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CLEARWATER HOUSING AUTHORITY

BARBEE TOWERS

COMMISSION #: 19079.00

PROJECT MANUAL

VOL II

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KEM
ENGINEERS, INC
MECHANICAL • ELECTRICAL • STRUCTURAL
LICENSE FL #EB-0007103
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DIVISION 16 – ELECTRICAL

SECTION 15010
GENERAL MECHANICAL PROVISIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 00 and Division 01 Specification Sections, apply to this and the other sections of Division 15.

1.02 SUMMARY

A. Section includes:

1. General administrative and procedural requirements, as well as basic mechanical materials and methods.
2. Submittals.
3. Coordination drawings.
4. Record documents.
5. Operation and Maintenance manuals.
6. Rough-ins.
7. Mechanical installations.
8. Cutting and patching.
9. Concrete equipment base construction requirements.
10. Equipment nameplate data requirement.
11. Labeling and identifying mechanical systems and equipment is specified in "Identification for HVAC Piping and Equipment."
12. Non-shrink grout for equipment installations.
13. Field-fabricated metal and wood equipment supports.
14. Installation requirements common to equipment specification Sections.
15. Touchup painting and finishing.

1.03 ACRONYMS

A. The following list of abbreviations are utilized within the specifications and are provided as a reference:

AABC	Associated Air Balance Council
ADA	American Disability Act
ADC	Air Diffusion Council
AGA	American Gas Association
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association

BOCA	Building Officials and Code Administrators
CS	Commercial Standard
IEEE	Institute of Electrical and Electronics Engineers
FBCM	Florida Building Code – Mechanical
FBCP	Florida Building Code – Plumbing
MSSP	Manufacturers Standards Society of the Valve and Fittings Industry
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
TEMA	Tubular Exchanger Manufacturers Association
UL	Underwriters' Laboratories

1.04 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: Changes proposed by Contractor in products, materials, equipment, and methods of construction required by the Contract Documents.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named, or a product is 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. Extended 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.

1.05 SYSTEM DESCRIPTION

A. Design Requirements: Contract drawings are generally diagrammatic and do not indicate all offsets, fittings, transitions, access panels and other specialties required.

1. Furnish and install all items as may be required at no additional cost to fit the work to the conditions encountered.
2. Arrange piping, ductwork, equipment and other work generally as shown on the contract drawings, providing proper clearances and access.
3. Where departures are proposed because of field conditions or other causes, prepare and submit a detailed shop drawing submittal for approval in accordance with Submittals specified below.
4. Subject to the provisions of Division 1, Architect may make reasonable changes in location of equipment piping and ductwork up to the time of rough-in or fabrication.

1.06 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the contract and Division 01 Specification Sections.

B. Comply with the Division 01 specifications.

C. Shop Drawings and Product Data:

1. Clearly identify all submittals:
   a. Indicate intended application, location, etc.
   b. Each submittal shall indicate the associated specification section, and paragraphs. Do not combine product data and shop drawing submittals from different spec sections into a single submittal package, even though they may be the same distributor, vendor or part of a single material order.
   c. Clearly indicate the exact type, model number, size and special features of the proposed item.
   d. Include catalog spec sheets to completely describe proposed equipment.
   e. Factory order forms only showing the required capacities are not acceptable.
   f. Identify all options furnished to meet specifications.
   g. The Architect shall not select equipment ratings and/or options. Submittals not properly marked shall be returned without review.

D. Product Substitutions: Comply with requirements of the Division 01 Specifications.

E. Comparable Products Submission:

1. Document each request for a proposed comparable product with supporting data substantiating compliance of proposed product with Basis-of-Design product.
2. Use the attached “Comparable Product Submittal Form” in addition to the requirements specified herein.
3. Comparable products will not be reviewed without completion of the attached form.

F. Coordination Drawings

1. Prepare coordination drawings to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:
   a. Indicate the proposed locations of piping, valving, ductwork, equipment, and materials. Include the following:
   b. Planned piping layout, including valve and specialty locations and valve stem movement.
   c. Planned duct systems layout, including elbow radii and duct accessories.
   d. Clearances for installing and maintaining insulation.
   e. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   f. Equipment connections and support details.
   g. Exterior wall and foundation penetrations.
   h. Fire-rated wall and floor penetrations.
   i. Sizes and location of required concrete pads and bases.
   j. Duct fire dampers, smoke dampers and combination fire/smoke dampers.
   k. Access doors.
   l. Clearances at electrical components in accordance with the National Electric Code.
   m. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
   n. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. Show all wall mounted access doors for mechanical devices.
   o. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, cable trays, sprinklers, access doors and other ceiling mounted items.
   p. Coordination drawings shall at a minimum include coordination with other divisions, fire protection, plumbing and electric installers. Include fire protection piping, domestic water piping (cold water, hot water and hot water re- circulation), sanitary piping, sanitary vent piping, ductwork, ceiling mounted air devices, lights, ceiling and building structural members (floor slabs, beams, joists, etc.). Coordination drawings shall be provided at a minimum for:
      1) First floor to seventh floor corridor. Provide floor plans.
      2) Commercial kitchen ductwork layout. Provide floor plans and at least two sections.
   q. Submit ductwork fabrication drawings.

G. Closeout Submittals:

1. Record Drawings: Prepare record documents in accordance with the requirements in the Division 01 Specifications. In addition to the requirements specified in Division 01, indicate the following installed conditions:

a. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
b. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart.
c. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
d. Approved substitutions, Contract Modifications, Responses to Contractor's Request for Information, and actual equipment and materials installed.
e. Record the locations and invert elevations of underground installations.

2. Operation and Maintenance Data: Prepare operation and maintenance data in accordance with the Division 01 Specifications. In addition to the requirements specified in Division 01, include the following information for equipment items:
a. List of systems and equipment requiring service manuals.
b. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
c. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
d. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
e. Servicing instructions and lubrication charts and schedules.
f. Systems and Equipment test reports.

H. Color Selection: Color of finishes shall be as selected by the Architect. Submit color charts of any factory finished equipment specified for color for acceptance prior to ordering.

I. Products and Materials:
1. Submit complete descriptive data for all materials as follows:
a. Material specifications.
b. Data sheets.
c. Samples.
d. Capacity ratings.
e. Performance curves.
f. Operating characteristics.
g. Catalog cuts.
h. Dimensional drawings.
i. Wiring diagrams.
j. Installation instruction.
k. Any other information necessary to indicate compliance with contract documents.
2. Highlight submittal data specifically for application to this project.
3. Submit actual operating conditions and characteristics for all equipment.
4. Catalogs or catalog cuts are not acceptable unless the particular item and all

relative data has been marked in such a manner as to be clearly defined.

5. Color of finishes shall be as selected by the Architect. Submit colors of factory finished equipment for acceptance prior to ordering.
6. No mechanical item shall be fabricated, purchased, delivered to the site or installed, until reviewed by the Engineer and/or Architect.
   a. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer and/or Architect.
7. Provide shop drawing and product data submittals as indicated under individual specification sections.
8. Provide any other data requested by the Engineer and/or Architect.

1.07 QUALITY ASSURANCE

A. Underwriter's Laboratory (UL) Requirements: All equipment containing electrical components and provided under Division 16 shall bear the Underwriter's Laboratory (UL) label, as a complete packaged system.
   1. Equipment not provided with a UL label shall be tested in the field, certified and provided with a listed label at the installer's expense.
      a. Field testing shall be performed by a testing agency approved by the authority having jurisdiction.
      b. Provide services of a UL recognized, independent Electrical Testing Laboratory (ETL) to provide field inspection and testing. Provide and ETL Label on all such equipment.

