for reuse in renovated project space.

PART 2 PRODUCTS

2.1 MATERIALS

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping to be demolished serve only equipment and facilities within the demolition areas.

B. Demolition drawings are based on casual field observation and existing record documents.

C. Report discrepancies to Owner before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Identify locations for capping plumbing piping before any demolition work commences.

B. Coordinate utility service shut-downs with Utility Companies.

C. Provide temporary connections to maintain existing systems in service during construction.

D. Confirm isolation valve locations for domestic water piping. Repair leaking isolation valves or replace inoperable valves before commencing piping demolition.

3.3 DEMOLITION AND EXTENSION OF EXISTING PLUMBING WORK

A. In general plumbing remodeling work is shown on Drawings but carefully study all drawings for all contracts for “demolition” and “remodeling” work in existing building and field check to verify locations where such work is being done to determine exact extent of work required. No extra will be allowed for additional work required because of demolition or remodeling whether or not work is specifically noted, itemized or shown on Drawings.

B. Remove existing equipment and materials pertaining to contract as specified or as required, whether shown on Drawings or not, to prepare for new work of all contracts.

C. Where necessary, reroute piping, ducts, etc. from within walls, floors, ceilings, etc. being removed. Contractor involved with interrupted service shall be responsible for accomplishing required work whether shown on Drawings or not.

D. Remove, relocate, and extend existing plumbing piping to accommodate new construction.

E. Remove domestic water piping back to main and provide isolation valve and cap. DEAD LEGS ARE NOT ALLOWED.

F. Remove sanitary and waste piping to branch connection fitting to negate any dead legs.

3.4 CLEANING AND REPAIR

A. Refer to Division 01 - General Requirements for procedures.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

END OF SECTION

SECTION 22 0519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

1.2 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments 2013.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014, with Editorial Revision (2017).

D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service Current Edition, Including All Revisions.

1.3 SUBMITTALS

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

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.4 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.

2. Size: 4-1/2 inch diameter.

3. Mid-Scale Accuracy: One percent.

4. Scale: Psi and kPa.

2.2 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

2.3 STEM TYPE THERMOMETERS

A. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint

with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Accuracy: 2 percent, per ASTM E77.
4. Calibration: Degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples to allow clearance from insulation.

C. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

D. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 SCHEDULES

A. Pressure Gauges, Location and Scale Range:

1. Pumps, 0 to 120 psi.

B. Stem Type Thermometers, Location and Scale Range:

1. Domestic hot water supply and recirculation, 0 to 180 degrees F.

END OF SECTION

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Applications.

B. General requirements.

C. Ball valves.

D. Butterfly valves.

E. Check valves.

F. Globe valves.

G. Manual balancing valves.

H. Pressure reducing valves.

I. Plug valves.

J. Drain valves.

K. Relief valves.

1.2 RELATED REQUIREMENTS

A. Section 08 3100 - Access Doors and Panels.

B. Section 22 0553 - Identification for Plumbing Piping and Equipment.

C. Section 22 0719 - Plumbing Piping Insulation.

D. Section 22 1005 - Plumbing Piping.

1.3 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. PTFE: Polytetrafluoroethylene.

E. TFE: Tetrafluoroethylene.

1.4 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch) 2013 (Reaffirmed 2018).

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.

C. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard 2017.

D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2017.

E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2018.

F. ASME B16.34 - Valves - Flanged, Threaded and Welding End 2017.

G. ASME B31.9 - Building Services Piping 2020.

H. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications 2019.

I. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2003 (Reapproved 2016).

J. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2019).

K. ASTM A536 - Standard Specification for Ductile Iron Castings 1984 (Reapproved 2014).

L. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.

M. AWWA C606 - Grooved and Shouldered Joints 2015.

N. MSS SP-67 - Butterfly Valves 2017.

O. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends 2018.

P. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service 2010a.

Q. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends 2011.

R. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves 2013.

S. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010.

T. NSF 61 - Drinking Water System Components - Health Effects 2020.

U. NSF 372 - Drinking Water System Components - Lead Content 2020.

1.5 SUBMITTALS

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

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Grooved joint valves shall be referred to on drawings and product submittals, and be identified by the manufacturer’s listed model or series designation.

1.6 QUALITY ASSURANCE

A. Manufacturer:

1. Obtain valves for each valve type from single manufacturer.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

C. Grooved end valves shall be of the same manufacturer as the adjoining couplings.

D. All castings used for valve bodies shall be date stamped for quality assurance and traceability.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.

a. Provide temporary inlet and outlet caps.

b. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Provide the following valves for the applications if not indicated on drawings:

1. Shutoff: Ball or butterfly.

a. Plug valves or ball valves can be used for natural gas shutoff.

2. Dead-End: Single-flange butterfly (lug) type.

3. Swing Check:

a. 2 NPS and Smaller: Bronze swing check valves with bronze or nonmetallic disc.

b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.

4. Spring Loaded Check: At pump discharge.

5. Manual Balancing Valves: At hot water return pump discharge only.

B. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

C. Required Valve End Connections for Non-Wafer Types:

1. Steel Pipe:

a. 2 NPS and Smaller: Threaded ends.

b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

c. 5 NPS and Larger: Grooved or flanged ends.

d. Grooved-End Copper Tubing and Steel Piping: Grooved.

2. Copper Tube:

a. 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

c. 5 NPS and Larger: Grooved or flanged ends.

D. Domestic, Hot and Cold Water Valves:

1. 2 NPS and Smaller:

a. Bronze: Provide with solder-joint or threaded ends.

b. Ball: Two piece, full port, bronze with bronze or stainless steel trim.

c. Bronze Swing Check: Class 125, bronze disc.

d. Bronze Globe: Class 125, bronze disc.

2. 2-1/2 NPS and Larger:

a. Iron, 2-1/2 NPS to 4 NPS: Provide with threaded or flanged ends.

b. Iron Ball: Class 150.

c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.

d. Grooved End, Cast Brass Butterfly: 300 CWP, Fluoroelastomer pressure-responsive seat, aluminum-bronze disc.

E. Natural Gas Valves:

1. Ball Valve: 4 NPS and Smaller:

a. Bronze: Provide with solder-joint or threaded ends with union.

b. Ball: Class 150, regular port, teflon seats.

2. Plug: 2-1/2 NPS an Larger:

a. Lubricated Plug: Class 125, regular gland.

2.2 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:

1. Gear Actuator: Quarter-turn valves 8 NPS and larger.

2. Handwheel: Valves other than quarter-turn types.

3. Hand Lever: Quarter-turn valves 6 NPS and smaller.

D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:

1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or

disturbing insulation.

2. Butterfly Valves: Extended neck.

3. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:

1. Threaded End Valves: ASME B1.20.1.

2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.

3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.

4. Solder Joint Connections: ASME B16.18.

5. Grooved End Connections: Copper-tube dimensions, similar to AWWA C606.

F. General ASME Compliance:

1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.

2. Solder-joint Connections: ASME B16.18.

3. Building Services Piping Valves: ASME B31.9.

G. Valve Materials for Potable Water: NSF 61 and NSF 372.

H. Bronze Valves:

1. Fabricate from dezincification resistant material.

2. Copper alloys containing more than 15 percent zinc are not permitted.

I. Source Limitations: Obtain each valve type from a single manufacturer.

2.3 BRONZE BALL VALVES

A. Two Piece, Full Port with Bronze or Stainless Steel Trim:

1. Comply with MSS SP-110.

2. SWP Rating: 150 psig.

3. CWP Rating: 600 psig.

4. Body: Bronze.

5. Ends: Threaded.

6. Seats: PTFE or TFE.

7. Manufacturers:

a. Apollo Valves: www.apollovalves.com/#sle.

b. Viega LLC: www.viega.us/#sle.

c. Substitutions: See Section 01 6000 - Product Requirements.

B. For Natural Gas Service: Two Piece, Regular Port with Bronze, Chrome Plated Brass or Stainless Steel Trim:

1. Comply with MSS-SP110.
2. SWP Rating: 150 psig.
3. CWP Rating: 400 psig.
4. Body: Bronze
5. Ends: Threaded or Solder with union.
6. Stem: Blow-out proof

2.4 IRON BALL VALVES

A. Class 125, Full Port, Stainless Steel Trim:

1. Comply with MSS SP-72.
2. CWP Rating: 200 psig.
3. Body: ASTM A536 Grade 65-45-12, ductile iron.
4. Ends: Flanged.
5. Seats: PTFE, TFE, or Teflon.
6. Operator: Lever, with locking handle.
7. Manufacturers:
   a. Apollo Valves: www.apollovalves.com/#sle.
   b. Ferguson Enterprises Inc: www.fnw.com/#sle.
   c. Substitutions: See Section 01 6000 - Product Requirements.

2.5 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug type: Bi-directional dead-end service without use of downstream flange.

1. Comply with MSS SP-67, Type I.
2. CWP Rating: 200 psig.
3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
4. Stem: One or two-piece stainless steel.
5. Seat: EPDM.
6. Disc: Coated ductile iron.
7. Manufacturers:
   a. Apollo Valves: www.apollovalves.com/#sle.

b. Substitutions: See Section 01 6000 - Product Requirements.

2.6 BRASS, GROOVED-END BUTTERFLY VALVES

A. Grooved Ends: Bi-directional dead-end service.

1. CWP Rating: 300 psig.

2. Body: Cast brass, UNS C87850.

3. Stem: Stainless steel, offset from the disc centerline to provide complete 360-degree circumferential seating.

4. Seat: Pressure responsive Fluoroelastomer.

5. Disc: Aluminum-bronze.

6. UL classified in accordance with NSF-61 for potable water service, and meets the lead requirements of NSF-372.

2.7 BRONZE SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa).

1. Comply with MSS SP-80, Type 3.

2. Design: Horizontal flow.

3. Body: Bronze, ASTM B62.

4. Ends: Threaded or soldered as indicated.

5. Disc: Bronze.

6. Manufacturers:

a. Apollo Valves: www.apollovalves.com/#sle.

b. Milwaukee: www.milwaukeevalve.com.

c. Substitutions: See Section 01 6000 - Product Requirements.

2.8 BRONZE SPRING LOADED CHECK VALVES

A. Class 125: CWP Rating 200 psig (1380 kPa).

1. Design: Vertical flow.

2. Body: Bronze, ASTM B61 or ASTM B62

3. Spring: Bronze

4. Ends: Threaded or soldered as indicated.

5. Disc: Nonmetallic

6. Manufacturers:

a. Milwaukee: www.milwaukeevalve.com

b. Apollo Valves[<>]: www.apollovalves.com/#sle.

c. Substitutions: See Section01 6000-Product Requirements.

2.9 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125 with Lever and Spring-Closure Control.

1. Comply with MSS SP-71, Type I.

2. Description:

a. CWP Rating: 200 psig.

b. Design: Clear or full waterway.

c. Body: ASTM A126, gray iron with bolted bonnet.

d. Ends: Flanged or threaded as indicated.

e. Spring: Stainless steel.

f. Trim: Bronze.

g. Gasket: Asbestos free.

h. Closer Control: Factory installed, exterior lever, and spring.

3. Manufacturers:

a. Apollo Valves: www.apollovalves.com/#sle.

b. Flomatic Valves: www.flomatic.com/#sle.

c. Substitutions: See Section 01 6000 - Product Requirements.

2.10 BRONZE GLOBE VALVES

A. Class 125: CWP Rating: 200 psig:.

1. Comply with MSS SP-80, Type 1.

2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.

3. Ends: Threaded joint.

4. Stem: Bronze.

5. Disc: Bronze, PTFE, or TFE.

6. Packing: Asbestos free.

7. Handwheel: Malleable Iron.

8. Manufacturers:

a. Apollo Valves: www.apollovalves.com/#sle.

b. Substitutions: See Section 01 6000 - Product Requirements.

2.11 LUBRICATED PLUG VALVES

A. Regular Gland with Threaded or Flanged Ends.:

1. Comply with MSS SP-78, Type II.
2. Class 125: CWP Rating: 200 psig.
3. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
4. Pattern: Regular or short.
5. Plug: Cast iron or bronze with sealant groove.
6. Manufacturers:
    a. Homestead: www.homesteadvalve.com.
    b. Norgas Controls: www.norgascontrols.com.
    c. Flowserve Corporation: www.flowserve.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.

2.12 MANUAL BALANCING VALVES

A. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

C. Manufacturers:

1. ITT Bell & Gossett: www.bellgossett.com/#sle.
2. Griswold Controls: www.griswoldcontrols.com/#sle.
3. Taco, Inc: www.taco-hvac.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.13 WATER PRESSURE REDUCING VALVES

A. Valves over 2 inches: ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.

1. Manufacturers:
    a. Amtrol: www.amtrol.com
    b. Apollo valves: www.apollovalves.com
    c. Watts Regulator Company: www.wattsregulator.com
    d. Substitutions: See Section 01 6000 - Product Requirements.

2.14 DRAIN VALVES

A. Drain Valve with hose thread and chain and dust cap; chrome plated ball, blow-out-proof stem, and adjustable packing gland.

B. Manufacturers:

1. Hammond: www.hammondvalve.com
2. Apollo valves: www.apollovalves.com
3. Nibco: www.nibco.com/valves
4. Milwaukee: www.milwaukeevalve.com
5. Substitutions: See Section 01 6000 - Product Requirements.

2.15 RELIEF VALVES

A. Pressure Relief Valves: Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

B. Manufacturers:

1. CASH (A.W.) Valve Manufacturing Corp: www.cashvalve.net
2. Zurn Industries; Wilkins-Regulator Division: www.zurn.com
3. Watts Regulator Company: www.wattsregulator.com
4. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

D. Provide access where valves and fittings are not exposed.

E. Install check valves where necessary to maintain direction of flow as follows:

1. Spring Loaded Check: Install with stem plumb and vertical.
2. Swing Check: Install horizontal maintaining hinge pin level.

F. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

G. Install valves with stems upright or horizontal, not inverted.

END OF SECTION

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.2 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

1.3 SUBMITTALS

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

B. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Piping: Pipe markers.

B. Pumps: Nameplates.

C. Equipment, Water Heaters, and Tanks: Nameplates.

D. Valves: Tags.

2.2 NAMEPLATES

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Laminated three-layer plastic with engraved letters.

2.3 TAGS

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.4 PIPE MARKERS

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.

2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

3. Seton Identification Products: www.seton.com/#sle.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

1. Install in clear view and align with axis of piping.

2. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 22 0719 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2013).

C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.

D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2019.

E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

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

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER

A. Manufacturers:

1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville Corporation: www.jm.com/#sle.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

1. Vapor Barrier Lap Adhesive shall be compatible with the insulation and as recommended by the insulation manufacturer.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Indoor Vapor Barrier Finish:

1. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
2. Armacell LLC: www.armacell.us/#sle.
3. K-Flex USA LLC: www.kflexusa.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.

1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.4 JACKETS

A. PVC Plastic.

1. Manufacturers:

a. Johns Manville Corporation: www.jm.com/#sle.

b. Proto Corporation: www.protocorporation.com.

c. Substitutions: See Section 01 6000 - Product Requirements.