B. Fire Safe Materials: Unless otherwise indicated, materials shall conform to UL, National Fire Protection Association (NFPA) or American Society for Testing and Materials (ASTM) standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

C. Flow rate tolerance for HVAC equipment are listed in the Testing Adjusting and Balancing Section.

D. Equipment Vibration tolerances: Equipment shall be factory balanced and re-balanced on site after installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Division 01 Specifications and the requirements contained herein.
   1. Deliver, store, and handle products according to manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
   2. Schedule delivery to minimize long-term storage at Project Site and to prevent overcrowding of construction spaces.
   3. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   4. 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.
   5. Inspect products upon delivery to ensure compliance with Contract Documents and to ensure that products are undamaged and properly protected.

6. Store products in manner that will facilitate inspection and measurement.
7. Store materials in a manner that will not endanger project structure.
8. Store products subject to damage by elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation.
9. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather protection requirements for storage.

1.09 PROJECT CONDITIONS

A. Outages

1. All mechanical outages which will interfere with the normal use of the building in any manner shall be done at such times as shall be mutually agreed upon with the Owner.
2. Unless otherwise specified, outages of any services required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled with the Owner at least fourteen days (14) days in advance. All such outages shall be coordinated with the owner in writing. The owner reserves the right to partially occupy the building. Provide all necessary bypasses, isolation valves and dampers and other means and methods to limit the amount of time the building is without services.
3. The bid price shall include the cost of all premium time required for outages and other work which interferes with the normal use of the building.
4. The operation of valves or switches required to achieve an outage shall be accomplished by the Contractor in the Owner’s presence. Unauthorized operation of valves, power switches, or other control devices shall not be permitted.

1.10 SEQUENCING

A. Coordinate mechanical equipment installation with other building components and trades.

B. Coordinate for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.

G. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

1.11 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. Refer to Divisions 02 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in the Division 01 Specifications.

1.12 DISCREPANCIES

A. Where discrepancies occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Architect shall determine the manner in which the work shall be provided, based on the design intent of the documents.

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with Contract Documents that are undamaged and new at time of installation.
   1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and intended use and effect.
   2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Where products are accompanied by the term as selected, Architect will make selection.
   4. Where products are accompanied by the term match sample, sample to be matched is Architect's.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. General Compliance Requirements: Compliance requirements for individual products, as indicated in Contract Documents, are multiple in nature and may include generic descriptions, performance requirements, compliance with reference standards, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.

C. Procedures for Selecting Products: Contractor's options for selecting products are limited by Contract Document requirements, and are not controlled by industry traditions or

procedures experienced by Contractor on previous construction projects.

D. Products specified by Reference Standards, Codes and Regulations: Select from among products, which can be shown to comply with referenced documents.

E. Products specified by Naming Products and Manufacturers: Select from among products listed.

F. Products specified by Naming One Manufacturer's Product as the Basis-of-Design with Reference to Other Manufacturers: Select either the specified Basis-of-Design product or an approved comparable product by one of the other named manufacturers.

1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named manufacturers.

G. Products specified by Naming One Manufacturer's Product and Indicating Option of Selecting Comparable Products by stating or Approved Equivalent or similar language: Select either the specified product or an approved comparable product.

1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named or un-named manufacturers.

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

I. Visual Selection Specification: Where Specifications include the phrase as selected from manufacturer's standard colors, patterns, textures or similar phrase, select a product that complies with other specified requirements. Architect will select color, pattern, and texture.

1. 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.
2. 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.

2.02 COMPARABLE PRODUCTS

A. Where Basis-of-Design products are specified by name, submit the following, in addition to other required submittals, to obtain approval of a comparable product by one of the named manufacturers:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work. Use the attached Comparable Products Submittal Form in addition to requirements listed herein.
2. Detailed comparison of significant qualities of proposed product with the Basis-of- Design product in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, serviceability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

2.03 GROUT

A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B, "Packaged Dry, Hydraulic-Cement Grout (Nonshrink)".
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.50MPa), 28-day compressive strength.
3. Packaging: Premixed and factory-packaged.

2.04 ACCESS DOORS AND PANELS

A. Provide manufactured steel door assemblies consisting of:
1. Hinged door.
2. Flush screwdriver camlocks and frame.

B. Doors shall be Milcor Metal Access doors. Provide key locks where indicated.

C. Design shall be provided for the following installations:
1. Masonry or Dry Wall: Style M.
2. Hard Finish Plaster: Style AP.
3. Fire rated dry wall ceilings: Style CFRAD, 1 hour combustible floor ceiling system, 1 hour non-combustible floor ceiling system, 3 hour non-combustible floor ceiling system.
4. Suspended ceilings: Style CT.

PART 3 - EXECUTION

3.01 PREPARATION

A. Interface With Site Utility Companies:
1. Contact UTILITY prior to any excavation or underground work.
2. Contact local utility companies (gas, water, sewer, etc.) immediately upon award of contract. Do not install related equipment until fully coordinated with appropriate utilities.
3. Provide all construction schedules, dates of requested services, outage windows, equipment locations, etc. necessary for utility work.

3.02 INSTALLATION

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where systems, materials and equipment are intended for overhead installation, and where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 08
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

B. Rough-In

1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
2. Refer to equipment specifications in Divisions 02 through 16 for rough-in requirements.

C. Housekeeping and Equipment Pads

1. Construct pads of dimensions indicated, but not less than 4 inches (100 mm) larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi (20.70MPa), 28-day compressive strength concrete and reinforcement bars. Refer to Division 03 Specifications and plan details for additional requirements.

D. Erection of Metal Supports and Anchorage

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1, "Structural Welding Code -Steel",

2001.

E. Erection of Wood Supports and Anchorage

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
2. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
3. Attach to substrates as required to support applied loads.

F. Grouting

1. Install nonmetallic non-shrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
2. Clean surfaces that come into contact with grout.
3. Provide forms for placement of grout, as required.
4. Avoid air entrapment when placing grout.
5. Place grout to completely fill equipment bases.
6. Place grout on concrete bases to provide a smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout according to manufacturer's printed instructions.

G. Lintels

1. Lintels shall be provided for openings in masonry, brick, concrete, etc. walls to accommodate work of this division.
   a. Lintels shall be provided under this division when not being provided under other divisions. Lintels shall be approved by the Architect.

3.03 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Specifications. In addition to the requirements specified in Division 1, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping,

heating units, ductwork, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.04 PAINTING AND FINISHING

A. Refer to Division 09 Specifications.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Do not paint manufacturer's labels or tags.

3.05 CONSTRUCTION

A. Cutting, Welding, Burning

1. If required, before commencing any cutting, welding, burning, brazing (pipe sweating), obtain a hot work permit from Environmental Health and Safety.
2. If required, the hot work permit copy shall remain on the job site at the hot work location until such work is completed at which time the permit shall be returned to Environmental Health and Safety.

3.06 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction.

B. Furnish and install drains, curbs, vent assemblies, sleeves, flashing, etc. specifically designed for application to the particular construction. Install system in accordance with the roofing manufacturer's instructions.

3.07 EXCAVATION AND BACKFILLING

A. General

1. Perform all necessary excavation, for installation of work under Division 15, in accordance with Division 02.

3.08 CLEANING

A. Clean surfaces prior to application of insulation, adhesives, coating, and paint.

B. Provide factory applied finish where specified.

C. Protect all finishes, and restore all finishes to their original condition if damaged as a result of work under Division 15.

D. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces.

E. General: General cleaning during construction is required by the General Conditions and included in Section Temporary Facilities.

F. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

G. Remove all mechanical clipping, wiring, nuts, bolts, etc. left on top of ceilings and ceiling tiles, in access panel, roof, etc.

3.09 PROTECTION

A. Protect work, material and equipment from weather and construction operations before and after installation.

B. Properly store and handle all materials and equipment.

C. Cover temporary openings in piping, ductwork and equipment to prevent the entrance of water, dirt, debris, and other foreign matter.

3.10 LUBRICATION

A. All bearings, motors and all equipment requiring lubrication shall be provided with accessible fittings.

B. Before turning over the equipment to the Owner, provide the following:

1. Fully lubricate each item of equipment.
2. Provide 1 year's supply of lubricant for each type of lubricant.
3. Provide complete written lubricating instructions, together with diagram locating the points requiring lubrication.

C. Motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal extended grease fittings and drain plugs.

3.11 ELECTRICAL WORK

A. It is the intent to provide a complete and operational system. The work between Division 15 and 16 is complementary and is meant to produce a single and operating system. Contractor shall make its own determination as to the distribution of responsibility among the various trades.

B. All electrical work performed under Division 15 shall be provided in accordance with Division 16.

3.12 PROVISIONS FOR ACCESS

A. Furnish and install adequate access to all HVAC and plumbing components. The following list shall be used as a guide only:

1. Mechanical equipment.
2. Valves.
3. Dampers and operators.
4. Filters.
5. Heating and air conditioning units.
6. Controls.

7. Cleanouts.
8. Traps.
9. Automatic temperature control panels.
10. Coils.

B. Access shall be adequate as determined by the Engineer and/or Architect.

C. Refer to contract drawings where panels have been specifically located.

D. Provide additional panels for adequate access as indicated in paragraph A above.

E. Where access is by means of lift out ceiling tiles or panels mark each panel using small color-coded or numbered tabs. Provide an index chart for identification. Place markers in corner of grid.

3.13 OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing and balancing.

B. Do not operate equipment unless all proper safety devices or controls are operational.

C. Provide all maintenance and service for equipment, which is operated during construction.

D. Where specified and otherwise required, provide the services of a manufacturer's factory trained service organization to start the equipment.

E. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Architect.

1. Where such authorization is granted, temporary use of equipment shall not limit or otherwise affect warranties or guarantees of the work.

F. Upon completion of work, clean and restore all equipment to new conditions and replace all filters.

3.14 DEMONSTRATION

A. Demonstrate operation and maintenance of equipment and systems to Owner’s personnel a minimum two (2) weeks prior to date of final inspection.

1. For equipment requiring seasonal operation, perform instructions for other seasons at the same time.
2. Training period shall be performed within 1 - one week period.

B. Use operation and maintenance manuals and video as basis of instruction. Review contents of manual and video with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate the following:

1. Start up.
2. Operation.
3. Control.
4. Adjustment.
5. Trouble shooting.

6. Servicing.
7. Maintenance.
8. Shutdown.

D. Provide at least 40 hours of instruction to the operating personnel.
1. This instruction period shall consist of not less than five-8 hour days.
2. Time of instruction shall be designated by the Owner.
3. This instruction shall be in addition to instructional requirements of specific equipment specified elsewhere in Division 16.
4. Record all instruction periods. Provide the owner with three copies of the recordings in digital versatile disk (DVD) format.

3.15 WALL, FLOOR AND ROOF PENETRATIONS

A. All penetrations of partitions, walls, floors and roof by ducts, piping or conduit shall be sealed and caulked. Provide U.L. listed fire stopping systems at penetrations through fire rated walls and roof.

B. Coordinate with Architectural and Structural drawings for locations of all duct and pipe drops through floors and roof.

3.16 EQUIPMENT PROVIDED UNDER ANOTHER DIVISION AND BY OTHERS

A. Make all system connections required to equipment furnished and installed under another division and by others.

B. It shall be the responsibility of the Contractor to coordinate all necessary data from the equipment supplied under other Divisions.

3.17 PROJECT PUNCH OUT

A. Architect/Engineer will perform punch out reviews and will provide the Contractor with a list of punch list items to be completed before contract close out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer will not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed by the Contractor and the Architect/Engineer determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at his regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer.

COMPARABLE PRODUCT SUBMITTAL FORM

Table of Compliance (Sample)
Shop Drawing and Product Data Submittal

The Contractor shall prepare a Table of Compliance Form similar in format to the sample shown below to facilitate and expedite the Shop Drawing and Product Data Review. Failure to comply with this requirement will be basis for rejecting the Submittal.

The Table of Compliance Form will list and compare the performance parameters as the submitted equipment to that listed on equipment schedule and specifications as basis of design. All non-compliance items (differences) must be explained in full, indicating their impact, if any, on maintainability, durability, energy use, operating costs, code compliance and environmental considerations.

(Sample)
TABLE OF COMPLIANCE

EQUIPMENT: _____ SPEC. SECTION: _____

BASIS OF DESIGN SAMPLE ITEMS	DRAWINGS	SUBMITTED	EXPLANATION
Flow (Cfm Or Gpm)			
Ext. Static Press.			
Head (Ft.)			
Electrical Requirements			
Cooling Capacity			
Heating Capacity			
Discharge Air Temp.			
Filter Type & Eff.			
Equipment Eff. (Eer)			
Sound Data			
Weights			
Etc.			
Specifications:			
A. Quality assurance compliance (ARI)			
(ASHRAE)			
(AMCA)			
B. Specifications: List each and every specification paragraph			
C. Etc.			

END OF SECTION

SECTION 15053
COMMON MOTOR REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and all sections of Division 15.

1.02 SUMMARY

A. Section includes:

1. Motor requirements for all plumbing and HVAC equipment.
2. Source Quality Control.
3. Bearing Protection Ring.
4. Motors that are factory installed as part of equipment and appliances as well as field installed motors.

1.03 REFERENCES

A. (Unless otherwise noted, references apply to "latest editions.")

B. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings, 1990 (R2000).

C. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators, 2006.

D. International Electrical Testing Association:

1. NETA ATS – Acceptance Testing, 2007.

1.04 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the Contract and Division 01 specification sections.

B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

B. Testing Agency: Company who is a member of the International Electrical Testing Association and specializing in testing products specified in this section with

minimum five years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.01 REQUIREMENTS FOR MOTORS

A. General: Requirements below apply to motors covered by this Section except as otherwise indicated.

1. Motors Larger than 1/2 HP: 3-phase.
2. Motors 1/2 HP and Smaller: Single-phase.
3. Frequency Rating: 60 Hz.
4. Voltage Rating: Determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):
   a. 120 V Circuit: 115 V - motor rating.
   b. 208 V Circuit: 200 V - motor rating.
   c. 240 V Circuit: 230 V - motor rating.
5. Minimum service factor shall be 15% and shall apply at frequency and utilization voltage at which motor is connected. Provide motors, which will not operate in service factor range when supply voltage is within 10 percent of motor voltage rating.
6. Capacity: Sufficient to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence, without exceeding nameplate ratings. Provide motors rated for continuous duty at 100 percent of rated capacity.
7. Temperature Rise: Based on 40°C ambient except as otherwise indicated.
8. Enclosure: Open dripproof, unless otherwise specified. Provide screen over slots, where slots will permit passage of human extremities.
9. Provide adjustable motor slide base for belt driven equipment. Include adjusting bolts and locknuts.

B. Three-phase Motors

1. General: Squirrel-cage induction-type conforming to the following requirements except as otherwise indicated.
2. National Electrical Manufacturers Association NEMA Design Letter Designation: "B."
3. Multi-Speed Motors: Separate winding for each speed.