2. Jacket: One piece molded type fitting covers and sheet material, off-white color.

a. Minimum Service Temperature: 0 degrees F.

b. Maximum Service Temperature: 150 degrees F.

c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.

d. Thickness: 10 mil.

e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert Location: Between support shield and piping and under the finish jacket.

4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

3.3 SCHEDULES

A. Plumbing Systems:

1. Domestic Hot Water Supply & Recirculation:

a. Pipe Size Range: 1/2 to 1-1/4 inch

1) Thickness: 1 inch

b. Pipe Size Range: 1-1/2 to 8 inch

1) Thickness: 1-1/2 inch

2. Domestic Cold Water: 1 inch thick.

END OF SECTION

SECTION 22 1005 - PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.

1. Sanitary sewer.
2. Domestic water.
3. Storm water.
4. Natural gas.
5. Condensate drains.
6. Flanges, unions, and couplings.
7. Pipe hangers and supports.
8. Manufactured sleeve-seal systems.

1.2 RELATED REQUIREMENTS

A. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.

B. Section 22 0553 - Identification for Plumbing Piping and Equipment.

C. Section 22 0719 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2016.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2018.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.

D. ASME B31.1 - Power Piping 2020.

E. ASME B31.9 - Building Services Piping 2020.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.

G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2019.

H. ASTM B32 - Standard Specification for Solder Metal 2020.

I. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.

J. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

K. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube 2016.

L. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings 2016.

M. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.

N. AWWA C651 - Disinfecting Water Mains 2014.

O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018.

P. NSF 61 - Drinking Water System Components - Health Effects 2020.

Q. NSF 372 - Drinking Water System Components - Lead Content 2020.

1.4 SUBMITTALS

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

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1. Grooved joint couplings and fittings shall be referred to on drawings and product submittals, and be identified by the manufacturer’s listed model or series designation.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

C. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).

1. Fittings:

a. ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

b. Grooved end fittings manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)

2. Joints:

a. ASTM B32, alloy Sn95 solder.

b. Grooved joint coupling consisting of two ductile iron housings cast with offsetting angle-pattern bolt pads, Fluoroelastomer center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth, and ASTM A449 compliant bolts and nuts. Installation ready rigid coupling for direct stab installation without field disassembly.

1) UL classified in accordance with NSF-61 for potable water service. The system shall meet the low-lead requirements of NSF-372.

3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.

a. Manufacturers:

1) Apollo Valves: www.apollovalves.com/#sle.

2) Viega LLC: www.viega.us/#sle.

3) Nibco: www.nibco.com.

4) Substitutions: See Section 01 6000 - Product Requirements.

2.3 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.

2. Joints: Threaded or welded to ASME B31.1.

2.4 CONDENSATE DRAINAGE SYSTEMS SERVING MULTIPLE PIECES OF EQUIPMENT.

A. PVC Pipe: ASTM D2665.

1. Fittings: PVC

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.5 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous Pipe: Class 150 malleable iron threaded unions.

2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:

1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

D. Dielectric Connections:

1. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2. Waterway Fitting: Copper-silicon casting conforming to UNS C87850, and UL classified in accordance with ANSI / NSF-61 for potable water service. Fittings shall have threaded ends, grooved ends, or a combination.

2.6 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.

3. Trapeze Hangers: Welded steel channel frames attached to structure.

4. Vertical Pipe Support: Steel riser clamp.

2.7 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:

1. The Metraflex Company: www.metraflex.com/#sle.

2. CALPICO: www.calpicoinc.com.

3. Advanc Products & Systems, Inc.: www.apsonline.com.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Modular/Mechanical Seal:

1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.

2. Provide watertight seal between pipe and wall/casing opening.

3. Elastomer element size and material in accordance with manufacturer's recommendations.

4. Glass reinforced plastic pressure end plates.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges, grooved joint couplings, or unions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions. Cast iron soil pipe installed in accordance to CISPI's Handbook.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access door with Division 01.

I. Establish elevations of buried piping outside the building to ensure not less than 4 ft of cover.

J. Install valves with stems upright or horizontal, not inverted. Refer to Section 22 0523.

K. Install water piping to ASME B31.9.

L. Slope water piping and arrange to drain at low points.

M. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

N. Grooved joints shall be installed in accordance with the manufacturer’s latest published instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer’s factory trained field representative shall provide on-site training for contractor’s field personnel in the

proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

O. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

P. Sleeve pipes passing through partitions, walls, and floors.

Q. Manufactured Sleeve-Seal Systems:

1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.

2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.

3. Locate piping in center of sleeve or penetration.

4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.

5. Tighten bolting for a watertight seal.

6. Install in accordance with manufacturer's recommendations.

R. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

S. In general, all piping, and similar items shall be installed concealed from view above ceiling, in partitions, shafts, chases, unless otherwise indicated.

T. Where pipes are in partitions, furred out spaces and chases, obtain information as to their exact location and size and install work so as to be entirely concealed in allotted space. If conflicts arise making this impossible, obtain instructions from Architect/Engineer before proceeding with work.

U. Where there is evidence that plumbing work will interfere with other work, assist in working out space conditions and/or structure, make necessary adjustments to accommodate work.

V. Plumbing work installed before coordinating with other work so as to cause interference with other work to be changed to correct such condition without additional cost to Owner.

W. Appliances and equipment to be installed and connected with best engineering practices and in accordance with manufacturer’s instructions and recommendations. Piping, valves, connections and other like items recommended by manufacturer or as required for proper operation to be provided without additional cost to Owner.

X. In no case will any pipe, conduit or duct be installed where it is supported on or suspended from another pipe, conduit or duct.

3.3 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

3.4 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope; 1/4 inch per foor slope for piping serving low flow fixtures.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed, and clean.

B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 22 1006 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Back water valves.

B. Backflow preventers.

C. Strainers.

D. Water hammer arrestors.

E. Mixing valves.

F. Pump connectors.

G. Air Vents.

H. Natural gas regulators.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

B. Section 22 3000 - Plumbing Equipment.

C. Section 22 4000 - Plumbing Fixtures.

1.3 REFERENCE STANDARDS

A. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers 2011.

B. NSF 61 - Drinking Water System Components - Health Effects 2020.

C. NSF 372 - Drinking Water System Components - Lead Content 2020.

D. PDI-WH 201 - Water Hammer Arresters 2017.

1.4 SUBMITTALS

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

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, and other specialties applicable to project.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Loose Keys for Outside Hose Bibbs: One.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 BACKFLOW PREVENTERS

A. Manufacturers:

1. Apollo Valves: www.apollovalves.com/#sle.

2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.

3. Zurn Industries, LLC: www.zurn.com/#sle.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Reduced Pressure Backflow Preventers:

1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2. Provide with air gap fitting; pipe to adjacent floor drain receptor

3. Device shall be approved for vertical installation.

2.3 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com

2. Green Country Filter Manufacturing: www.greencountryfilter.com

3. WEAMCO: www.weamco.com

4. Substitutions: See Section01 6000-Product Requirements.

B. Size 2 inches and Under:

1. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen. Lead free.

C. Size 1-1/2 inch to 4 inches:

1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen. Lead free.

D. Size 5 inch and Larger:

1. Class 125, flanged iron body, basket patern with 1/8 inch stainless steel perforated screen. Lead free.

2.4 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range 34 to 250 degrees F and maximum 150 psi working pressure.

2.5 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Manufacturers:
   a. Acorn: www.acorneng.com
   b. Leonard Valve Company: www.leonardvalve.com/#sle.
   c. Powers: www.powerscontrols.com.
   d. Caleffi; www.caleffi.com/usa/en-us
   e. Substitutions: See Section 01 6000 - Product Requirements.
2. Hi-Lo Master Mixing Valve:
   a. The Thermostatic Mixing Valve shall be IAPMO lab certified to ASSE 1017 and CSA standards and capable of meeting the control accuracy requirements of these standards at the manufacturer's listed minimum flow rates.
   b. The valve shall contain an advanced paraffin sensor with a temperature range of 100°F to 160°F (37.8°C to 71°C) and factory set at 120°F (38°C) with a lock nut to prevent unauthorized temperature changes.
   c. Checks and screens must be integral to the valve.
   d. External inlet shut-offs will be included with the valve and shall be a reliable ball valve design.
   e. Body material shall be “lead-free” brass with corrosion resistant internal components. Include outlet temperature gauge.

2.6 PUMP CONNECTORS

A. Manufacturers:

1. Twin City Hose: www.twincityhose.com
2. Metraflex: www.metraflex.com
3. FlexHose: www.flexhose.com

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Flexible Connectors: Braided type with wetted components or stainless steel or bronze, sized to match piping. Materials of construction shall be consistent with pipe material and equipment/pipe connection fittings. Flexible hose connectors shall be capable of compensating for lateral movement and vibrations.

C. NSF 61 listed for potable water use.

D. End connections: Same as specified for pipe jointing. Copper fittings shall not be attached to stainless steel hose.

2.7 AIR VENTS

A. Manufacturers:

1. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.

2. ITT Bell & Gossett: www.bellgossett.com/#sle.

3. Taco, Inc: www.taco-hvac.com/#sle.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

2.8 NATURAL GAS PRESSURE REGULATORS

A. Manufacturers:

1. Fisher

2. Eaton

3. Harper Wyman Co

4. Substitutions: See Section 01 6000-Product Requirements.

B. Comply with ANSI Z21.18

C. Provide with inlet and outlet pressure gage on piping.

D. Regulator shall be capable of towndown from 10 psi (or max pressure from Utility) to median pressure range of equipment served.

E. Regulator to be "ventless" where installed indoors, as approved by AHJ.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

C. Pipe relief from backflow preventer to nearest drain.

D. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to any fixture or equipment with quick closing valves..

END OF SECTION

SECTION 22 3000 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water Heaters:

1. Commercial gas fired.

B. Diaphragm-type compression tanks.

C. In-line circulator pumps.

1.2 RELATED REQUIREMENTS

A. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less 2014.

B. ANSI Z21.10.3 - Gas-Fired Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous 2015.

C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2019.

D. ICC (IPC) - International Plumbing Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

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

B. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.

2. Indicate pump type, capacity, power requirements.

3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

4. Provide electrical characteristics and connection requirements.

C. Project Record Documents: Record actual locations of components.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Pump Seals: One of each type and size.

3. Extra Water Softener Salt: 50 pounds.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Certifications:

1. All products in contact with potable water: NSF approved.

2. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1 or ANSI Z21.10.3, as applicable, in addition to requirements specified elsewhere.

3. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.

4. Water Tanks: ASME labeled to ASME BPVC-VIII-1.

5. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.1 WATER HEATERS

A. Manufacturers:

1. A.O. Smith Water Products Co: www.hotwater.com/#sle.

2. PVI: www.pvi.com/#sle.

3. Lochinvar: www.lochinvar.com/#sle.

4. Bradford White: www.bradfordwhite.com.

5. Bock

6. Substitutions: See Section 01 6000 - Product Requirements.

B. Performance:

1. The water heater shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 standard.

2. The water heater's efficiency shall be verified through third party testing by AHRI and listed in the AHRI Certification Directory.

3. Minimum hot water storage temperature shall be 140 degrees F, unless otherwise noted on Schedules.

C. Commercial Gas Fired:

1. Type: Automatic, natural gas-fired, vertical storage.

2. Performance: Refer to Schedules.

3. Tank: Glass lined welded steel ASME labeled or AquaPLEX stainless steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.

4. Accessories:

a. Water Connections: Brass.

b. Dip Tube: Brass.

c. Drain valve.

d. Anode: Magnesium.

e. Temperature and Pressure Relief Valve: ASME labeled.

5. Certified For The Following Applications as scheduled:

a. Automatic storage water heater.

b. Automatic circulating tank water heater.

6. Controls: The water heater shall feature a SMART Control with an LCD display with soft key pad. The control system shall have an electronic display for water heater set-up, water heater status, and water heater diagnostics. All electronic circuitry shall be easily accessed and serviceable from the front of the jacket.

7. Controls: Automatic water thermostat with temperature range adjustable from 120 to 180 degrees F, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers:

1. Amtrol Inc: www.amtrol.com/#sle.

2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.

3. Taco, Inc: www.taco-hvac.com/#sle.

4. Lochinvar: www.lochinvar.com.

5. Substitutions: See Section 01 6000 - Product Requirements.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 150 psi and 240 degrees F max working temperature, with heavy duty butyl fixed diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.3 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:

1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.

2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.

3. Taco: www.tacocomfort.com.

4. Grundfos Pumps: www.grundfos.com

5. Substitutions: See Section 01 6000 - Product Requirements.

B. Wet Rotor Inline Pump:

1. The pump shall be of the horizontal system lubricated type specifically designed and guaranteed for quiet operation.

2. Pump to be suitable for 225 degrees F (107 degrees C) operation at 150 psig working pressure.

3. The pump shall have a ceramic shaft supported by carbon bearings. Bearings are to be lubricated by the circulating fluid.

4. Pump body shall be lead-free bronze.

5. Motor stator to be isolated from circulating fluid through use of stainless steel can. Rotor to be sheathed in stainless steel.

6. Motors shall be non-overloading at any point on the pump curve. Motors shall have built-in thermal protection or impedance protection.

7. Accessories:

a. Check valve

b. Automatic timer kit - to turn pump on and off automatically at preset times.

c. Aquastat kit - to thermostatically turn on pump on at 100 degrees F and off at 120 degrees F.

2.4 ELECTRICAL WORK

A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.

B. Electrical characteristics to be as specified or indicated.

C. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related gas venting and electrical work to achieve operating system.

C. Provide for the service of a competent factory-trained supervising agent from the equipment manufacturer to inspect the completed installation, start the system and acquaint the operators with the proper operation and maintenance of the equipment.

D. Domestic Water Storage Tanks:

1. Provide steel pipe support, independent of building structural framing members.

2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

E. Pumps:

1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve, balancing valve and isolating valve on discharge.

2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3. Reduction from line size to pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow and to avoid air pockets.

4. Provide temperature and pressure gauges where and as detailed or directed.

5. All piping shall be brought to equipment and pump connections in such a manner so as to prevent the possibility of any load or stress being applied to the connections or piping.

6. Power wiring, as required, shall be the responsibility of the electrical contractor. All wiring shall be performed per manufacturer’s instruction and per applicable state, federal, and local codes.

7. Control wiring for remote mounted switches and sensor / transmitters shall be the responsibility of the control’s contractor. All wiring shall be performed per manufacturer’s instructions and applicable state, federal, and local codes.

8. Power and control wiring shall run in separate channel.

9. Pumps shall NOT be run dry to check rotation.

F. Floor Mounted Equipment:

1. Install the system level and in accordance with manufacturer’s published recommendations.

2. Locate equipment with allowance for manufacturer's recommended clearances around unit.

3. Set entire unit on 4" high reinforced concrete equipment pad.

4. Pipe discharge from all relief valves, drains and individual pump thermal purge protection solenoid valves, indirectly to floor drain having adequate capacity to accept discharge.

END OF SECTION

SECTION 23 0005 - BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. This section applies to all sections of Division 23.

B. Drawings and general provisions of the contract, including Division 00 and Division 01 specification sections, apply to work of this section.

C. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

D. The items in this section are supplementary to the requirements set forth in other portions of the specifications as indicated under item "A" above.