4. Minimum motor efficiencies shall be as follows:

HP	Percent Efficiency, Minimum
1 and less	84.0
1 ½	85.5
2	86.5
3	89.5
5	89.5
7 1/2	91.0
10	91.7
15	92.4
20	93.0
25	93.6
30	94.1
40	94.5
50	94.5
60	95.0
75 and larger	95.4

5. Variable Speed Motors for Use With Solid-State Drives: Energy efficient, squirrel- cage induction, design B units and ratings, characteristics, and features coordinated with and approved by drive manufacturer. Motors shall be labeled to indicate that they are provided with inverter duty capability in accordance with the National Electrical Manufacturers Association NEMA MG-1, Part 31.
6. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading of the application. Provide bearings without plugs for grease fittings.
7. Motors for Reduced Inrush Starting: Coordinate with indicated reduced controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.
8. All motors shall be provided with manufacturer's stamped nameplate, to include all pertinent and capacity data.

C. Single-phase Motors

1. General: Conform to the following requirements except as otherwise indicated.
2. Energy Efficient Motors: One of the following types as selected to suit the starting torque and other requirements of the specific motor application.
   a. Permanent Split Capacitor.
   b. Split-Phase Start, Capacitor-Run.
   c. Capacitor-Start, Capacitor-Run.
3. Shaded-Pole Motors: Use only for motors smaller than 1/20 hp.
4. Internal Thermal Overload Protection for Motors: Protection shall automatically opens the power supply circuit to the motor, or a control circuit arranged for external connection. Protection operates when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Provide device that automatically resets when motor temperature returns to normal range except as otherwise indicated.
5. Bearings: Belt connected motors and other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single phase motors.

2.02 SOURCE QUALITY CONTROL

A. Test motors in accordance with National Electrical Manufacturers Association NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

2.03 BEARING PROTECTION RING

A. All motors driven by a variable frequency PWM drive shall include a maintenance free, circumferential, conductive micro fiber shaft grounding ring to discharge shaft currents to ground.

B. Provide AEGIS SGR Bearing Protection Ring as manufactured by Electro Statis Technology.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: The following requirements apply to field-installed motors.

1. Install motors in accordance with manufacturer's published instructions and the following:
   a. Direct Connected Motors: Mount securely in accurate alignment. Connect to driven equipment with coupler of appropriate type and material for the given duty. Coupler shall be selected for high and range of motor application.
   b. Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts identified by the manufacturer and tension belts in accordance with manufacturer recommendations.

3.02 FIELD QUALITY CONTROL

A. Inspect and test in accordance with the International Electrical Testing Association - NETA ATS, 2007.

3.03 VARIABLE FREQUENCY MOTORS

A. Install Bearing Protection Ring in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 15061

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 16.

1.2 SUMMARY

A. General Requirements
1. Incorporate in construction pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular product components, parts, and assemblies.
2. Comply with maximum load ratings with considering for allowable stresses prescribed by ASME B31.1 or MS SP-58.
3. Provide support, guides and anchors that do not transmit unacceptable heat and vibration to building structure.
4. Installation of pipe hangers and supports shall be based upon the overall design concept of the piping system. The support system shall provide for and control the free movement of piping including its movement in relation to the connected equipment.
5. Provide for vertical adjustments after installation of supported material and during commissioning, where feasible, to ensure pipe is at design elevation and slope.

B. Section Includes:
1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping relating to HVAC work.
10. Firestopping accessories.
11. Equipment bases and supports.
12. Acoustical Sealant.

C. Related Sections: The following Sections contain requirements that relate to this Section:
1. Section 15053 - "Common Motor Requirements."
2. Section 15001 – "Hydronic Piping & Specialties"
3. Section 15080 - "HVAC Insulation."
4. Section 15446 - "Vibration Controls for HVAC Piping and Equipment"
5. Section 15651 – "Refrigeration Piping System"

1.3 REFERENCES
(Unless otherwise noted, references apply to "latest editions.")

A. American Society of Mechanical Engineers:
1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:
1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:
1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:
1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

1.4 DEFINITIONS

A. Terminology used in this Section is defined in Manufacturer's Standardization Society Specification 90, "Valve and Fittings Standards," 2000.

1.5 SUBMITTALS

A. General: Submit each item in this Section according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product data for each type of hanger and support, including load capacity.

C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.

D. Welder certificates signed by Contractor certifying that welders comply with requirements

specified under the "Quality Assurance" Article.

E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

F. Submit following in accordance with Conditions of Contract and Division 01 Specifications:
   1. Shop drawings of items.
   2. Complete description of products to be supplied including product data, dimensions materials of construction and specifications.
   3. Installation instructions for each product.
   4. Layout of piping and ductwork to be isolated including vertical risers showing:
      a. Support points.
      b. Weight at support points.
      c. Isolator type.
      d. Static deflection expected under actual load.
      e. Specified static deflection.
      f. Additional deflection to solid under actual load.
      g. Ratio of spring height under load to spring diameter.
   5. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method and location of equipment attachment bolts.
   6. Special details at large scale and other necessary information to convey understanding of work.

G. Submission of samples may be requested for each type of vibration isolation device. After approval, samples shall be returned for installation at job site.

1.6 QUALITY ASSURANCE

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code - Steel".
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. NFPA Compliance: Comply with NFPA 13, "Installation of Sprinkler Systems," for hangers and supports used as components of fire protection systems.

D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70 "Definitions."
   1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.

E. Operators: Use operators that are experienced by powder-operated tool manufacturers to operate their tools and fasteners.

F. Supply and install incidental materials needed to meet requirements, even if not expressly specified or shown on drawings without claim for additional payment.

G. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 01 Specifications and requirements contained herein for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Refer to Division 01 Specifications for requirements regarding environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air are not in accordance with the manufacturer's installation procedures.

C. Maintain manufacturer's required temperature before, during, and after installation of firestopping materials for minimum periods of time as required by the manufacturer.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel: ASTM A 36/A 36M, "Carbon Structural Steel," steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, "Track Bolts and Nuts," steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, "Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use," steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)," non-shrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.

2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

2.2 HANGERS AND SUPPORTS

A. Hangers, Supports, and Components: Provide factory-fabricated products as manufactured by B-Line, Tyco – (Anvil Hangers), Pipe Shields, Inc., or Michigan Hanger. Basis of Design shall be B-Line.
1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal-Hanger Shield Inserts: 100-psi (690kPa) average compressive strength, waterproofed calcium silicate or treated lumber inserts, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

C. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

D. Install rigid round and rectangular metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4- 8.

E. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

F. Support vertical ducts at a maximum interval of 16 feet and at each floor.

G. Upper attachments to structures shall have an allowable load not exceeding 3 times of the failure (proof test) load but are not limited to the specific methods indicated.

H. Horizontal Non-Insulated Copper Piping Hangers:
1. Two inch and smaller: Figure No. B3104 CTC.
2. Two and one-half inch and larger: Figure No. B3104 CT.

I. Insulated Horizontal Piping Hangers: Refrigerant Piping:
1. Two inch and smaller: Figure No. B3108 with metal shield, Figure No. B3151.
2. Two and one-half inch and larger: Figure No. B3108 with metal shield, Figure No. B3151.

J. Vertical Piping Riser Clamps:
1. Copper Pipe: Figure No. B3373CT.
2. Steel Pipe: Figure No. B3136 and B3137.

K. Beam Clamps and Attachments:
1. For bolt-on locations to structure, Figure Nos. B3291, B3036, or B3050.
2. Welded beam attachments, Figure No. B3083.

L. Concrete Inserts:
1. For concrete spot inserts at single locations for casting into structure, Figure No. B3014 for pre- determined rod size and Figure No. B2500 for universal use.
2. For continuous slot concrete insert at multi-locations for casting into structure,

Figure No. B2505.

M. Brackets:
1. For equipment and piping adjacent to walls or steel columns, Figure Nos. B3066, B3063 and B3067 depending on weight to be supported.

N. Pipe Rests:
1. For pipes close to floor where no expansion provision is required, Figure No. B3088T base stand with B3093 adjustable pipe saddle support.