1.2 APPLICATION

A. This section applies to all mechanical work. The contractors involved shall check all sections of the specifications in addition to the particular section covering their specific trade. Each distinct section of the specifications aimed for one trade may have detailed information with regards to other trades, therefore, it is imperative that all sections be reviewed to get a complete picture of all other trades' functions and work required.

B. The mechanical contractor is responsible for the installation and operation of the hvac systems and temperature control systems.

C. The mechanical contractor is responsible for receiving, unloading and placement of all of the owner provided equipment.

1.3 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the work must be conducted before submitting proposal.

B. The submitting of a proposal implies that the contractor has visited the site and understands the conditions under which the work must be conducted.

1.4 ALTERNATES AND SUBSTITUTIONS

A. Refer to Division 01 - General Requirements for procedures.

1.5 DEVIATION FROM BASIS OF DESIGN MANUFACTURER

A. Products identified within the schedules and details are used as the basis of design for laying out and coordinating with other trades such as structural, architectural, and electrical. Should the Division 23 Contractors submit equipment by a Manufacturer other than that indicated as the Basis of Design in the Drawings, Contractor shall then be responsible for evaluating the impacts of the proposed Manufacturer’s equipment, even if the Manufacturer is listed in the specifications as an approved equal. This includes the proposed Manufacturer’s electrical, architectural and structural requirements and their subsequent impacts on the current design (roof openings, curbs, structural support, etc.) and coordination of any differing dimensions and clearances with all other trades.

1.6 MATERIALS

A. Mechanical equipment is to be furnished with motors, electrical controls and protective devices, and integral operating devices which are normally included by the manufacturer or required by the Contract Documents.

B. The Mechanical Trades shall provide all control wiring, 120 volts and less, for the equipment and devices furnished under Division 22, and 23 of these specifications, including all wiring devices, conduit, etc.

C. Power wiring 120 volts and greater shall be by the Electrical Trades.

1.7 DRAWINGS

A. The drawings are diagrammatic and show the general location and arrangement of all equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the drawings of other trades and verify the conditions governing the work on the job site. The mechanical and electrical contractor shall check all documents including architectural, structural, plumbing, HVAC and electrical to avert possible installation conflicts. Arrange work accordingly, providing such fittings, traps, valves and accessories as may be required to meet such conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Do not scale drawings for measurements.

F. Field verifications of actual existing conditions are required by the contractor since actual locations, distances, and levels will be governed by actual field conditions. All measurements shall be verified at the site.

G. If during field verification, the contractor identifies that there may require substantial changes from the original plans, the contractor shall notify the architect for agreement on necessary adjustment before the installation is started

H. Discrepancies shown between plans, or between plans and actual field conditions, or between plans and specifications shall promptly be brought to the attention of the Architect/Engineer for a decision.

I. Drawings and specifications are intended to cover the completed installation of systems to function as described. The omission of the expressed reference to any item of labor and material necessary to comply with practice codes, ordinances, etc., shall not relieve the contractor from providing such additional labor and material at no cost to Owner.

1.8 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for mechanical work shall be secured and paid for by the contractor. All work shall conform to all applicable codes, rules and regulations. Applicable publications listed in all sections

of Division 23 shall be the latest issue, unless otherwise noted.

B. Rules of local utility companies and municipalities shall be complied with. Check with the utility company and/or municipality supplying service to the installation and determine all devices including, but not limited to: meters, regulators, valves which will be required and include the cost of all such items in the proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

1.9 MAINTENANCE

A. Provide 40 hours of instruction to the owner's designated personnel in the maintenance and operation of equipment and systems.

B. Provide complete maintenance and operating instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Four (4) copies of all literature shall be furnished for owner and shall be bound in book or ring binder form. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

1.10 UTILITY COMPANY REBATES

A. The contractor shall apply for all applicable utility company rebates in the name of the owner. In a timely manner after award of contract, the contractor shall complete pre-application notifications for the applicable rebates for each school or building. At the completion of the project, the contractor shall furnish and submit all additional information required and requested of the utility company for the final application and submit the final application. The contractor shall act as the technical contact for communication in securing the rebates. The rebates shall be forwarded directly from the utility company to the owner, in the owner name. The contractor shall not claim any of the rebates for themselves.

1.11 WARRANTY AND GUARANTEE

A. Contractor shall guarantee all work installed by themselves or their subcontractors to be free from defect in material and workmanship for a period of one year from date of final acceptance of the work, unless a longer period is stipulated under specific headings. Contractor shall repair or replace at no additional cost to the owner, any material or equipment developing defects and shall also make good any damage caused by such defects or the correction of defects. Repairs or replacements shall bear additional guarantee, as originally called for, dated from the final acceptance of the repair or replacement. This requirement shall be binding even though it will exceed product guarantees normally furnished by some manufacturers. Contractor shall submit his own and each equipment manufacturers written certificates, warranting that each item of equipment furnished complies with all requirements of the drawings and specifications. Note that guarantee shall run from date of final acceptance of the work, not from date of installation of a device or piece of equipment.

1.12 SUBMITTALS

A. Refer to Division 01 - General Requirements for procedures.

B. Contractor shall provide submittals where items are referred to by symbolic designation on the drawings. All submittals shall bear the same designation (hvac equipment, piping equipment, etc.). Refer to other sections of the mechanical specifications for additional requirements.

C. Engineer WILL NOT REVIEW:

1. Submittals not specified.

2. Submittals not reviewed by Contractor, including Contractor stamp with signature comments.

3. Submittals made after work is delivered to site and/or installed.

4. Submittal resubmissions unless resubmission is required by Architect/Engineer.

D. Types of submittals include the following:

1. Shop Drawings

2. Product Data Sheets

3. Samples

4. Manufacturers Instructions

5. Maintenance Data

6. Warranty

E. Installation of any item that requires submittal approval by the engineer shall be installed at the contractors risk. The contractor, at his cost, shall remove all work installed prior to approval of the submittal.

F. The engineer will not be responsible for errors in quantities, or dimensions required to fit the job condition, details of fabrication to insure proper assembly at the job, or for errors resulting from mistakes in submittals.

1.13 RECORD DRAWINGS

A. Refer to Division 01 - General Requirements for procedures.

B. Contractor shall provide the following record drawings as part of the Project closeout document process:

1. Contract Documents, specifications and submittals, indicating "As-Built" conditions and actual products selected for use.

2. Product and Maintenance manuals for all equipment listed within this specification manual and in Contract Documents. Provide with parts lists as applicable.

C. Record drawings shall be maintained by the contractor up to date as the project progresses.

D. Recording all deviations from the contract documents, indicate exact locations of all buried services both inside and outside of the building; include concealed piping and equipment in the entire contract. Final record drawings shall reflect the as-built conditions.

1.14 QUALITY ASSURANCE

A. Other referenced standards:

1. Comply with referenced standards, guidelines, data sheets from various associations, including NFPA, ANSI, ASTM, ASME, ASHRAE

PART 2 PRODUCTS

2.1 SLEEVES AND ESCUTCHEONS

A. Provide sleeves wherever pipes pass through exterior wall, and floors. Sleeves shall be schedule 40 steel pipe cut to length. Sleeves shall terminate flush with walls, partitions and ceilings in finished areas. All sleeves through floor shall extend 2" above floor. Provide cast brass nickel-plated escutcheons with positive catches on each visible sleeve penetration. Sleves are to be sealed at each installation with a 3M approved sealant. The space between the inside of the sleeve and the outside of the pipe or conduit with in the sleeve shall be sealed at each installation with a 3M approved sealant.

2.2 DIELECTRIC UNIONS

A. Dielectric unions shall be used to connect dissimilar metals (such as steel and copper) to prevent electrolytic action.

2.3 FILTERS

A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment without all prefilters and final filters as specified. Immediately prior to final building acceptance by the owner, contractor shall replace all disposable type air filters with new.

2.4 BUILDING ATTACHMENTS FOR MECHANICAL WORK SUPPORTS

A. General Requirements:

1. Provide building attachments required for supporting mechanical work, suitably selected and installed for the loads applied with a minimum additional safety factor of 3.

2. Where specified attachments are not suitable for conditions, submit to Engineer for approval, proposal for alternate building attachments.

3. If specially designed building attachments are required, retain the services of a licenced structural engineer to design such building attachments.

4. Approved Manufacturers: Grinnell, or equivalent products by Michigan Hanger and B-Line.

5. Provide supplemental trapeze supports where necessary. Design trapeze to support all trades. Coordinate loads, and supports with all trades. Size trapeze for maximum deflection of 1/64 of the span.

B. Attachments to Structural Steel:

1. Support mechanical work from building structural steel where possible and approved. No welding or bolting to structural steel is permitted unless authorized by Architect. C-clamps are not permitted.

a. Center beam clamp - for loads over 120 lb.: Malleable center hung Grinnell Fig. 228.

b. Side beam clamp with retaining clips - for loads up to 120 lb.

C. Cast in Place Concrete Inserts:

1. Provide inserts selected for applied load of present load plus 100% for future, and coordinated with concrete work. Except as detailed on drawings, inserts shall be Unistrut or Grinnell. Plan, lay out and coordinate setting of inserts prior to concrete pour. Use Grinnell Fig. 285 lightweight concrete insert for loads up to 400# or Grinnell Fig. 281 Wedge Type concrete insert for loads up to 1200#

D. Drilled Insert Anchors:

1. Where mechanical work cannot be supported from structural steel, or cast in place concrete inserts, provide drilled concrete insert anchors. Submit for approval, project specific installation drawings for all loads over 100 lbs. Install inserts in web of beam if possible and approved. Insert depth shall not exceed two thirds the thickness of the concrete. Where existing concrete appears to be deteriorating, or where applied load at insert exceeds 1000 lbs., conduct test of concrete to determine derated capacity of insert. Anchors may be adhesive or expansion type up to 1000 lbs., and shall be adhesive type for loads over 1000 lbs.

2. Manufacturers: Hilti

PART 3 EXECUTION

3.1 GENERAL

A. Existing piping and ductwork: when encountered during the course of work, protect, brace and support existing piping and ductwork where required for proper execution of the work.

B. Interruption of existing active piping and ductwork: when the course of work makes shut-down of services unavoidable, the mechanical contractor shall schedule the shut-down at such time as approved by the owners representative, which will cause least interference with established operating routine.

C. Arrange work accordingly, providing such fittings as duct transitions traps, valves and accessories necessary to complete all construction in an orderiy fashion.

D. Install all equipment in strict accordance all directions and recommendations furnished by the manufacturer.

3.2 ACCESSIBILITY

A. Do not locate valves, traps, controls, unions, dampers, etc. in any system at a location that will be inaccessible after construction is completed. Maintain accessibility for all components in mechanical, electrical, and plumbing systems.

3.3 ACCESS DOORS AND PANELS

A. Refer to Division 08 - Openings; Provide access doors in locations as required by applicable codes and as indicated below. Coordinate locations with architectural trades.

B. Furnish access panels to access valves, traps, control valves or devices, dampers, damper motors, etc. Access panels shall be sized as necessary for ample access, or as indicated

on drawings, but no smaller than 12" x 12" where devices are within easy reach of operator, and at least 24"x24" when operator must pass through opening in order to reach the devices. Architectural Trades shall install access panels coordinated with Mechanical Trades.

C. Access panels in fire rated walls or ceiling must be U.L. labeled for intended use. Unless otherwise indicated on plans, access doors shall be hinged flush type steel framed panel, 14 gauge minimum for frame, and with anchor straps. Only narrow border shall be exposed. Hinges shall be concealed type. Locking device shall be flush type and screw driver operated. Metal surfaces shall be prime coated with rust-inhibitive paint. Panels shall be compatible with architectural adjacent materials Manufacturer: Milcor, Bilco.

3.4 CUTTING AND PATCHING

A. Refer to Division 01 - General Requirements and Division 02 - Existing Conditions.

B. All cutting required shall be done by the contractor whose work is involved, without extra cost the owner. All patching and restoration including the furnishing and installation of access panels in ceiling, walls; etc. Within the building lines shall be done by the respective, responsible contractor. No cutting of structural steel, concrete, or wood shall be done without prior approval and explicit directions of the architect patched by the respective, responsible contractor.

C. The contractor, under whose jurisdiction the work may fall, shall provide labor, material, and tools required to cut, repair, protect, cap, or relocate existing pipes, conduits, or utilities interfering with or uncovered during work, per regulations of the authorities having jurisdiction.

3.5 ROUGH-IN FOR CONNECTION TO EQUIPMENT

A. It shall be the responsibility of each contractor to study the architectural, structural, electrical, and mechanical drawings, conferring with the various trades involved and checking with the supplier of equipment in order to properly rough-in for all equipment.

3.6 MATERIAL AND EQUIPMENT

A. All material and equipment shall be new and of the best quality used for the purpose in good commercial practice, and shall be the standard product of reputable manufacturers. The material and equipment must meet approval of state and local codes in the area it is being used. Roof decks shall not be used to support piping, conduit, equipment, devices, etc.

3.7 SEAL PENETRATIONS

A. Seal the space around pipes in sleeves and around duct openings through walls, floors and ceilings. Provide adequate clearance to allow for proper sealing.

3.8 SOUND CONTROL

A. Penetrations shall be maintained airtight to prevent sound transfer.

B. Piping, ductwork, etc. shall pass through sleeves. Pack sleeves tight with glass fiber or oakum and caulked on both sides with non-hardening acoustical sealant.

3.9 FIRESTOPPING

A. Refer to Division 07 - Thermal and Moisture Protection for more information.

B. Provide UL classified firestopping system for mechanical penetrations through rated walls and floors to maintain the fire rating.

3.10 DELIVERY, STORAGE AND HANDLING OF EQUIPMENT AND MATERIALS

A. Refer to Division 01 - General Requirements; All equipment and materials shall be delivered, stored and secured per manufacturer's recommendations.

B. On-site storage shall be coordinated with Construction Manager and be performed in a manner as to avoid damage, deterioration and loss.

C. Contractor shall provide temporary protection for installed equipment prior to project completion.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. All equipment shall be inspected prior to installation to assure that equipment is free from defect and damage.

F. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

G. Protect dampers, grilles, louvers from damage to operating linkages and blades.

3.11 CLEANING

A. Refer to Division 01 - General Requirements; all mechanical equipment and components shall be cleaned as frequently as necessary through the construction process and again prior to project completion.

3.12 CONTROL WIRING

A. All control wiring for mechanical and electrical equipment, including motor starters, shall be 120 volt maximum and wired with one side of the coil grounded and the operating contacts in the north side of the circuit. All control wiring shall be installed in conduit.

END OF SECTION

SECTION 23 0505 - SELECTIVE DEMOLITION FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Demolition and extension of existing mechanical work.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Division 02 - Existing Conditions: Demolition, cleaning and disposal requirements, cutting and patching requirements, repairs.

1.3 SUMMARY

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of minor electrical demolition as described in this specification.

B. The demolition documents plans and specification have been prepared from existing non-as built documents and cursory non-invasive field investigation.

C. It is the contractors obligation to become familiar with the extent of demolition and the existing condition before submitting their bid.

D. During demolition if the contractor discovers unforeseen significant non-code compliance conditions of the existing installation they shall notify the Architect and Engineer immediately in writing.