O. Hanger Rods:
1. Hanger rod, Figure No. B3205.
2. Continuous threaded rod, Figure No. ATR.
3. Eye rods, Figure No. B3210 or B3211, depending on load supported.

P. Trapeze Hangers - Direct Mounting Hangers:
1. Grinnell, Figure No. 46.

Q. Protection Saddles:
1. Cast iron pipe, insulated, Figure No. B3108 with metal shield, Figure No. B3151.
2. For high temperature steel pipe, insulated, No. B3160, B3161, B3162, B3163, B3164, or B3165.

R. Pipe Roll Stands:
1. For support of pipe where axial movement is encountered: Figure No. B3117SL where no vertical adjustment is required; and Figure No. B3118SL where vertical adjustment is required.

2.3 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes shall be one of following non-setting sealants:

Acoustical sealant.....D.A.P.
BR – 96.....Pecra
Acoustical sealant.....Tremco
Acoustical sealant..... U.S.G.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material. Install damming material to arrest liquid material leakage.

B. Remove incompatible materials affecting bond.

C. Drilling or cutting of structural members shall be as detailed / directed by structural engineer.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Comply with MSS SP-69, "Pipe Hangers and Supports C Selection and Application," and SP-89, "Pipe Hangers and Supports – Fabrication and Installation

Practices". Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. Piping shall be supported independently from equipment connections. Supports shall not interfere with removal of equipment.

B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

C. Install supports with maximum spacings complying with MSS SP-69, "Pipe Hangers and Supports C Selection and Application," and as specified in Section 15410 - "Pipes and Tubes for HVAC Piping and Equipment."

D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69, "Pipe Hangers and Supports C Selection and Application". Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts in new construction prior to placing concrete. Install reinforcing bars through openings at top of inserts.

F. Install mechanical-anchor fasteners in concrete after concrete according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36, "Carbon Structural Steel," steel shapes selected for loads being supported. Weld steel according to AWS D-1.1, "Structural Welding Code - Steel".

I. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.

L. Insulated Piping: Provide continuous insulation and vapor barrier through hangers and supports. Comply with the following installation requirements.
   1. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9. Insulate clamps on piping with insulation and vapor barrier.
   2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
   3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier.

Shields span an arc of 180 degrees (3.1 rad) and have dimensions in inches (mm) not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4 to 3 ½	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075

4. Pipes 4 Inches (200 mm) and Larger: Include treated wood inserts.
5. Insert Material: Length to equal to the length of the protective shield.
6. Conform to the table below for maximum spacing of supports and rod sizes:
7. Steel and Copper Pipe:

Nom. Pipe Size – In.	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. – In.
Up to 3/4	7	5	3/8
1	7	6	3/8
1 1/4	7	7	3/8
1 1/2	9	8	3/8
2	10	8	3/8
2 1/2	11	9	1/2
3	12	10	1/2
3 1/2	13	11	1/2
4	14	12	5/8 (1/2 for copper)
5	16	13	5/8 (1/2 for copper)
6	17	14	3/4 (5/8 for copper)
8	19	16	3/4 (3/4 for copper)
10	22	18	3/4 (3/4 for copper)
12	23	19	3/4 (3/4 for copper)

M. Support vertical steel pipe and copper tube at each floor:
1. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
2. Grouting: Place grout under supports for equipment and concrete bases. Make a smooth bearing surface.
3. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 4" beyond supported equipment.
4. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

N. Metal Fabrication:
1. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
3. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercut or overlap.
   c. Remove welding flux immediately.
   d. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent

contours.

3.3 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.4 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.5 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.6 APPLICATIONS FOR HANGER AND SUPPORT

A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

B. Comply with MSS SP-69, "Pipe Hangers and Supports C Selection and Application," for pipe hanger selections and applications that are not specified in piping specification Sections.

3.7 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Adjust for pipe alignment and final equipment connections. Flexible connections shall not be used for adjustment of alignment.

END OF SECTION

SECTION 15065
ELECTRICAL COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

B. The requirements of Section 15 Supplemental Provisions - Mechanical apply to this section.

1.02 DESCRIPTION OF WORK

A. Provide and install all conduit and all control wiring including thermistor wiring for Division 15 work.

B. Provide and install all temperature control devices and equipment.

C. Provide starters for all packaged equipment furnished under Division 15 (final wiring under Division 16).

1.03 RELATED WORK

A. Electrical work required:

1. All power wiring and conduit. (Provided and installed under Division 16).
2. Control wiring. (Provided and installed under Division 15).
3. Motor disconnects. (Provided and installed under Division 16).
4. Starters furnished and installed under Division 16, except when furnished with packaged equipment; final wiring under Division 16.

1.04 QUALITY ASSURANCE

A. Requirements of the latest revision of the Standard Building Code and Standard Mechanical/Plumbing Code

B. Wiring and conduit shall conform to the National Electrical Code, latest edition.

C. Electrical equipment shall conform to NEMA standards and shall be UL listed.

1.05 SUBMITTALS

A. Furnish to Electrical Contractor equipment shop drawings that indicate power connections.

B. Prepare complete terminal-to-terminal wiring diagrams that show terminal designation on control items and equipment. Diagrams may be part of temperature control submittals.

PART 2 - PRODUCTS

2.01 MOTORS

A. Motors shall be furnished by the manufacturer or supplier of the specified equipment.

B. General purpose motors shall be open drip-proof conforming to NEMA Design, Class B insulation, continuous 40° C ambient, 60 Hz, 1.15 service factor, and 1800 RPM maximum speed unless specified otherwise. Voltage shall be as specified in individual Sections.

C. Provide special motors where specified.

D. Motors shall be single phase below 3/4 HP and three phase 3/4 HP and larger, unless specified otherwise.
   1. Single phase motors shall have built in overload protection.
   2. Single phase motors shall be capacitor start, capacitor run.

E. All motors shall be NEMA Design E motors.

2.02 EQUIPMENT POWER FACTOR

A. Equipment requiring 1000 watts or more shall have a factor of 85% or greater at rated load conditions. Equipment with power factor less than 85% shall be corrected to at least 90% under full load operating conditions. Power factor corrective devices shall be switched with related equipment.

PART 3 - EXECUTION

3.01 CONTROL WIRING INSTALLATION

A. Control wiring shall be run in thin wall conduit

B. Coordinate with other contractors.

C. Check out system operation in all modes.

3.02 ADDITIONAL REQUIREMENTS

A. Motor characteristics which change from that specified, due to the Contractor electing to use one of the optional manufacturers, or an updated model, etc., shall be coordinated with the Electrical Contractor.

B. This Contractor is responsible for the cost and design of any revision necessary to provide proper control connections in full accordance with the National Electric Code and state and local codes.

END OF SECTION

SECTION 15072

VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 16.

1.2 SUMMARY

A. This Section includes vibration control for mechanical systems piping and equipment.

B. Section Includes:
1. Vibration isolators.

1.3 REFERENCES
(Unless otherwise noted, references apply to "latest editions.")

A. Air Movement and Control Association International, Inc.:
1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

B. American National Standards Institute:
1. ANSI S1.4 - Sound Level Meters.
2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.

C. Air-Conditioning and Refrigeration Institute:
1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.

D. ASTM International:
1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

E. International Mechanical Code, 2015

F. ASCE-7, Minimum Design Loads for Buildings and Other Structures

1.4 DEFINITIONS

A. Terminology used in this Section is defined in Manufacturer's Standardization Society Specification - 90, "Valve and Fittings Standards," 2000.

B. Life Safety Systems:
1. All systems involved with fire dampers and smoke damper systems.

2. All HVAC systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection.

C. Positive Attachment:
1. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead ductwork, hydraulic piping, bus duct, or any other equipment are not acceptable on this project.