E. The contractor shall become familiar with the drawings and scope of work of other trades as the work scope of those trades relates to mechanical equipment and connection requirements.

F. During demolition the contractor shall record on site as-builts all hydronic system piping capped branches, capped supply air, return air and exhaust ducts for reuse in renovated project space.

PART 2 PRODUCTS

2.1 MATERIALS

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping and ductwork to be demolished serve only equipment and facilities within the demolition areas.

B. Demolition drawings are based on casual field observation and existing record documents.

C. Report discrepancies to Owner before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Identify locations for capping piping and ductwork before any demolition work commences.

B. Confirm isolation valve locations for hydronic piping. Repair leaking isolation valves or replace inoperable valves before commencing piping demolition.

C. Cap and seal air-tight supply, return and exhaust air ductwork at shaft walls before commencing sheet metal demolition

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

A. Remove, relocate, and extend existing mechanical piping or sheet metal work to accommodate new construction.

B. Remove hydronic water piping back to isolation valve.

C. Remove all supply, return and exhaust air ductwork back to main connection.

3.4 CLEANING AND REPAIR

A. Refer to Division 01 - General Requirements for procedures.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

END OF SECTION

SECTION 23 0519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gages and pressure gage taps.

B. Thermometers and thermometer wells.

C. Static pressure gages.

1.2 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

1.3 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments 2013.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014, with Editorial Revision (2017).

1.4 SUBMITTALS

A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.5 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers:

1. Miljoco Corporation: www.miljoco.com.

2. H.O. Trerice Co.:www.trerice.com.

3. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.

4. Moeller Instrument Co., Inc: www.moellerinstrument.com/#sle.

5. Omega Engineering, Inc: www.omega.com/#sle.

B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.

2. Size: 4-1/2 inch diameter.

3. Mid-Scale Accuracy: One percent.

4. Scale: Psi.

2.2 PRESSURE GAGE TAPPINGS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:

1. Miljoco Corporation: www.miljoco.com.

2. H.O. Trerice Co.:www.trerice.com.

3. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.

4. Omega Engineering, Inc: www.omega.com/#sle.

5. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

1. Size: 12 inch scale.

2. Window: Clear Lexan.

3. Stem: 3/4 inch NPT brass.

4. Accuracy: 2 percentper ASTM E77.

5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.6 STATIC PRESSURE GAGES

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com.

2. Omega Engineering, Inc: www.omega.com.

3. Weksler Glass Thermometer Corp: www.wekslerglass.com.

B. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.

C. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Extend nipples and siphons to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometers in air duct systems on flanges.

F. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

J. Locate test plugs adjacent thermometers and thermometer sockets.

3.2 SCHEDULE

A. Pressure Gages, Location and Scale Range:

1. Pumps, 0 to 100 psi.

2. Expansion tanks, 0 to 60 psi.

B. Stem Type Thermometers, Location and Scale Range:

1. Headers to central equipment, 0 to 250 (HW), 0 to 120 (CHW) degrees F.
2. Boilers - inlets and outlets, 0 to 250 degrees F.
3. Water zone supply and return, 0 to 250 (HW), 0 to 120 (CHW) degrees F.

C. Static Pressure and Filter Gages, Location and Scale Range:

1. Air Handling Unit Filter Banks, 0 to 3 inches W.C.
2. Supply fan discharge, 0 to 6 inches W.C..

END OF SECTION 23 0519

SECTION 23 0523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Applications.

B. General requirements.

C. Ball valves.

D. Butterfly valves.

E. Check valves.

F. Combination flow measuring and balancing valves.

G. Chainwheels.

1.2 RELATED REQUIREMENTS

A. Section 23 0553 - Identification for HVAC Piping and Equipment.

B. Section 23 0719 - HVAC Piping Insulation.

C. Section 23 2113 - Hydronic Piping.

1.3 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. PTFE: Polytetrafluoroethylene.

E. SWP: Steam working pressure.

F. TFE: Tetrafluoroethylene.

1.4 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding 2017.

B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch) 2013 (Reaffirmed 2018).

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.

D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard 2017.

E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2017.

F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2018.

G. ASME B16.34 - Valves - Flanged, Threaded and Welding End 2017.

H. ASME B31.9 - Building Services Piping 2020.

I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2019).

J. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2018).

K. ASTM A536 - Standard Specification for Ductile Iron Castings 1984 (Reapproved 2014).

L. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.

M. AWWA C606 - Grooved and Shouldered Joints 2015.

N. MSS SP-45 - Bypass and Drain Connections 2003 (Reaffirmed 2008).

O. MSS SP-67 - Butterfly Valves 2017.

P. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends 2018.

Q. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves 2013.

R. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010.

1.5 SUBMITTALS

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

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

1.6 QUALITY ASSURANCE

A. Manufacturer:

1. Obtain valves for each valve type from single manufacturer.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Provide the following valves for the applications if not indicated on drawings:

1. Throttling (Hydronic): Combinations and Flow Measuring.

2. Isolation (Shutoff): Butterfly and Ball.

3. Pump Outlet: Spring Loaded Check.

4. Dead-End: Butterfly, single-flange (lug) type.

B. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

C. Required Valve End Connections for Non-Wafer Types: Use flanges, unions or grooved couplings to allow disconnection of components for servicing.

1. Steel Pipe:
    a. 2 NPS and Smaller: Threaded ends.
    b. 2-1/2 NPS and Larger: Grooved ends.
2. Copper Tube:
    a. 2 NPS and Smaller: Threaded ends (Exception: Solder-joint valve-ends).
    b. 2-1/2 NPS and Larger: Grooved ends.

D. Hydronic Valves:
1. 2 NPS and Smaller, Bronze Valves.
2. 2-1/2 NPS and Larger, Cast Steel Valves or Butterfly Valves.

2.2 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
2. Handwheel: Valves other than quarter-turn types.
3. Hand Lever: Quarter-turn valves 6 NPS and smaller.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: Provide 2 NPS stem extensions and the following features:
1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: Extended neck.
3. Memory Stops: Fully adjustable after insulation is installed.

E. Memory Stops: Fully adjustable after insulation is installed.

F. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.

G. General ASME Compliance:

1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.

2. Building Services Piping Valves: ASME B31.9.

H. Bronze Valves:

1. Fabricate from dezincification resistant material.

2. Copper alloys containing more than 15 percent zinc are not permitted.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE BALL VALVES

A. Two Piece, Full Port with brass Trim:

1. Comply with MSS SP-110.

2. SWP Rating: 150 psig.

3. CWP Rating: 600 psig.

4. Body: Bronze.

5. Ends: Solder or threaded with union.

6. Seats: PTFE .

7. Stem: Bronze or brass.

8. Ball: Chrome plated brass.

9. Manufacturers:

a. Apollo Valves: www.apollovalves.com/#sle.

b. Binomi North America.

c. Tyco Flow Control: www.tycoflowcontrol.com

d. Grinnel Products: www.grinnel.com

e. Victaulic Company: www.victaulic.com

f. Milwaukee Valve Company: www.milwaukeevalve.com

g. Kitz Corporation of Ameria.

h. Substitutions: See Section 01 6000 - Product Requirements.

2.4 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug type: Bi-directional dead end service without downstream flange.

1. Comply with MSS SP-67, Type I.

2. CWP Rating: 150 psig.

3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
4. Stem: Stainless steel with stem offset from the centerline to provide full 360 degree circumferential setting.
5. Seat: replaceable EPDM.
6. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.
7. Operator: 10 position lever handle.
8. Manufacturers:
    a. Apollo Valves: www.apollovalves.com/#sle.
    b. Tyco Flow Control: www.tycoflowcontrol.com.
    c. ABZ Valves and Controls.
    d. Hammond Valve: www.hammondvalve.com
    e. Grinnel Products: www.grinnel.com
    f. Victaulic Company: www.victaulic.com
    g. Substitutions: See Section 01 6000 - Product Requirements.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

A. CWP Rating: 175 psig (1200 kPa).
1. Comply with MSS SP-67, Type I.
2. Body: Coated ductile iron.
3. Stem: Stainless steel with stem offset from the centerline to provide full 360 degree circumferential setting.
4. Disc: Coated ductile iron.
5. Disc Seal: replaceable EPDM.
6. Operator: 10 position lever handle.
7. Manufacturers:
    a. Apollo Valves: www.apollovalves.com/#sle.
    b. Tyco Flow Control: www.tycoflowcontrol.com.
    c. ABZ Valves and Controls.
    d. Hammond Valve: www.hammondvalve.com
    e. Grinnel Products: www.grinnel.com
    f. Victaulic Company: www.victaulic.com

g. Substitutions: See Section 01 6000 - Product Requirements.

2.6 BRONZE SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa).

1. Comply with MSS SP-80, Type 3.
2. Body Design: Horizontal flow.
3. Body Material: Bronze, ASTM B62.
4. Ends: Soldered.
5. Disc: Bronze.
6. Manufacturers:
   a. Grinnell Products: www.grinnell.com.
   b. Kitz Corporation of America.
   c. Tyco Flow Control: www.tycoflowcontrol.com
   d. Victaulic Company: www.victaulic.com
   e. Substitutions: See Section 01 6000 - Product Requirements.

2.7 IRON, FLANGED END SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa) with Nonmetallic-to-Metal Seats.

1. Comply with MSS SP-71, Type I.
2. Design: Clear or full waterway with flanged ends.
3. Body: Gray iron with bolted bonnet in accordance with ASTM A126.
4. Trim: Bronze.
5. Disc: Stainless steel, bronze, or bronze faced rotating swing. Renewable disc and seat.
6. Gasket: Asbestos free.

B. Manufacturers:

1. Grinnel Products: www.grinnell.com.
2. Kitz Corporation of America.
3. Tyco Flow Control: www.tycoflowcontrol.com
4. Victaulic Company: www.victaulic.com
5. Substitutions: See Section 01 6000 - Product Requirements.

2.8 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP:

1. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
2. Seal: EPDM or Nitrile.
3. Disc: Stainless steel.
4. Coating: Black, non-lead paint.
5. Manufacturers:
    a. Grinnel Products: www.grinnell.com.
    b. Kitz Corporation of America.
    c. Tyco Flow Control: www.tycoflowcontrol.com
    d. Victaulic Company: www.victaulic.com
    e. Substitutions: See Section 01 6000 - Product Requirements.

2.9 IRON, PLATE-TYPE, SPRING LOADED CHECK VALVES

A. Class 125 Dual-Plate:

1. Comply with API STD 594.
2. 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
3. Body Design: Wafer or threaded lug ends, spring-loaded plates.
4. Body Material: ASTM A126, gray iron.
5. Trim: Bronze.
6. Resilient Seat: EPDM.
7. Spring: Stainless steel.
8. Manufacturers:
    a. Tyco Flow Control: www.tycoflowcontrol.com.
    b. Crane Co.: www.cranevalve.com
    c. Kitz Corporation of America.
    d. Victaulic Company: www.victaulic.com
    e. Substitutions: See Section 01 6000 - Product Requirements.

2.10 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly valve stems.

3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.

4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.1 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Install valves with stems upright or horizontal, not inverted.

D. Install check valves where necessary to maintain direction of flow as follows:

1. Swing Check: Install horizontal maintaining hinge pin level.

E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.2 SUBMITTALS

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

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
2. Brady Corporation: www.bradycorp.com.
3. Champion America, Inc: www.champion-america.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Letter Color: White.

C. Letter Height: 1/4 inch.

D. Background Color: Black.

2.2 TAGS

A. Manufacturers:

1. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
2. Brady Corporation: www.bradycorp.com.
3. Champion America, Inc: www.champion-america.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.3 PIPE MARKERS

A. Manufacturers:

1. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

2. Brady Corporation: www.bradycorp.com.

3. Champion America, Inc: www.champion-america.com.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Color: Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

E. Identify boilers, pumps, heat transfer equipment, tanks, and water treatment devices with nameplates. Small devices, such as inline pumps, may be identified with tags.

F. Identify control panels and major control components outside panels with nameplates.

G. Identify thermostats relating to terminal boxes or valves with nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify air terminal units and radiator valves with numbered tags.

J. Identify piping, concealed or exposed, with pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs

including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of hydronic systems.

B. Measurement of final operating condition of HVAC systems.

1.2 RELATED REQUIREMENTS

A. Section 23 0005 - Basic HVAC Requirements.

1.3 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008 (Reaffirmed 2017).

C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems 2015, with Errata (2017).

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.4 SUBMITTALS

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

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Owner and Engineer and for inclusion in operating and maintenance manuals.

2. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

3. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

4. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

5. Include the following on the title page of each report:

a. Name of Testing, Adjusting, and Balancing Agency.

b. Address of Testing, Adjusting, and Balancing Agency.

c. Telephone number of Testing, Adjusting, and Balancing Agency.

d. Project name.

e. Project location.

f. Report date.

D. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC (NSTSB), AABC National Standards for Total System Balance.

2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

3. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

2. Certified by one of the following:

a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.

b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.

c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Hydronic systems are flushed, filled, and vented.
8. Pumps are rotating correctly.
9. Proper strainer baskets are clean and in place.
10. Service and balance valves are open.

B. Beginning of work means acceptance of existing conditions.

3.3 ADJUSTMENT TOLERANCES

A. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.6 SCOPE

A. Test, adjust, and balance the following:

1. Plumbing Pumps.
2. HVAC Pumps.
3. Boilers.
4. Terminal Heat Transfer Units.

3.7 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. Pumps:

1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

C. Combustion Equipment:

1. Boiler manufacturer.
2. Model number.
3. Serial number.
4. Firing rate.
5. Burner manifold gas pressure.
6. Ambient temperature.
7. Heat output.

D. Heating Coils:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

E. Air Moving Equipment:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.

10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

END OF SECTION

SECTION 23 0713 - DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

1.2 RELATED REQUIREMENTS

A. Section 23 0005 - Basic HVAC Requirements.

B. Section 23 3100 - HVAC Ducts and Casings: Glass fiber ducts.

1.3 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

D. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

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

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Johns Manville: www.jm.com/#sle.

3. Knauf Insulation: www.knaufinsulation.com/#sle.

4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

5. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.

2. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.

2. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts Conveying Air Below Ambient Temperature:

1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.

3. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.

2. Secure insulation without vapor barrier with staples, tape, or wires.

3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.

4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.

5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.3 SCHEDULES

A. Combustion Air Duct:

1. Flexible Glass Fiber Duct Insulation: 1-1/2 inches thick.

END OF SECTION

SECTION 23 0719 - HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

C. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2013).

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.

D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation 2017.

E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2019.

F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.

I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

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

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, RIGID

A. Manufacturers:

1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Johns Manville Corporation: www.jm.com/#sle.

3. Knauf Insulation: www.knaufinsulation.com/#sle.

4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

5. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. K Value: ASTM C177, 0.24 at 75 degrees F.

2. Maximum Service Temperature: 850 degrees F.

3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Indoor Vapor Barrier Finish:

1. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.3 HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.

1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.

2. Maximum Service Temperature: 1200 degrees F.

3. Density: 15 lb/cu ft.

B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

2.4 JACKETS

A. PVC Plastic.

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.

a. Minimum Service Temperature: 0 degrees F.

b. Maximum Service Temperature: 150 degrees F.

c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.

d. Thickness: 10 mil.

e. Connections: Brush on welding adhesive.

2. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. 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.

E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

3. Do not bury hangers in the insulation. Insulation vapor barrier shall not be broken.

F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert location: Between support shield and piping and under the finish jacket.

4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.

3.3 SCHEDULE

A. Heating Systems:

1. Heating Water Supply and Return:

a. Pipe Size Range: 3/4 to 1-1/2" inch: 1-1/2 inches thick.

b. Pize Size Range: 2 to 12 inch: 2 inches thick.

END OF SECTION

SECTION 23 0915 - VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable frequency drives. This specification is to cover a complete variable frequency motor drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Division 03 - Concrete: Concrete equipment pads.

C. Section 23 0005 - Basic HVAC Requirements.

D. Division 26 - Electrical

1.3 REFERENCE STANDARDS

A. NEMA ICS 7.1

B. NEMA ICS 7

C. IEEE 519

D. UL 508A

E. UL 508

1.4 SUBMITTALS

A. Contractor shall provide submittals for equipment listed herein. Refer to Division 01 - General Requirements for submittal procedures.

B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.

D. Manufacturer's Field Reports: Indicate start-up inspection findings.

E. Qualifications: VFDs and options shall be UL listed as a complete assembly. The base VFD shall be UL listed for 100 KAIC without the need for input fuses. It is required that the drive manufacturer has an existing sales representative exclusively for HVAC products with expertise in HVAC systems and controls, and an independent service organization.

1.5 WARRANTY

A. Warranty shall be twenty-four (24) months from the date of certified startup, not to exceed thirty (30) months from the date of manufacture. The warranty shall include all parts, labor, travel time and expenses.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB U.S.; Model ACH 550: www.abb.us/drives.com.

B. Danfoss

C. Square D www.squared.com.

2.2 DESCRIPTION

A. Variable Frequency Drives: The VFD shall be solid state, with a pulse width modulated (PWM) output. The VFD package, as specified herein, shall be enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier, integral line reactors, capacitors and insulated gate bipolar transistors as the output switching device. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.

2.3 OPERATING REQUIREMENTS

A. Rated Input Voltage: Input 460/480 VAC +/- 10 percent, 3-phase, 48-63 Hz or input 208/220/230/240 VAC +/- 10 percent 3-phase, 48-63 Hz Undervoltage trip at rated input -35 percent. Overvoltage trip at rated input +30 percent.

B. Interrupt Rating: 65 kAIC, suitable for use on a circuit capable of delivering not more than 65,000 RMS symmetrical amps, 480V maximum.

C. Output Frequency: 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.

D. Operating Conditions: 0 to 40C, less that 95 percent humidity, noncondensing.

E. VFD Enclosure: The VFD package, as specified herein, shall be enclosed in a UL listed Type 12 enclosure, completely assemble and tested by the manufacturer in an ISO9001 facility.

F. Input Signal: 4 to 20 mA DC.

2.4 COMPONENTS

A. Display: All VFDs shall have the same customer interface, including digital display and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters and for stepping through the displays and menus. The keypad shall be removable, be capable of remote mounting, and have its own nonvolatile memory. The keypad shall include hand-off-auto membrane selections. When in “Hand” the VFD will be started and the speed will be controlled from the up/down arrows. When in “Off” the VFD will be stopped. When in “Auto” the VFD will start via and external speed reference. The drive shall incorporate “bumpless transfer” of speed reference when switching between “Auto” and “Hand” modes. There shall be fault reset and “Help” buttons on the keypad. The “Help” button shall include “on-line” assistance for programming and troubleshooting.

1. The VFDs shall utilize preprogrammed application macros specifically designed to facilitate startup. The application macros shall provide on command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow end-user to create

and save custom settings.

2. There shall be a built in time clock in the VFD keypad. The clock shall have a battery backup with a ten (10) year minimum lifespan. The clock shall be used to date and time stamp faults and record operation parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power-up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock, when in the off mode, for a programmable timeframe. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

B. Status Indicators: The following operating information displays shall be standard on the VFD digital display, All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words, alpha-numeric codes are not acceptable.

1. Output Frequency.
2. Motor Speed (RPM, percent or engineering units).
3. Motor Current.
4. Calculated Motor Torque.
5. Calculated Motor Power (kW).
6. DC Bus Voltage.
7. Output Voltage.
8. Analog Input Values.
9. Analog Output Values.
10. Keypad Reference Values.
11. Elapsed Time Meter (resettable).
12. kWh meter (resettable).
13. Digital Input Status.
14. Digital Output Status.
15. Ammeter.

C. The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage or loss of input signal protective trip. The number of restart attempts, trial time and time between reset attempts shall be programmable.

1. The VFD shall be capable of starting into a rotating load and accelerate or decelerate to setpoint without safety tripping or component damage. The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.

2. The VFD shall be equipped with an automatic extended control power ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Typical control power ride-through for a fan load shall be two (2) seconds minimum.

3. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the use the option of either: stopping and displaying fault, running at a programmable preset speed, hold the VFD speed based on the last good reference received, or cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and or over the serial communication bus.

4. The customer terminal strip shall be isolated from the line and ground.

5. The drive shall be employ current limit circuits to provide trip free operation: The slow current regulation limit circuit shall be variable to 150 percent (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad and shall be displayed in actual amps, not as a percent of full load. The current switch-off limit shall be fixed at 350 percent (minimum, instantaneous) of the VFD's normal duty current rating.

6. The overload rating of the drive shall be 110 percent of its normal duty current rating for one minute in every ten minutes, 130 percent overload for two seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL Table 430-150 for 4-pole motors.

7. The VFD shall have an integral 5 percent impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule-rated MOV's (phase to phase and phase to ground), a capacitor clamp and 5 percent impedance reactors.

8. The VFD shall be capable of sensing a loss of load (broken belt, no water in pump, etc.) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and or over the serial communications bus.

D. VFD Adjustments: Three programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. Two PID setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. There shall be a independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process. All setpoints, process variables, etc, to be accessible from the serial communication network. Two programmable analog inputs shall accept a current or voltage signal for speed reference or for reference and actual signals for PID controller. Two programmable analog outputs (0-20 ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power, and other data. Six programmable digital inputs. Three programmable digital Form C relay outputs. Seven programmable preset speeds. Two independently adjustable accel and decal ramps.

E. Serial Communications: The VFD shall have an RS-485 port as standard. The standard protocols shall be Modbus and Johnson Controls NS bus, with optional protocols for LonWorks, BACnet and Ethernet available. Serial communications capabilities shall include, but not be limited to: run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decal time adjustments, and lock/unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such

as process variable feedback, output speed/frequency, current, precent torque, kilowatt hours, operating hours and drive temperature. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface.

F. Microprocessor based Bypass Controller: A complete factory wired and tested bypass system consisting of an input contactor, output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes. Controller shall be manual or automatic (selectable) transfer to line power via contactors. A keypad to control the bypass controller shall be mounted on the enclosure door. The bypass keypad shall include a one-one diagram and status LED's to indicate the mode of operation, drive and bypass status, and ready and enable conditions. When in "Drive" mode, the bypass contactor is open and the drive output contactor is closed. In the "Bypass" position, the drive output contactor is open and the bypass controller is closed.

G. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.

H. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.

I. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.

J. Disconnecting Means: Include integral fused disconnect switch on the line side of each controller.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Provide fuses in fusible switches; refer to Section 16491 for product requirements.

D. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

E. Power wiring shall be completed by the electrical contractor.

F. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

3.2 MANUFACTURER'S FIELD SERVICES

A. Provide the service of the manufacturer's field representative to prepare and start controllers. Certified factory startup shall be provided for each drive by a factory-authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner and a copy kept on file at the manufacturer.

3.3 DEMONSTRATION

A. Demonstrate operation of controllers in automatic and manual modes.

END OF SECTION

SECTION 23 0923 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. System description.

B. Controllers.

C. Power supplies and line filtering.

D. System software.

E. Controller software.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

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

B. Product Data: Provide data for each system component and software module.

C. Shop Drawings:

1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.

2. List connected data points, including connected control unit and input device.

3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

5. Indicate description and sequence of operation of operating, user, and application software.

D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.

E. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

1. Revise shop drawings to reflect actual installation and operating sequences.

F. Operation and Maintenance Data:

1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.

2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.

3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Acceptable Control System Contractors: Company specializing in the installation of building control, automation and monitoring systems (a.k.a. DDC systems, Building Management Systems (BMS) or Building Automation Systems (BAS)) and HVAC control systems with a minimum five years documented HVAC experience, trained, certified and approved by the system manufacturer. Approved Control System Contractors include:

1. Metro Controls

2. CSO Michigan

3. Others by Prior Approval before receipt of bids - ONLY

B. Perform work in accordance with NFPA 70.

C. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.6 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a one year period after Substantial Completion.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

D. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.2 CONTROLLERS

A. CUSTOM APPLICATION CONTROLLERS

1. Manufacturers:

a. Automated LOgic

b. Others by Prior Approval before receipt of bids

c. Provide sufficient memory to support controller's operating system, database, and programming requirements.

d. Share data between networked, microprocessor based controllers.

e. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.

f. Utilize real-time clock for scheduling.

g. Continuously check processor status and memory circuits for abnormal operation.

h. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

i. Communication with other network devices to be based on assigned protocol.

j. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.

k. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

l. Outdoors and/or in Wet Ambient Conditions:

1) Mount within waterproof enclosures.

2) Rated for operation at 40 to 150 degrees F.

m. Conditioned Space:

1) Mount within dustproof enclosures.

2) Rated for operation at 32 to 120 degrees F.

n. Diagnostic LED's for power, communication, and processor.

o. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

2. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

a. Maintain operation at 90 to 110 percent of nominal voltage rating.

b. Perform orderly shutdown below 80 percent of nominal voltage.

c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. Application Specific Controllers:

1. General:

a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.

b. Customized for operation within the confines of equipment served.

c. Communication with other network devices to be based on assigned protocol.

2. Communication:

a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.

b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:

a. Outdoors and/or in Wet Ambient Conditions:

1) Mount within waterproof enclosures.

2) Rated for operation at 40 to 150 degrees F.

b. Conditioned Space:

1) Mount within dustproof enclosures.

2) Rated for operation at 32 to 120 degrees F.

4. Provisions for Serviceability:

a. Diagnostic LEDs for power, communication, and processor.

b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

6. Power and Noise Immunity:

a. Maintain operation at 90 to 110 percent of nominal voltage rating.

b. Perform orderly shutdown below 80 percent of nominal voltage.

c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

2.3 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:

1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.

2. Limit connected loads to 80 percent of rated capacity.

3. Match DC power supply to current output and voltage requirements.

4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.

5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.

6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.

7. Operational Ambient Conditions: 32 to 120 degrees F.

8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.

9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:

1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.

2. Minimum surge protection attributes:

a. Dielectric strength of 1000 volts minimum.

b. Response time of 10 nanoseconds or less.

c. Transverse mode noise attenuation of 65 dB or greater.

d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.4 LOCAL AREA NETWORK (LAN)

A. Provide communication between control units over local area network (LAN).

B. LAN Capacity: Not less than 60 stations or nodes.

C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

D. LAN Data Speed: Minimum 19.2 Kb.

E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

F. Transmission Median: Fiber optic or single pair of solid 24 gage twisted, shielded copper cable.

G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.5 SYSTEM SOFTWARE

A. The BMS system software (head end software) is existing. The new controllers and equipment shall be connected and configured into the existing BMS system.

B. Operating System:

1. Concurrent, multi-tasking capability.

2. Custom Graphics Generation Package: Create custom graphics for the new equipment being connected into the existing BMS system.

a. Create, modify, and save graphic files and visio format graphics in PCX formats.

b. HTML graphics to support web browser compatible formats.

c. Capture or convert graphics from AutoCAD.

C. Workstation System Applications:

1. The BMS system is existing. Configure the new equipment into the existing BMS system. Provide for scheduling equipment on/off, occupied/unoccupied, set point adjustment, monitoring, alarming, etc.

2. The new equipment shall be connected via BACnet MSTP to an existing or new BMS controller. Provide for integration of data points from equipment controllers into BMS for remote monitoring and control.

2.6 CONTROLLER SOFTWARE

A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.

B. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.

C. Alarms:

1. Binary object is set to alarm based on the operator specified state.

2. Analog object to have high/low alarm limits.

3. All alarming is capable of being automatically and manually disabled.

4. Alarm Reporting:

a. Operator determines action to be taken for alarm event.

b. Alarms to be routed to appropriate workstation.

c. Reporting Options:

D. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.

E. Anti-Short Cycling:

1. All binary output objects protected from short-cycling.

2. Allows minimum on-time and off-time to be selected.

F. On-Off Control with Differential:

1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.

2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.

G. Run-Time Totalization:

1. Totalize run-times for all binary input objects.

2. Provides operator with capability to assign high run-time alarm.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

3.2 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.

C. Provide conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

D. Install control components provided with packaged equipment, including but not limited to temperature sensors, CO2 sensors, pressure sensors.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. The control contractor shall be responsible to provide additional 120V power as required for temperature controls and building automation. Some circuits may be indicated on the electrical drawings (if applicable) or provided from existing controllers being removed. If additional circuits are required, coordinate with the electrical contractor and/or owner's representative for locations of available circuits and provide circuit breakers, wiring and conduit as necessary.

B. The control contractor shall be responsible to provide low-voltage power supplies, wiring, conduit, etc. as necessary to power control, metering and monitoring devices.

C. Install signal and communication cable according to DDC system or packaged equipment manufacturer's recommendations.

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.

2. Install exposed cable in raceway. Wiring and cable in mechanical rooms shall be installed in conduit.

3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

8. Low voltage cabling shall be run separate from 120V control wiring.

9. Input and output wiring shall be run in separate conduit systems.

10. Analog inputs shall be run separate from digital inputs.

11. Network cabling shall be run in separate conduit systems.

12. No control wiring splices are allowed.

3.4 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

3.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate complete and operating system to Owner.

3.6 MAINTENANCE

A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.

B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

C. Provide complete service of systems, including call backs. Make minimum of 2 complete normal inspections of approximately 2 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

SECTION 23 2113 - HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water piping, above grade.

C. Pipe hangers and supports.

D. Unions, flanges, mechanical couplings, and dielectric connections.

1.2 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting.

B. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.

C. Section 23 0523 - General-Duty Valves for HVAC Piping.

D. Section 23 0553 - Identification for HVAC Piping and Equipment.

E. Section 23 0719 - HVAC Piping Insulation.

F. Section 23 2114 - Hydronic Specialties.

G. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.3 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications 2019.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2016.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2018.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.

E. ASME B31.9 - Building Services Piping 2020.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.

G. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts 2014 (Reapproved 2020).

H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2019.

I. ASTM A536 - Standard Specification for Ductile Iron Castings 1984 (Reapproved 2014).

J. ASTM B32 - Standard Specification for Solder Metal 2020.

K. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.

L. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

M. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2015, with Editorial Revision (2018).

N. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) 2020.

O. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2017.

P. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 2020.

Q. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.

R. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2011 (Amended 2012).

S. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.

1.4 SUBMITTALS

A. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

B. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.