D. Transverse Bracing:
1. Restraint(s) applied to limit motion perpendicular to the centerline of the hydraulic piping or duct.

E. Longitudinal Bracing:
1. Restraint(s) applied to limit motion parallel to the centerline of the hydraulic piping or duct.

1.5 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 hp (0.35 kW), plus connected piping and ductwork.

1.6 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the contract and Division 01 Specification Sections.

B. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

C. Shop drawings for each type of isolator, indicating dimensions, weights, required clearances, and methods of component assembly.

D. Submit the following in accordance with Conditions of Contract and Division 01 Specifications:
1. Shop drawings of items.
2. Complete description of products to be supplied including product data, dimensions materials of construction and specifications.
3. Installation instructions for each product.
4. Tabulation showing for each vibration isolator supporting equipment:
   a. Equipment identification tag no.
   b. Isolator type.
   c. Actual load.
   d. Static deflection expected under actual load.
   e. Specified minimum static deflection.
   f. Additional deflection to solid under actual load.
   g. Ratio of spring height under actual load to spring diameter.
5. Layout of piping to be isolated including vertical risers showing:
   a. Support points.
   b. Weight at support points.
   c. Isolator type.
   d. Static deflection expected under actual load.

e. Specified static deflection.
f. Additional deflection to solid under actual load.
g. Ratio of spring height under load to spring diameter.

6. Special details at large scale and other necessary information to convey understanding of work.

E. Submission of samples may be requested for each type of vibration isolation device. After approval, samples shall be returned for installation at job site.

1.7 QUALITY ASSURANCE

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code - Steel," 2001.
1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. Manufacturer of vibration isolation equipment shall have the following responsibilities:
1. Determine vibration isolation sizes and locations.
2. Provide calculations and materials if required for restraint of un-insulated equipment.
3. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

D. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

E. Coordinate size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

F. Provide vibration isolators of appropriate sizes and proper loading to meet specified deflection requirements.

G. Supply and install incidental materials needed to meet requirements, even if not expressly specified or shown on drawings without claim for additional payment.

H. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

I. Should any rotating equipment cause excessive noise or vibration, rebalance, realign or do other remedial work to reduce noise and vibration levels. Excessive is defined as exceeding manufacturer's specifications for unit in question.

J. Speed And Balance Requirements For Rotating Equipment:
1. Fans and other rotating mechanical equipment shall not operate at speeds in excess of 80% of their critical speed.
2. Vertical vibration of rotating equipment shall not be greater than levels indicated elsewhere. Measure vibration on equipment or steel frame equipment base when equipment is mounted on its vibration isolation mounts. If equipment has inertia base, allowable vibration level is reduced by ratio of equipment weight alone to equipment weight plus inertia base weight.

Equipment Speed (rpm)	Vibration Displacement (mils, peak-to-peak)
Under 600	4
600 to 1000	3
100 to 2000	2
Over 2000	1

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel: ASTM A 36/A 36M, "Carbon Structural Steel," steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, "Track Bolts and Nuts," steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, "Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use," steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)," nonshrink, nonmetallic.
1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.
2. Water: Potable.
3. Packaging: Premixed and factory-packaged.

2.2 VIBRATION ISOLATION MOUNT TYPES

A. General
1. Metal parts of vibration isolation units installed out-of-doors shall be hot-dip galvanized, cadmium- plated or Neoprene-coated after fabrication. Galvanizing shall meet ASTM 144 "Salt Spray Test Standards and Federal Test Standard."
2. Isolator types are scheduled to establish minimum standards. Optionally, labor-saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation

advantages. Accessories shall not degrade vibration isolation system.

B. Unit HSN (Hanger Spring and Neoprene) (Type 3)
1. Hangers shall consist of rigid steel frames containing minimum 1 1/4" thick neoprene or pre-compressed elastomer coated fiberglass elements at the top and a steel spring with general characteristics as in specification 5 seated in an optional steel washer reinforced neoprene cup on the bottom. The neoprene element and the optional cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree E arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30 degree E capability. Hangers shall be Model SRH or SFH as manufactured by Kinetics Noise Control or type 30N as manufactured by Mason Industries, Inc., or comparable acceptable product.

2.3 FLEXIBLE ELECTRICAL CONNECTION

A. Unit FEC-A (Flexible Electrical Connection Type A):
1. Flexible electrical coupling shall be prefabricated units incorporating flexible watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wire way and end hubs with standard tapered electrical threads to fit standard threaded, rigid metal conduit.
2. Unit FEC-A shall be as specified in section “Raceways and Boxes for Electrical Systems” for liquid tight flexible metal conduit.

B. Unit FEC-B (Flexible Electrical Connection Type B):
1. Flexible electrical couplings shall be field-fabricated using minimum 2 ft length of flexible conduit or cable installed in grossly slack "U" shape.
2. Unite FEC-B shall be as specified in section “Raceways and Boxes for Electrical Systems” for flexible metal conduit.

2.4 RESTRAINTS

A. Thrust Restraint
1. Thrust restraints shall consist of spring element in series with Neoprene pad.
2. Thrust restraint shall be designed to have same deflection as specified for isolators supporting equipment generating thrust.
3. Spring element shall be contained within steel frame and be designed to be factory-preset for thrust and be field-adjustable to allow for maximum of 1/4" movement during starting or stopping of equipment.
4. Furnish assembly complete with rods and angle brackets for attachment to both equipment generating thrust and adjacent fixed structural anchor.
5. Thrust restraint shall be Model HSR as manufactured by Kinetics Noise Control or Mason Industries Type WB, or comparable acceptable product.

2.5 GROMMETS

A. Grommets shall be either custom made by combining Neoprene washer and sleeve, or be Isogrommets as manufactured by MBIS, Inc., or be Series W by Barry Controls.

B. Neoprene shall be between 40 and 50 durometer.

C. Grommets shall be specially formed to prevent fastening bolts from directly contacting isolator base plate.

2.6 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes shall be one of following non-setting sealants:
1. Acoustical sealant ..... D.A.P.
2. BR-96 ..... Pecra
3. Acoustical sealant ..... Tremco
4. Acoustical sealant ..... U.S.G.

VIBRATION ISOLATION SCHEDULE

			Slab on Grade			Up to 30 Ft. Floor Span			Greater Than 30′ Floor Span		
Fans (Not Within	**Horsepower/**	**RPM**	**Base**	**Isolator**	**Minimum**	**Base**	**Isolator**	**Minimum**	**Base**	**Isolator**	**Minimum**
Inline Centrifugal, Cabinet, Ceiling	All	All	A	3	0.75	A	3	1.50	A	3	1.50

			Slab on Grade			Up to 30 Ft. Floor Span			Greater Than 30′ Floor Span		
Miscellaneous	**Horsepower/**	**RPM**	**Base**	**Isolator**	**Minimum**	**Base**	**Isolator**	**Minimum**	**Base**	**Isolator**	**Minimum**
Heat Pump Units, and other Miscellaneous Motor Driven Equipment	All	All	N/A	3	0.75	A	3	0.75	A	3	1.50

PART 3 EXECUTION

3.1 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General
1. Locations of vibration isolation equipment shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with manufacturer's written instructions.

B. Isolation Mounts
1. Squarely align vibration isolators above or below mounting points of supported equipment.
2. Isolators for equipment with bases shall be located on sides of bases, which are parallel to equipment shaft unless this is not possible because of physical

constraints.