2. Provide manufacturers catalogue information.

3. Indicate valve data and ratings.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

A. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

B. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

C. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.

2. Use non-conducting dielectric connections whenever jointing dissimilar metals.

3. Grooved mechanical joints may be used in any location.

a. Grooved mechanical connections and joints comply with AWWA C606.

1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.

2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.

b. Use rigid joints unless otherwise indicated.

c. Use gaskets of molded synthetic rubber with central cavity, pressure responsive configuration and complying with ASTM D2000, Grade 2CA615A15B44F17Z for circulating medium up to maximum 230 degrees F or Grade M3BA610A15B44Z for circulating medium up to maximum 200 degrees F.

d. Provide steel coupling nuts and bolts complying with ASTM A183.

4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

5. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:

1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch ball valves with cap; pipe to nearest floor drain.

2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.

3. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.

4. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.

E. Performance Requirements:

1. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated.

a. Heating water piping: 150 psig @ 200 deg F.

2.2 HEATING WATER **PIPING, ABOVE GRADE**

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:

1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.

2. Threaded Joints: ASME B16.3, malleable iron fittings.

3. Grooved Mechanical Joint Fittings and Couplings:

a. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 325110 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pins, locking toggle, or lugs to secure grooved pipe fittings.

b. Couplings: Ductile or malleable iron housing and EPDM or nitrile gasket of central cavity pressure responisive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved ppe and fittings.

B. Steel Pipe Sizes 12 Inches and Greater: ASTM A53/A53M, 3/8 inch wall, black, using one of the following joint types:

1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.

2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

C. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.

a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.

2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.

3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.

1. Fittings: ASTM D2466 or D2467, PVC.

2. Joints: Solvent welded in accordance with ASTM D2855.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

C. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis. Do not bury the hanger in the insulation. Provide inserts and shields.

D. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis. Do not bury the hanger in the insulation. Provide inserts and shields.

E. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger. Provide inserts and shields.

F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

G. Vertical Support: Steel riser clamp.

H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

I. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

J. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.5 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.

2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.

2. Copper Piping: Bronze.

3. Gaskets: 1/16 inch thick preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.

2. Mechanical Couplings: Comply with ASTM F1476.

3. Housing Material: Ductile iron complying with ASTM A536.

4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.

5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.

6. When pipe is field grooved, provide coupling manufacturer's grooving tools.

7. Manufacturers:

a. Grinnell Products, a Tyco Business: www.grinnell.com.

b. Victaulic Company: www.victaulic.com.

D. Dielectric Connections:

1. Waterways:

a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.

b. Dry insulation barrier able to withstand 600 volt breakdown test.

c. Construct of galvanized steel with threaded end connections to match connecting piping.

d. Suitable for the required operating pressures and temperatures.

2. Flanges:

a. Dielectric flanges with same pressure ratings as standard flanges.

b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.

c. Dry insulation barrier able to withstand 600 volt breakdown test.

d. Construct of galvanized steel with threaded end connections to match connecting piping.

e. Suitable for the required operating pressures and temperatures.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.

3.2 **PIPING APPLICATIONS**

A. Heating water piping, above ground:

1. Pipe sizes 3/4" - 2 1/2": Copper, soldered/brazed joints.

2. Pipe sizes 2 1/2" and larger: Schedule 40 black steel, welded or grooved joints

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interfere with use of space.

F. Group piping whenever practical at common elevations.

G. Sleeve pipe passing through partitions, walls and floors.

H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

I. Slope piping and arrange to drain at low points.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 0516.

K. Grooved Joints:

1. Install in accordance with the manufacturer's latest published installation instructions.

2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

L. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

M. Pipe Hangers and Supports:

1. Install in accordance with MSS SP-58.

2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

4. Place hangers within 12 inches of each horizontal elbow.

5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

8. Provide copper plated hangers and supports for copper piping.

9. Prime coat exposed steel hangers and supports. Refer to Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

10. For piping over 2", provide inserts and shields. Do not bury hangers in piping.

N. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 0719.

O. Use eccentric reducers to maintain top of pipe level.

P. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

Q. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 9123.

R. Install valves with stems upright or horizontal, not inverted.

3.4 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect pumps for proper rotation. Set makeup pressure-reducing valves for required system pressure.

3. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

4. Set temperature controls so all coils are calling for full flow.

5. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

6. Verify lubrication of motors and bearings.

3.5 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.

3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. 2-1/2 inch: Maximum span, 9 feet; minimum rod size, 3/8 inch.

B. Hanger Spacing for Steel Piping.

1. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
2. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
3. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
5. 6 inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
6. 8 inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
7. 10 inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
8. 12 Inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.

END OF SECTION

SECTION 23 2114 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Suction diffusers.

F. Combination pump discharge valves.

G. Pressure-temperature test plugs.

H. Relief valves.

1.2 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

B. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.3 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2019.

1.4 SUBMITTALS

A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 EXPANSION TANKS

A. Manufacturers:

1. Amtrol Inc: www.amtrol.com.

2. ITT Bell & Gossett: www.bellgossett.com.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psi.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.2 AIR VENTS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com.

2. ITT Bell & Gossett: www.bellgossett.com.

3. Taco, Inc: www.taco-hvac.com.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type:

1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.3 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com.

2. Grinnell Products, a Tyco Business: www.grinnell.com.

3. The Metraflex Company: www.metraflex.com.

B. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:

1. Flanged iron body for 175 psi working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger:

1. Provide flanged or grooved iron body for 175 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.4 SUCTION DIFFUSERS

A. Manufacturers:

1. ITT Bell & Gossett: www.bellgossett.com.

2. Anvil International, Inc: www.anvilintl.com.

3. Victaulic Company of America: www.victaulic.com.

B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh start up screen, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

2.5 PUMP CONNECTORS

A. Manufacturers:

1. The Metraflex Company: www.metraflex.com/#sle.

B. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.

1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.

2. End Connections: Same as specified for pipe jointing.

3. Provide necessary accessories including, but not limited to, swivel joints.

2.6 COMBINATION PUMP DISCHARGE VALVES

A. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.7 PRESSURE-TEMPERATURE TEST PLUGS

A. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.

B. Application: Use extended length plugs to clear insulated piping.

2.8 RELIEF VALVES

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com.
2. ITT Bell & Gossett: www.bellgossett.com.
3. Conbraco Industries: www.apollovalves.com.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide valved drain and hose connection on strainer blow down connection.

F. Support pump fittings with floor mounted pipe and flange supports.

END OF SECTION 23 2114

SECTION 23 2123 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. In-line circulators.

B. Base-mounted pumps.

1.2 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 23 0716 - HVAC Equipment Insulation.

C. Section 23 0719 - HVAC Piping Insulation.

D. Section 23 2113 - Hydronic Piping.

E. Section 23 2114 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators 2018.

B. UL 778 - Standard for Motor-Operated Water Pumps Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

B. Millwright's Certificate: Certify that base mounted pumps have been aligned.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Armstrong Fluid Technology, Inc: www.armstrongfluidtechnology.com/#sle.

B. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com.

2.2 HVAC PUMPS - GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Minimum Quality Standard: UL 778.

C. Base Mounted Pumps: Aligned by qualified millwright.

D. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.

2.3 IN-LINE CIRCULATORS

A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psi maximum working pressure.

B. Casing: Cast iron, with flanged pump connections.

C. Impeller: Non-ferrous keyed to shaft.

D. Bearings: Oil-lubricated bronze sleeve.

E. Shaft: Alloy steel with bronze sleeve, integral thrust collar.

F. Seal: Mechanical seal, 225 degrees F maximum continuous operating temperature.

2.4 BASE-MOUNTED PUMPS

A. Type: Horizontal shaft, single stage, direct connected, radially or horizontally split casing, for 125 psi maximum working pressure.

B. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze or stainless steel, fully enclosed, keyed to shaft.

D. Bearings: Grease lubricated roller or ball bearings.

E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

F. Seal: Mechanical seal, 225 degrees F maximum continuous operating temperature.

G. Drive: Flexible coupling with coupling guard suitable for VFD applications.

H. Baseplate: Cast iron or fabricated steel with integral drain rim.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

D. Provide line sized shut-off valve, strainer and pump suction fitting on pump suction, and line sized, shut-off valve, soft seat check valve and balancing valve on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals, piped to and discharging into floor drains.

G. Check, align, and certify alignment of base-mounted pumps prior to start-up.

H. Install base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 3000.

I. Lubricate pumps before start-up.

END OF SECTION 23 2123

SECTION 23 2500 - HVAC WATER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials.

1. System cleaner.

2. Closed system treatment (water).

B. Cleaning of piping systems.

C. Chemical treatment.

1.2 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

B. Section 23 2114 - Hydronic Specialties.

1.3 SUBMITTALS

A. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

B. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

C. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

D. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

E. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. AmSolv/Division of Amrep, Inc: www.amsolv.com/#sle.

B. GE Water Technologies: www.gewater.com/#sle.

C. Nalco Company: www.nalco.com/#sle.

D. H-O-H Water Technologies Inc..

2.2 MATERIALS

A. System Cleaner:

1. Manufacturers:

a. As recommended by chemical treatment manufacturer.

2. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.

B. Closed System Treatment (Water):

1. Manufacturers:

a. AmSolv/Division of Amrep, Inc: www.amsolv.com/#sle.

b. GE Water Technologies: www.gewater.com/#sle.

c. Nalco Company: www.nalco.com/#sle.

d. H-O-H Water Technologies Inc..

2. Sequestering agent to reduce deposits and adjust pH.

3. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.

4. Conductivity enhancers; phosphates or phosphonates.

PART 3 EXECUTION

3.1 PREPARATION

A. Place terminal control valves in open position during cleaning.

B. Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

A. Concentration:

1. As recommended by manufacturer.

B. Hot Water Heating Systems:

1. Using the normally closed bypass valve - open the valve and close valves to each boiler and circulate water thru the system, but not the boilers for 24 hours to clean existing system. Then drain, refill and circulate through boilers following the procedure below.

2. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.

3. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.

4. Circulate for 6 hours at design temperatures, then drain.

5. Refill with clean water and repeat until system cleaner is removed.

C. Remove, clean, and replace strainer screens.

D. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

3.5 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.

1. Provide minimum of two hours of instruction for two people.

2. Have operation and maintenance data prepared and available for review during training.

3. Conduct training using actual equipment after treated system has been put into full operation.

3.6 MAINTENANCE

A. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the equipment manufacturer or original installer.

B. Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.

C. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

D. Provide laboratory and technical assistance services during this maintenance period.

E. Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

END OF SECTION 23 2500

SECTION 23 3100 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single-wall round ducts and fittings.

B. Sheet metal materials.

C. Sealants and gaskets.

D. Hangers and supports.

1.2 RELATED REQUIREMENTS

A. Section 23 0005 - Basic HVAC Requirements

B. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

C. Section 23 0713 - Duct Insulation: External insulation and duct liner.

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 2020.

C. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2018.

E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).

F. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.5 SUBMITTALS

A. Contractor shall provide submittals for equipment listed herein. Refer to Division 01 - General Requirements for submittal procedures.

B. Product Data: Provide data for duct materials, duct connections, and factory fabricated fittings.

1.6 REGULATORY REQUIREMENTS

A. Construct ductwork to SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 1995, Second Edition with Addendum No. 1.

PART 2 PRODUCTS

2.1 SINGLE-WALL ROUND DUCT AND FITTING ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.

B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

E. Tees and Laterals: Select types ansd fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inchminimum diameter for lengths 36 inches or less; 3/8-inchminimum diameter for lengths longer than 36 inches.

2.3 SEALANTS AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

2. Tape Width: 3 inches.

3. Sealant: Modified styrene acrylic.

4. Water resistant.

5. Mold and mildew resistant

6. Maximum Static-Pressure Class: 10-ing wg, positive and negative

7. Service: Indoor and outdoor

8. Service Temperature: Minus 40 to plus 200 deg F.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.

4. Water resistant.

5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

8. Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.

3. Grade: NS.

4. Class: 25.

5. Use: O.

6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg pressure class, positive or negative.

2.4 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, "Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.5 DUCTWORK FABRICATION

A. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Provide turning vanes in all mitered elbows.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

D. T's, bends, and elbows: construct according to SMACNA (DCS).

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

G. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

H. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

I. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

D. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

E. Install round ducts in maximum practical lengths.

F. Install ducts with fewest possible joints.

G. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

H. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

I. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

J. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

K. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

L. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

N. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

O. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

P. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

Q. Use double nuts and lock washers on threaded rod supports.

3.2 HANGERS AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2. Outdoor, Supply-Air Ducts: Seal Class A.

END OF SECTION

SECTION 23 5100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Special Gas Vent.

1.2 REFERENCE STANDARDS

A. NFPA 54 - National Fuel Gas Code 2018.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).

C. UL 1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV.

1.3 DEFINITIONS

A. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

B. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.4 SUBMITTALS

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

B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory built units are used.

1.5 **WARRANTY**

A. The prefabricated flue system (Doubel Wall Metal Stacks) shall be warranted against functional failure due to defects in material and manufacturer’s workmanship for a period of 15 years from date of installation.

B. Special Gas Vent (AL-294C for condensing appliances) shall be warranted by the manufacturer against defects in material and workmanship for a period of (15) years from the date of manufacture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. AMPCO: www.ampcostacks.com/#sle.

B. Centrotherm

C. Heatfab:

D. Metal-Fab, Inc: www.mtlfab.com/#sle.

E. Selkirk Corporation: www.selkirkcommercial.com/#sle.

F. Schebler Company

G. Others by prior approval during the bidding process

2.2 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL

A. Regulatory Requirements:

1. Conform to applicable code for installation of natural gas burning appliances and equipment.

2.3 **SPECIAL GAS VENTS**

A. Vent shall be factory-built special gas type, double wall stainless or zero clearance poly, engineered and designed for use on Category IV appliances and as specified by the equipment manufacturer. Comply with UL 1738.

B. Vent shall be listed for an internal static pressure of 15” w.g. and tested to 37” w.g.

C. Stainless Steel Vents

1. Vent shall be constructed with an inner conduit constructed of AL29-4C® or 29-4 (S44735) superferritic stainless steel with a minimum thickness of .015” for diameters 3”-8” and .020” for diameters 10”-16”.

2. Design, fabricate, and install gas-tight preventing products of combustion leaking into the building.

a. All inner wall conduit components shall be manufactured from AL29-4C® or 29-4 (S44735). Joints shall not use screws or fasteners that penetrate the inner conduit.

b. Inner wall joints shall be designed with a male and female overlapping metal-metal connection to maintain condensate on the AL29-4C stainless steel. Proper ¼” per foot pitch must be maintained at all times and condensate should flow back toward the appliance to the required number of drains

3. The outer wall casing shall be constructed of 430 stainless steel that shall not require additional surface preparation, such as painting, in order to withstand the outdoors or high humidity environments.

4. Inner conduit and outer wall casing shall be constructed with a one-inch air space between them and in such a fashion that prevents cross-alloy contamination.

D. Polypropylene Vents (must be listed by the apliance manufacturer as acceptable)

1. Venting material shall conform to the requirements of The National Fuel Gas Code, ANSI Z223.1/NFPA-54 where applicable and shall comply with and be listed to UL-1738, the US Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV gas vent systems.

2. The vent shall be of the single wall, factory-built type, designed for use in conjunction with Category II, or IV condensing gas fired appliances.

3. The vent shall be constructed from Flame Resistant Polypropylene.

4. The vent system shall be continuous from the appliance's flue outlet to the vent termination outside the building. All systems components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings required to install the vent system shall be UL/cUL listed and supplied by the same manufacturer.

5. All systems components shall include a factory- installed gasket in their female-end to render the vent air and water tight when the male/female ends are pushed together as per manufacturer's instructions. Vent systems requiring field installed sealants or compounds shall not be acceptable.

E. Provide with appliance adapter, drain sections, supports clamps, rain cap, storm color, and other accessories to provide a complete system.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.

C. Extend boiler breeching up as required to discharge per applicable codes. Provide guy wires as recommended by breeching manutacturer. Coordinate with architectural trades for installatin of guy wire anchors.

D. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

E. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

3.2 SCHEDULES

A. Condensing Boilers: Category IV Special Gas Vent

B. Condensing Water Heater: Category IV Special Gas Vent

END OF SECTION

SECTION 23 5216 - CONDENSING BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured units.

B. Boiler construction.

C. Boiler trim.

D. Fuel burning system.

E. Factory installed controls.

1.2 RELATED REQUIREMENTS

A. Section 23 0913 - Instrumentation and Control Devices for HVAC.

B. Section 23 2114 - Hydronic Specialties.

C. Section 23 2123 - Hydronic Pumps.

D. Section 23 2500 - HVAC Water Treatment.

E. Section 23 5100 - Breechings, Chimneys, and Stacks.

F. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Current Edition.

B. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers 2017.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers 2019.

E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI) Current Edition.

F. NFPA 54 - National Fuel Gas Code 2018.

1.4 SUBMITTALS

A. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

B. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.

C. Manufacturer's Factory Inspection Report: Submit boiler inspection prior to shipment.

D. Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Electrical Components, Devices and Accessories: Boilers must be 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. I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.

D. ASME Compliance: Condensing boilers must be constructed in accordance with ASME Boiler and Pressure Vessel Code, Section IV “Heating Boilers”.

E. UL Compliance: Boilers must be tested for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

F. NOx Emission Standards: When installed and operated in accordance with manufacturer’s instructions, the following condensing boiler shall comply with the NOx emissions referenced below:

1. 20 ppm NOx corrected to 3% oxygen at all firing rates when firing on natural gas.

1.6 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Warranty Period for Fire-Tube Condensing Boilers:

1. The pressure vessel/heat exchanger shall carry a 15 year from shipment, non-prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.

2. The burner shall be conditionally guaranteed against any failure for (5) five years from shipment.

3. Manufacturer labeled control panels are conditionally warranted against failure for (3) three years from shipment.

4. All other components, with the exception of the igniter, flame detector and sen-sor, are conditionally guaranteed against any failure for (2) two years from shipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Natural Gas Boiler for Indoor Applications:

1. Lochinvar :
2. Aerco International, Inc
3. Cleaver-Brooks, Inc

2.2 MANUFACTURED UNITS

A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Metal membrane wall, stainless steel fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.3 BOILER CONSTRUCTION

A. Conform to the minimum requirements of ANSI Z21.13 and ANSI Z21.13 for construction of boilers.

B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE 90.1.

C. Required Directory Listings:

1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.

D. Heat Exchanger: Construct with Stainless Steel.

E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.

F. Insulate casing with insulation material, protected and covered by heavy gauge, metal jacket.

G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic or powder coated finish.

2.4 BOILER TRIM

A. ASME rated pressure relief valve.

B. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.

C. Temperature and pressure gauge.

D. Gas train, controls and safety to meet ASME CSD-1 requirements.

E. Pressure Switches:

1. High gas pressure.

2. Low gas pressure.

3. Air pressure.

F. Manual reset high limit.

2.5 FUEL BURNING SYSTEM

A. Provide forced draft automatic burner, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.

1. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.

2. Combustion Air Filter: Protects fuel burning system from debris.

B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.

C. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe

2.6 FACTORY INSTALLED CONTROLS

A. Option for internal or external (0-10) VDC control.

B. Temperature Controls:

1. Automatic reset type to control fuel burning system modulation with minimum of 10:1 turndown to maintain temperature.

2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.

3. Low-fire start time delay relay.

C. Electronic PI setpoint/modulation control system.

D. Microprocessor-based, fuel/air mixing controls.

2.7 **ACCESSORIES**

A. Condensate neutralization kit.

B. Control System Communication Card capable of BACnet communication with the Building Automation System.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.

C. Install boiler on concrete housekeeping base, sized minimum of 4 inches larger than boiler base in accordance with Section 03 3000.

D. Coordinate provisions for water treatment in accordance with Section 23 2500.

E. Pipe relief valves to nearest floor drain.

F. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.

G. Provide piping connection and accessories in accordance with Section 23 2114.

H. Provide for connection to electrical service in accordance with Section 26 0583.

I. Vent combustion fumes in accordance with manufacturer's recommendations. Refer to Section 23 5100.

3.2 FACTORY AUTHORIZED START-UP

A. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct start-up as recommended by the manufacturer to secure and maintain all warranties.

3.3 CLOSEOUT ACTIVITIES

A. CSD-1 required reporting: Complete CSD-1 boiler analysis and inspection as required by Michigan boiler divisions. Provide completed forms to authority having jurisdiction and owner.

B. Demonstration: Demonstrate operation of system to Owner's personnel.

1. Use operation and maintenance data as reference during demonstration.

2. Briefly describe function, operation, and maintenance of each component.

C. Training: Train Owner's personnel on operation and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of two hours of training.

END OF SECTION

SECTION 26 0005 - BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. This section applies to all sections of Division 26 and Division 28.

B. Drawings and general provisions of the contract, including Division 00 and Division 01 specification sections, apply to work of this section.

C. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

D. The items in this section are supplementary to the requirements set forth in other portions of the specifications as indicated under Item "A" above.

1.2 DRAWINGS

A. The drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

1.3 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the work must be conducted before submitting proposal.

B. The submitting of a proposal implies that the contractor has visited the site and understands the conditions under which the work must be conducted.

1.4 TEMPORARY FACILITIES

A. Provide and remove upon completion of the project, in accordance with the general conditions, a complete temporary electrical and telephone service during construction.

1.5 ALTERNATES

A. Refer to Division 01 - General Requirements for procedures.

1.6 GUARANTEE

A. Contractor guarantees that the installation is free from defects and agrees to replace or repair, any part of this installation which becomes defective within a period of one year following final acceptance, unless noted otherwise, provided that such failure is due to defects in the equipment, material or installation or to follow the specifications and drawings. File with the Owner any and all guarantees from the equipment manufacturers.

1.7 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the contractor. All work shall conform to all applicable codes, rules and regulations. Applicable publications listed in all sections of Division 26 shall be the latest issue, unless otherwise noted.

B. Rules of local utility companies shall be complied with. Check with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items in proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

1.8 STANDARDS OF MATERIAL AND WORKMANSHIP:

A. All materials shall be new, unless noted otherwise. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable standard specifications of the following recognized authorities:

1. A.N.S.I. - American National Standards Institute
2. A.S.T.M. - American Society for Testing Materials
3. I.C.E.A. - Insulated Cable Engineers Association
4. I.E.E.E. - Institute of Electrical and Electronics Engineers
5. N.E.C. - National Electrical Code (NFPA 70)
6. N.E.C.A. - National Electrical Contractors Association
7. N.E.M.A. - National Electrical Manufacturer's Association
8. N.F.P.A. - National Fire Protection Association
9. U.L. - Underwriters Laboratories, Inc.

B. Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.

C. All equipment of the same or similar systems shall be by the same manufacturer.

1.9 RECORD DRAWINGS

A. Refer to Division 01 - General Requirements for procedures. All literature shall be furnished in accordance with requirements listed in Division 01.

B. Contractor shall provide the following record drawings as part of the Project closeout document process:

1. Contract Documents, specifications and submittals, indicating "As-Built" conditions and actual products selected for use.

2. Product and Maintenance manuals for all equipment listed within this specification manual and in Contract Documents. Provide with parts lists as applicable.

1.10 SUBMITTALS

A. Refer to Division 01 - General Requirements for procedures.

B. Contractor shall provide submittals where items are referred to by symbolic designation on the drawings. All submittals shall bear the same designation (light fixtures, wiring devices, etc.). Refer to other sections of the electrical specifications for additional requirements.

C. Engineer WILL NOT REVIEW:

1. Submittals not specified.

2. Submittals which do not indicate optional equipment being provided.

3. Submittals not reviewed by Contractor; including Contractor stamp with signature comments.

4. Submittals made after work is delivered to site and/or installed.

5. Submittal resubmissions unless resubmission is required by Architect/Engineer.

1.11 MANUFACTURERS LISTED

A. The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.

B. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer five (5) days prior to bid date.

1.12 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's light fixtures for temporary lighting except as allowed and directed by the Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 INSTALLATION OF EQUIPMENT

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the drawings and specifications, report such conflicts to the Architect/Engineer for resolution.

B. Equipment location shall be as close as practical to locations shown on the drawings.

C. Working clearances shall not be less than specified in NFPA 70 (National Electric Code).

3.2 COORDINATION

A. Install work to avoid interference with work of other trades including, but not limited to, architectural and mechanical trades. Remove and relocate any work that causes an interference at Contractor's expense. Disputes regarding the cause of an interference will be resolved by the Construction Manager or Architect/Engineer.

3.3 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

A. Refer to Division 01 - General Requirements and Division 02 - Existing Conditions.

B. All cutting, patching and repair work shall be performed by the contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.4 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 30" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical drawings.

C. Backfill all excavations inside building, under drives and parking areas with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

D. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling. Tamp, roll as required.

3.5 EQUIPMENT FOUNDATION AND SUPPORTS

A. Shall be as required or as shown on plans or specified.

B. Provide concrete house keeping bases 4" above finished floor, with leveling channels, where noted, for floor-mounted equipment. Coordinate requirements with Division 03 - Concrete.

C. For equipment suspended from ceilings or walls, furnish and install all inserts, rods, structural steel frames, brackets and platforms required.

3.6 EQUIPMENT CONNECTIONS

A. Make connections to equipment, motors, lighting fixtures, and other items included in the work in accordance with the approved shop drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional

connections not shown on the drawings, but called out by the equipment manufacturer's shop drawings shall be provided.

3.7 ACCESS DOORS AND PANELS

A. Refer to Division 08 - Openings; Provide access doors in locations as required per N.E.C. Coordinate locations with architectural trades.

3.8 CLEANING

A. Refer to Division 01 - General Requirements; All equipment shall be cleaned as frequently as necessary through the construction process and again prior to project completion.

B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.9 DELIVERY, STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

A. Refer to Division 01 - General Requirements; All equipment and materials shall be delivered, stored and secured per manufacturer's recommendations.

B. On-site storage shall be coordinated with Construction Manager and be performed in a manner as to avoid damage, deterioration and loss.

3.10 DRAWINGS AND MEASUREMENTS

A. Electrical drawings are not intended to be scaled for rough-in measurements nor to serve as submittals. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement shall be taken by the Contractor.

END OF SECTION

SECTION 26 0505 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition and extension of existing electrical work.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements

B. Division 02 - Existing Conditions: Demolition, cleaning and disposal requirements.

C. Section 26 0005 - Basic Electrical Requirements.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that abandoned wiring and equipment serve only abandoned facilities.

B. Demolition drawings are based on casual field observation and existing record documents.

C. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.

1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.

2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.

1. Notify Owner before partially or completely disabling system.

2. Notify local fire service.

3. Make notifications at least 24 hours in advance.

4. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:

1. PCB-containing electrical equipment, including transformers, capacitors, and switches.

2. PCB- and DEHP-containing lighting ballasts.

3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

3.4 CLEANING AND REPAIR

A. See Division 01 - General Requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Metal-clad cable.

C. Wiring connectors.

D. Electrical tape.

E. Heat shrink tubing.

F. Oxide inhibiting compound.

G. Wire pulling lubricant.

H. Cable ties.

I. Firestop sleeves.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Division 02 - Existing Conditions: Demolition, cleaning and disposal requirements, cutting and patching requirements, and repairs.

C. Section 07 8400 - Firestopping.

D. Section 26 0005 - Basic Electrical Requirements.

E. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.

F. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

G. Section 26 0536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.

H. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

I. Section 28 4600 - Fire Detection and Alarm: Fire alarm system conductors and cables.

J. Division 31 - Earthwork: Excavating, bedding, and backfilling.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).

E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

F. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC) 2012.

G. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2009.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.

K. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.

L. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.

M. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.

N. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.

O. UL 1569 - Metal-Clad Cables Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Contractor shall provide submittals for equipment listed herein. Refer to Division 01 for submittal procedures.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is permitted only as follows:

1. Where not otherwise restricted, may be used:

a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.

1) Maximum Length: 6 feet.

b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.

H. Manufactured wiring systems are not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.

3. Tinned Copper Conductors: Comply with ASTM B33.

H. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.

a. Exceptions:

1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.

2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.

3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.

I. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

J. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.

2. Color Coding Method: Integrally colored insulation.

3. Color Code:

a. 480Y/277 V, 3 Phase, 4 Wire System:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

4) Neutral/Grounded: Gray.

b. 208Y/120 V, 3 Phase, 4 Wire System:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

4) Neutral/Grounded: White.

c. Equipment Ground, All Systems: Green.

d. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:

a. Cerro Wire LLC: www.cerrowire.com.

b. Encore Wire Corporation: www.encorewire.com.

c. General Cable Technologies Corporation: www.generalcable.com.

d. Southwire Company: www.southwire.com.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:

a. Size 10 AWG and Smaller: Stranded.

b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

2.4 METAL-CLAD CABLE

A. Manufacturers:

1. AFC Cable Systems Inc: www.afcweb.com/#sle.

2. Encore Wire Corporation: www.encorewire.com/#sle.

3. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:

1. Size 10 AWG and Smaller: Stranded.

2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide oversized neutral conductors where indicated or required.

G. Grounding: Full-size integral equipment grounding conductor.

H. Armor: Steel, interlocked tape.

2.5 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.

2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

H. Mechanical Connectors: Provide bolted type or set-screw type.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.

2. When circuit destination is indicated without specific routing, determine exact routing required.

3. Arrange circuiting to minimize splices.

4. Include circuit lengths required to install connected devices within 10 ft of location indicated.

5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.

6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.

7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.

8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

9. Provide oversized neutral/grounded conductors where indicated and as specified below.

a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.

b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.

2. Pull all conductors and cables together into raceway at same time.

3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.

4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

H. Terminate cables using suitable fittings.

1. Metal-Clad Cable (Type MC):

a. Use listed fittings.

b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

I. Install conductors with a minimum of 12 inches of slack at each outlet.

J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

M. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.

2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.

3. Do not remove conductor strands to facilitate insertion into connector.

4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.

5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

O. Insulate ends of spare conductors using vinyl insulating electrical tape.

P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07.

Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements

B. Division 02 - Existing Conditions: Demolition, cleaning and disposal requirements, cutting and patching requirements, repairs.