3. If housekeeping pad is provided, isolators shall bear on housekeeping pad and isolator base plate shall rest entirely on pad. Maintain at least ten bolt diameters from isolator anchors to edge of pad.
4. Hanger rods for vibration isolated support shall be connected to structural beams or joists; not from floor slab between beams and joists. Provide intermediate support members as necessary.
5. Position vibration isolation hanger elements as high as possible in hanger rod assembly but not in contact with building structure, and so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
6. Parallel-running pipes may be hung together on trapeze, which is isolated from building. Isolator deflections must be largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes on same trapeze.
7. No pipes or equipment shall be supported from other pipes or equipment.
8. Resiliently-isolated pipes shall not contact rigid building structure or equipment.
9. Adjust leveling bolts and hanger rod bolts so isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Bases

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by equipment manufacturer. This provision shall apply whether or not base frame is specified or indicated on drawings. If base frame is required for unit because of equipment manufacturer's requirements and is not specifically called for, base frame recommended by equipment manufacturer shall be provided at no additional expense.

D. Resilient Penetration Sleeve/Seals

1. Penetration seals shall maintain airtight seal around penetrating element and shall prevent contact of penetrating element and building structure. Fit sleeve tightly to building construction and with acoustical sealant seal airtight on both sides of construction penetrated.

3.2 APPLICATIONS FOR VIBRATION CONTROLS

A. Major Equipment

1. Unless otherwise shown or specified, major floor-mounted equipment shall be set on housekeeping type concrete pads. See architectural or structural drawings for details.
2. Electrical connections to vibration-isolated equipment exposed to weather shall be unit FEC-A.
3. Electrical connections to vibration-isolated equipment located indoors shall be unit FEC-B.
4. Thrust Restraints shall be installed on equipment as called for in schedule on drawings or specified hereunder.

B. Pipes

1. Refrigerant piping within mechanical rooms or within 50 ft total pipe length (whichever is longer) for air cooled, air conditioning units that are 1" or larger, shall be isolated from building structure by vibration mounts, resilient pipe guides, and resilient penetration sleeve/seals.
2. Isolators for first three support points adjacent to connected equipment shall achieve half of specified static deflection of isolators supporting connected equipment. When required static deflection of these pipe isolators is greater than 0.50," Unit FSN or HSN isolators, (whichever is applicable for mounting condition)

shall be used.

3. Where lateral support of pipe risers is required within specified limits, use resilient lateral supports.
4. Pipes within specified limits that penetrate building construction shall be isolated from building structure by (Unit RPS-A or Unit RPS-B) resilient penetrating sleeve/seals.

3.3 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Adjust for pipe alignment and final equipment connections. Flexible connections shall not be used for adjustment of alignment.

END OF SECTION

SECTION 15075

MECHANICAL HVAC IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and all sections of Division 16.

1.2 SUMMARY

A. Section Includes:

1. Painted Identification Materials.
2. Plastic Pipe Markers.
3. Underground-Type Plastic Line Marker.
4. Valve Tags.
5. Valve Schedule Frames.
6. Engraved Plastic-Laminate Signs.
7. Plastic Equipment Markers.
8. Plasticized Tags.

1.3 REFERENCES
(Unless otherwise noted, references apply to "latest editions.")

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems, 2007.

B. National Fire Protection Association:

1. NFPA 99 - Standard for Health Care Facilities, 2005.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the Contract and Division 01 specification sections.

B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

C. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

D. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8 1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. Furnish copies for Maintenance Manuals as specified in the Division 01 Specifications.

E. Maintenance Data: Include product data and schedules in maintenance manuals, in accordance with requirements of Division 01.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1, for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Equipment Lettering and Graphics:

1. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.
   a. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification, which indicates individual system number as well as service (for example; Water Heater No. 3).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering identification materials which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide plumbing identification materials of one of the following:

1. Brady (W.H.) Co.; Signmark Div.
2. Industrial Safety Supply Co., Inc.
3. Seton Name Plate Corp.

2.2 MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

B. Painted Identification Materials:

1. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes not less than 1 1/4" high for ductwork and not less than 3/4" high for access door signs and similar operational instructions. Stencils shall not be utilized on piping and plumbing equipment.
2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
3. Identification Paint and Background Color; Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems and plumbing equipment comply with ANSI A13.1 for colors.

C. Plastic Pipe Markers:

1. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, UV-resistant color-coded pipe markers, complying with ANSI/ASME A13.1
2. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   b. Adhesive lap joint in pipe marker overlap.
   c. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1 1/2".
3. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
   a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1 1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
   b. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
4. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
   a. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
5. Provide pipe markers with the following background colors and designations:

SERVICE	STENCIL DESIGNATION	LETTER COLOR	BACKGROUND COLOR
Domestic Cold Water	Cold Water	White	Green
Domestic Hot Water	Hot Water	Black	Yellow
Domestic Hot Water	Hot Water Return	Black	Yellow
Fire Protection Water	Fire Water	White	Red
Condensate	Condensate	White	Green
Refrigerant Hot Gas	Refrigerant Hot Gas	White	Blue
Refrigerant Liquid	Refrigerant Liquid	White	Blue

D. Valve Tags:

1. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved

plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
   a. Provide 1 1/2" sq. black tags with white lettering, except as otherwise indicated.
   b. Provide size, shape and color combination as specified or scheduled for each piping system.
2. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.
   a. Provide 1 1/8" sq. white tags with black lettering.
   b. Provide size, shape and color combination as specified or scheduled for each piping system.
3. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
4. Ceiling Grid and Access Panel Markers: Provide Kroy type clear adhesive printed labels with 3/16" high letters to identify the type of concealed plumbing devices.

E. Engraved Plastic-laminate Signs:

1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/8", except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
4. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
5. Size: Provide approximate 2 1/2" x 4" markers for control devices, dampers, and valves; and 4 1/2" x 6" for equipment.

F. Plasticized Tags:

1. General: Manufacturer's standard pre-printed or partially pre- printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 1/4" x 5 5/8", with brass grommets and wire fasteners, and with appropriate pre- printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

A. General:

1. Coordination: Where identification is to be applied to surfaces, which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
2. Confined Spaces: Provide labels and signs on all duct and equipment doors, plenums, etc. to indicate service and provide operator warnings as required by OSHA, NFPA, and authority having jurisdiction.

B. Piping System Identification:

1. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
   a. Plastic pipe markers, with application system as indicated under "Materials" in this section.
2. Locate pipe markers and color bands as follows on all piping in occupied spaces, above ceilings, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   a. Near each valve and control device.
   b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
   c. Near locations where pipes pass through walls or floors/ ceilings, or enter non-accessible enclosures.
   d. At access doors, manholes and similar access points, which permit view of concealed piping.
   e. Near major equipment items and other points of origination and termination.
   f. Spaced intermediately at maximum spacing of 25' along each piping run, except reduce spacing to 10' in congested areas.

C. Underground Piping Identification:

1. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

D. Valve Identification:

1. General: Provide valve tag on every valve, cock and control device in each piping

system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures. List each tagged valve in valve schedule for each piping system.

E. Equipment Identification:

1. General: Install engraved plastic laminate sign on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
   a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   b. Water meters and flow meters.
   c. Fuel-burning units.
   d. Pumps, compressors, and similar motor- driven units.
   e. Heat exchangers, expansion tanks, and similar equipment.
   f. Tanks and pressure vessels.
   g. Filters, water treatment systems and similar equipment.
   h. Domestic water heater, etc.
2. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
3. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety precautions, and warn of hazards and improper operations.

3.3 ADJUSTING

A. Adjusting: Relocate any identification device, which has become visually blocked by work of this division or other divisions.

3.4 CLEANING

A. Cleaning: Clean face of identification devices.

3.5 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

SECTION 15080

HVAC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplemental Conditions and Division 01 Specifications, apply to this section and all sections of Division 15.