C. Section 26 0005 - Basic Electrical Requirements

D. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

E. Section 26 0536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.

F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

H. Division 31 - Earthwork: Excavating, trenching and fill.

1.3 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2017.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.

2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.

3. Notify Strategic Energy Solutions, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

A. Contractor shall provide submittals for equipment listed herein. Refer to Division 01 for submittal procedures.

B. Project Record Documents: Record actual locations of grounding electrode system components and connections.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.

2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.

a. Provide continuous grounding electrode conductors without splice or joint.

b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.

2. Metal Underground Water Pipe(s):

a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.

b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.

c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Concrete-Encased Electrode:

a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

4. Ground Ring:

a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.

b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.

c. Provide ground enhancement material around conductor.

d. Provide connection from ground ring conductor to:

1) Perimeter columns of metal building frame.

2) Ground rod electrodes located as indicated.

5. Ground Rod Electrode(s):

a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.

b. Space electrodes not less than 10 feet from each other and any other ground electrode.

c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.

6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.

    a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.

    b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.

    c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

G. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.

2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.

3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.

4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

H. Cable Tray Systems: Also comply with Section 26 0536.

I. Pole-Mounted Luminaires: Also comply with Section 26 5600.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.

2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:

1. Use insulated copper conductors unless otherwise indicated.

    a. Exceptions:

        1) Use bare copper conductors where installed underground in direct contact with earth.

2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.

2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.

3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

4. Manufacturers - Mechanical and Compression Connectors:

a. Advanced Lightning Technology (ALT): www.altfab.com

b. Burndy LLC: www.burndy.com

c. Harger Lightning & Grounding: www.harger.com

d. Thomas & Betts Corporation: www.tnb.com

5. Manufacturers - Exothermic Welded Connections:

a. Burndy LLC: www.burndy.com

b. Cadweld, a brand of Erico International Corporation: www.erico.com

c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.

2. Size: As indicated.

3. Holes for Connections: As indicated or as required for connections to be made.

4. Manufacturers:

a. Advanced Lightning Technology (ALT): www.altfab.com

b. Erico International Corporation: www.erico.com

c. Harger Lightning & Grounding: www.harger.com

d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.

2. Material: Copper-bonded (copper-clad) steel.

3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.

5. Manufacturers:

a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.

b. Erico International Corporation: www.erico.com/#sle.

c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.

d. Harger Lightning & Grounding: www.harger.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

D. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.

4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements

B. Division 02 - Existing Conditions: Demolition, cleaning and disposal requirements, and cutting and patching requirements.

C. Division 03 - Concrete: Concrete equipment pads.

D. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

E. Section 26 0005 - Basic Electrical Requirements

F. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

G. Section 26 0536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.

H. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

I. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

J. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.

D. MFMA-4 - Metal Framing Standards Publication 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.

2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.

2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.

4. Do not use products for applications other than as permitted by NFPA 70 and product listing.

5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.

a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.

2. Conduit Clamps: Bolted type unless otherwise indicated.

3. Manufacturers:

a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com

b. Erico International Corporation: www.erico.com

c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com

d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com

e. Thomas & Betts Corporation: www.tnb.com

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

1. Manufacturers:

a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.

b. Erico International Corporation: www.erico.com/#sle.

c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.

d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.

e. Thomas & Betts Corporation: www.tnb.com/#sle.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

1. Comply with MFMA-4.

2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.

3. Manufacturers:

a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com

b. Thomas & Betts Corporation: www.tnb.com

c. Unistrut, a brand of Atkore International Inc: www.unistrut.com

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:

a. Equipment Supports: 1/2 inch diameter.

b. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.

c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.

d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.

e. Outlet Boxes: 1/4 inch diameter.

f. Luminaires: 1/4 inch diameter.

F. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

4. Manufacturers:

a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com

b. Erico International Corporation: www.erico.com

c. PHP Systems/Design: www.phpsd.com

d. Unistrut, a brand of Atkore International Inc: www.unistrut.com

G. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Division 03.

5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: Also comply with Section 26 0533.13.

I. Cable Tray Support and Attachment: Also comply with Section 26 0536.

J. Box Support and Attachment: Also comply with Section 26 0533.16.

K. Secure fasteners according to manufacturer's recommended torque settings.

L. Remove temporary supports.

3.2 FIELD QUALITY CONTROL

A. See Division 01 - General Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 0533.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Aluminum rigid metal conduit (RMC).

C. Flexible metal conduit (FMC).

D. Electrical metallic tubing (EMT).

E. Rigid polyvinyl chloride (PVC) conduit.

F. Conduit fittings.

G. Accessories.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Division 02 - Existing Conditions: Demolition, cleaning and disposal requirements, cutting and patching requirements, and repairs.

C. Division 07 - Thermal and Moisture Protection: Firestopping.

D. Section 07 8400 - Firestopping.

E. Section 26 0005 - Basic Electrical Requirements

F. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

G. Section 26 0526 - Grounding and Bonding for Electrical Systems.

H. Section 26 0529 - Hangers and Supports for Electrical Systems.

I. Section 26 0533.16 - Boxes for Electrical Systems.

J. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

K. Section 28 4600 - Fire Detection and Alarm: Fire alarm wiring in conduit.

L. Division 31 - Earthwork: Excavating, trenching and fill.

M. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2015.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2015.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.

E. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit 2004.

F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.

G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.

H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit 2018.

I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.

J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2016.

K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.

M. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.

N. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.

O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.

P. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

1. Under Slab on Grade: Use galvanized steel rigid metal conduit or rigid PVC conduit.

2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit or rigid PVC conduit.

3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit or rigid PVC conduit.

4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.

5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.

D. Embedded Within Concrete:

1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit or rigid PVC conduit.

2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

K. Exposed, Exterior: Use galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.

M. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.

1. Maximum Length: 6 feet.

N. Connections to Vibrating Equipment:

1. Dry Locations: Use flexible metal conduit.

2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.

3. Vibrating equipment includes, but is not limited to:

a. Transformers.

b. Motors.

O. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.2 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Minimum Conduit Size, Unless Otherwise Indicated:

1. Branch Circuits: 3/4 inch (21 mm) trade size.

2. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.

3. Underground, Interior: 1 inch (27 mm) trade size.

4. Underground, Exterior: 1 inch (27 mm) trade size.

E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedeg.com

2. Republic Conduit: www.republic-conduit.com

3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:

1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:

1. AFC Cable Systems, Inc: www.afcweb.com

2. Electri-Flex Company: www.electriflex.com

3. International Metal Hose: www.metalhose.com

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedeg.com

2. Republic Conduit: www.republic-conduit.com

3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use compression (gland) or set-screw type.

a. Do not use indenter type connectors and couplings.

4. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

5. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.6 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:

1. Cantex Inc: www.cantexinc.com

2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com

3. JM Eagle: www.jmeagle.com

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.7 ACCESSORIES

A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

D. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

E. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

E. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.

2. When conduit destination is indicated without specific routing, determine exact routing required.

3. Conceal all conduits unless specifically indicated to be exposed.

4. Conduits in the following areas may be exposed, unless otherwise indicated:

   a. Electrical rooms.

   b. Mechanical equipment rooms.

5. Unless otherwise approved, do not route conduits exposed:

6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.

7. Arrange conduit to maintain adequate headroom, clearances, and access.

8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.

9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.

10. Group parallel conduits in the same area together on a common rack.

F. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.

4. Use conduit strap to support single surface-mounted conduit.

   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.

5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.

6. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.

7. Use of wire for support of conduits is not permitted.

G. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.

3. Use suitable adapters where required to transition from one type of conduit to another.

4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

5. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.

6. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

H. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.

2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.

4. Conceal bends for conduit risers emerging above ground.

5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.

6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.

8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07.

I. Underground Installation:

1. Provide trenching and backfilling in accordance with Division 31.

J. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):

1. Secure conduits to prevent floating or movement during pouring of concrete.

K. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Division 03 with minimum concrete cover of 2 inches on all sides unless otherwise indicated.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

3. Where conduits are subject to earth movement by settlement or frost.

M. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:

1. Where conduits pass from outdoors into conditioned interior spaces.

2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

N. Provide grounding and bonding in accordance with Section 26 0526.

O. Identify conduits in accordance with Section 26 0553.

3.3 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 0533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Division 03 - Concrete: Concrete.

C. Division 07 - Thermal and Moisture Protection: Firestopping.

D. Division 08 - Openings: Access Doors.

E. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

F. Section 26 0005 - Basic Electrical Requirements.

G. Section 26 0526 - Grounding and Bonding for Electrical Systems.

H. Section 26 0529 - Hangers and Supports for Electrical Systems.

I. Section 26 0533.13 - Conduit for Electrical Systems:

1. Conduit bodies and other fittings.

2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

J. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

K. Section 26 2726 - Wiring Devices:

1. Wall plates.

L. Section 26 2813 - Fuses: Spare fuse cabinets.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. SCTE 77 - Specification for Underground Enclosure Integrity 2017.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

J. UL 508A - UL Standard for Safety Industrial Control Panels 2018.

K. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.

4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.

5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.

6. Coordinate the work with other trades to preserve insulation integrity.

7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.

8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Contractor shall provide submittals for equipment listed herein. Refer to Division 01 for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.

C. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Keys for Lockable Enclosures: Two of each different key.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.

2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.

3. Provide products listed, classified, and labeled as suitable for the purpose intended.

4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.

2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.

3. Use suitable concrete type boxes where flush-mounted in concrete.

4. Use suitable masonry type boxes where flush-mounted in masonry walls.

5. Use raised covers suitable for the type of wall construction and device configuration where required.

6. Use shallow boxes where required by the type of wall construction.

7. Do not use "through-wall" boxes designed for access from both sides of wall.

8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.

9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.

10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.

12. Wall Plates: Comply with Section 26 2726.

13. Manufacturers:

    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com

    b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com

    c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com

    d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com

    e. Thomas & Betts Corporation: www.tnb.com

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.

2. NEMA 250 Environment Type, Unless Otherwise Indicated:

3. Junction and Pull Boxes Larger Than 100 cubic inches:

    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.

4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:

    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.

    b. Back Panels: Painted steel, removable.

    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with Division 08 as required where approved by the Architect.

2. Unless dimensioned, box locations indicated are approximate.

3. Locate boxes as required for devices installed under other sections or by others.

4. Locate boxes so that wall plates do not span different building finishes.

5. Locate boxes so that wall plates do not cross masonry joints.

6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.

7. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.

   a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.

8. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.

I. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.

2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

O. Close unused box openings.

P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

Q. Provide grounding and bonding in accordance with Section 26 0526.

3.3 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Floor marking tape.

G. Warning signs and labels.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Division 09 - Finishes: Interior and Exterior Painting.

C. Section 09 9113 - Exterior Painting.

D. Section 09 9123 - Interior Painting.

E. Section 26 0005 - Basic Electrical Requirements

F. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

G. Section 26 0536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.

H. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.

I. Section 26 2726 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

1.3 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.4 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.

a. Panelboards:

1) Identify ampere rating.

2) Identify voltage and phase.

3) Identify power source and circuit number. Include location when not within sight of equipment.

4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

b. Transformers:

1) Identify kVA rating.

2) Identify voltage and phase for primary and secondary.

3) Identify power source and circuit number. Include location when not within sight of equipment.

c. Enclosed switches, circuit breakers, and motor controllers:

1) Identify voltage and phase.

2) Identify power source and circuit number. Include location when not within sight of equipment.

3) Identify load(s) served. Include location when not within sight of equipment.

d. Transfer Switches:

1) Identify voltage and phase.

2) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

2. Service Equipment:

a. Use identification nameplate to identify each service disconnecting means.

3. Emergency System Equipment:

a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.

b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.

5. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.

6. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.

   a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 9123 and 09 9113.

7. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.

   a. Service equipment.

   b. Industrial control panels.

   c. Motor control centers.

   d. Elevator control panels.

   e. Industrial machinery.

8. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.

C. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.

2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

D. Identification for Cable Tray: Comply with Section 26 0536.

E. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.

2. Use voltage markers or color coded boxes to identify systems other than normal power system.

   a. Color-Coded Boxes: Field-painted in accordance with Division 09 per the same color code used for raceways.

F. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.

2. Use identification label to identify fire alarm system devices.

a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.

3. Use identification label to identify serving branch circuit for all receptacles.

a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.

G. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:

a. Indoor Clean, Dry Locations: Use plastic nameplates.

b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.

3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.

4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.

5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches by 4 inches.

2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 1/2 inch.

5. Color: Black text on yellow background unless otherwise indicated.

D. Format for Receptacle Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Power source and circuit number or other designation indicated.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch.

5. Color: Black text on clear background.

E. Format for Fire Alarm Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Designation indicated and device zone or address.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch.

5. Color: Red text on white background.

2.3 VOLTAGE MARKERS

A. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

B. Minimum Size:

1. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.

2. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

C. Legend:

1. Markers for Voltage Identification: Highest voltage present.

2. Markers for System Identification:

a. Emergency Power System: Text "EMERGENCY".

D. Color: Black text on orange background unless otherwise indicated.

2.4 UNDERGROUND WARNING TAPE

A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:

1. Tape for Buried Power Lines: Black text on red background.

2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.5 FLOOR MARKING TAPE

A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.6 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:

1. Materials:

a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.

b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.

2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.

3. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.

2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.

2. Flush-Mounted Equipment: Inside of equipment door.

3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.

4. Elevated Equipment: Legible from the floor or working platform.

5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Boxes: Outside face of cover.
8. Conductors and Cables: Legible from the point of access.
9. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

SECTION 26 2813 - FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Section 26 0005 - Basic Electrical Requirements.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0573 - Power System Studies: Additional criteria for the selection of protective devices specified in this section.

E. Section 26 2416 - Panelboards: Fusible switches.

F. Section 26 2816.16 - Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses 2012.

B. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements Current Edition, Including All Revisions.

C. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses Current Edition, Including All Revisions.

D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com

B. Littelfuse, Inc: www.littelfuse.com

C. Mersen: ep-us.mersen.com

2.2 APPLICATIONS

A. Service Entrance:

1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.

2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Feeders:

1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.

2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

2.3 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

H. Class L Fuses: Comply with UL 248-10.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 2816.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements: Project administrative and procedural requirements.

B. Section 26 0005 - Basic Electrical Requirements.

C. Section 26 0526 - Grounding and Bonding for Electrical Systems.

D. Section 26 0529 - Hangers and Supports for Electrical Systems.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 0573 - Power System Studies: Additional criteria for the selection of equipment and associated protective devices specified in this section.

G. Section 26 2813 - Fuses.

H. Section 26 3600 - Transfer Switches: Automatic and non-automatic switches listed for use as transfer switch equipment.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB/GE: www.geindustrial.com

B. Eaton Corporation: www.eaton.com

C. Schneider Electric; Square D Products: www.schneider-electric.us

D. Siemens Industry, Inc: www.usa.siemens.com

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.

2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

H. Provide with switch blade contact position that is visible when the cover is open.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1.

b. Outdoor Locations: Type 3R.

L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

M. Heavy Duty Switches:

1. Comply with NEMA KS 1.

2. Conductor Terminations:

a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

a. Provide means for locking handle in the ON position where indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Identify enclosed switches in accordance with Section 26 0553.

3.2 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

END OF SECTION