1.2 SUMMARY

A. Section includes:
1. Insulation Materials:
a. Cellular glass.
b. Flexible elastomeric.
c. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

1.3 REFERENCES
(Unless otherwise noted, references apply to "latest editions.")

A. ASTM:
1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
4. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
5. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
6. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
7. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
8. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

9. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
10. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
11. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
12. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
15. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
16. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
17. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
18. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
19. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
20. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
21. ASTM 1622 – 08 Standard Test Method for apparent density, apparent density, apparent overall density.
22. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
23. ASTM D3575 – 08 Standard Test Methods for flexible celluar materials made from Olefin Polymers, closed cell materials, flexible cellular, Olefin Polymers, Buoyancy,etc.
24. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
25. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
26. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
27. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
28. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Sheet Metal and Air Conditioning Contractors':
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the Contract and Division 01 specification sections.

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

C. Samples: Submit two samples of representative size illustrating each insulation type.

D. Manufacturer's Installation Instructions: Submit manufacturers published literature

indicating proper installation procedures.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Perform Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

C. Maintain one copy of each document on site.

D. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke developed index of 150 or less.

E. Insulation materials shall be tested and rated according to ASTM Test Method C-177 to determine k-factors. ASTM C 335 is for pre-formed pipe insulation. C177 is for flat slab materials such as board products, etc.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience and service facilities within 50 miles of the project.

B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

C. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping. Remove and replace any wet or damaged unsatisfactory insulation at the Architect’s direction.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature during and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Furnish five year manufacturer warranty for manmade fiber.

1.11 DEFINITIONS

A. ASJ: Al-service jacket.

B. FSK: Foil, scrim, Kraft paper.

C. FSP: Foil, Scrim, polyethylene.

D. PVDC: Polyvinylidene chloride.

E. SSL: Self-sealing lap.

F. ASJ: All service jacket composed of aluminum foil reinforced with glass scrim bonded to a Kraft paper interweaving with an outer film layer leaving no paper exposed.

G. PSK: Poly Scrim Kraft.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

2.2 INSULATION MATERIALS

A. Refer to Part 3 execution schedule for requirements regarding where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, mercury compounds, or formaldehyde.

C. Insulation products shall contain no formaldehyde-based binders or will be third-party certified for conformance with Greenguard children and schools or Indoor Advantage Gold.

D. When product to be in contact with austenitic stainless steel is tested according to ASTM C795 (which includes ASTM C692 and ASTM C871), the PH of the leach water from the specific material supplied shall be greater than 7.0 but not greater than 11.7 at 77°F (25°C). An acceptable proportion of sodium plus silicate ions to the chloride ions as found by

leaching from the insulation is shown in the "plot point" of figure 6 in ASTM C795.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not utilize CFC or HCFC blowing agents in the manufacturing process.

G. Cellular Glass: Inorganic, incombustible, foamed or celluated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
   a. Pittsburgh Corning Corporation; Foamglass
   b. Specialty Products & Insulation Company (SPI), Lancaster, PA.
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
6. Maximum K-Factor: 0.29 at 75 deg. F. mean temperature.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Closed-cell polyolefin/polyethylene insulation is not acceptable as a substitution for ASTM C534 closed-cell rubber materials.
1. Products:
   a. Aeroflex USA Inc.: Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. Nomaco; K-Flex Pipe
2. Water Vapor Permeability: 0.02 perm-inch per ASTM E96 Procedure A.
3. Warranty: 25 year warranty against breakdown of the membrane due to ultraviolet radiation.
4. Seal Tape: Thermoplastic rubber membrane backed with pressure sensitive adhesive.

2.3 FIRE RATED INSULATION KITCHEN HOOD/EQUIPMENT FLUE EXHAUST SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. UL tested and certified to provide a 2-hour fire rating.
1. Products:
   a. Johns Manville; Super Firetemp M.

B. Fire-RatedBlanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating.
1. Products:
   a. CertainTeed Corp.; FlameChek.
   b. Johns Manville; Firetemp Wrap.
   c. 3M; Fire Master Wrap Products.

2.4 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.5 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
1. Products:
a. Foster Products Corporation, H. B. Fuller Company; 81-84.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II,Class I.
1. Products:
a. Armacell LCC; 520 BLV Adhesive.
b. Foster Products Corporation, H. B. Fuller Company; 85-60.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products:
a. Foster Products Corporation, H. B. Fuller Company; 85-70.

E. Eagle Bridges - Marathon Industries, Inc.; 225.ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products:
a. Foster Products Corporation, H. B. Fuller Company; 85-70.
b. Eagle Bridges - Marathon Industries, Inc.; 225.

F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products:
a. Dow Chemical Company (The); 739, Dow Silicone.

G. Polyurethane Foam Insulation Board: Manufacturer's recommended synthetic adhesive compatible with polyurethane insulation.
1. Products:
a. Sarnafil Sarnacol 2170 or Sarnacol 21425.

2.6 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products:
a. Foster Products Corporation, H. B. Fuller Company; 30-90.
b. Eagle Bridges - Marathon Industries, Inc.; 590.
c. Mon-Eco Industries, Inc.; 55-40.
d. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry

film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products:
   a. Foster Products Corporation, H. B. Fuller Company; 35-00.
   b. Eagle Bridges - Marathon Industries, Inc.; 550.
   c. Mon-Eco Industries, Inc.; 55-50.
   d. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.7 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Products:
   a. Foster Products Corporation, H. B. Fuller Company; 81-42W.
   b. Eagle Bridges - Marathon Industries, Inc.; 130.
   c. Vimasco Corporation; 713/714.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.8 SEALANTS

A. Joint Sealants:
1. Joint Sealants for Cellular-Glass and Polyisocyanurate Products:
   a. Foster Products Corporation, H. B. Fuller Company; 30-45.
   b. Eagle Bridges - Marathon Industries, Inc.; 405.
   c. Mon-Eco Industries, Inc.; 44-05.
   d. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:
1. Products:
   a. Foster Products Corporation, H. B. Fuller Company; 95-44.
   b. Eagle Bridges - Marathon Industries, Inc.; 405.
   c. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.9 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. ASJ+SSL: ASJ+ - SSL: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.
4. Redi-Klad Jacket: Factory applied Venture Clad 5-ply weather ad abuse resistant with self-sealing lap. Zero permeability per ASTM E 96-05; puncture resistance 35.4 kg (189.3 N) per ASTM D 1000; tear strength 4.3 lb (19.4 N) per ASTM D 624; thickness 14.5 mils (0.0145″); tensile strength 68 lb/inch width [306 N (32 kg)/25 mm].
5. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.
6. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
7. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
8. PVDC Jacket for Indoor Applications: 4-mil thick, white PVDC bioxially oritented barrier film with a permeance at 0.02 perms when tested according to ASTM E96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
9. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
   a. Products:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
10. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.
11. ASJ: Owens Corning Evolution™ paper-free ASJ pipe insulation.
12. PSK Jacket, Polypropylene scrim with Kraft.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.
1. Products:

a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.11 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with Kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mil thickness; roll stock Ready for shop or field cutting and forming.
1. Products:
a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: white.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps and mechanical joints minimum 20 mil thickness.
5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:
1. Products:
a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
a. Sheet and roll stock ready for shop or field sizing.
b. Thickness:
1) Up to 24 inch diameter, width, or height: 0.016 inch minimum.
2) 25 inch to 59 inch diameter, width, or height: 0.024 inch minimum.
3) 60 inch and larger diameter, width, or height: 0.032 inch minimum.
c. Finish: Smooth finish.
d. Color: White
e. Moisture Retarder: 3-mil- thick Polysurlyn (co-extrusion of polyethylene and Dupont Surlyn® , heat laminated to the metal jacketing).
f. Factory-Fabricated Fitting Covers:
1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and longradius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.
   1. Products:
      a. Polygaurd; Alumaguard 60.
      b. MFM Building Products Corp., Flex Clad 400.
      c. Venture Clad Jacketing.

F. Rubber Membrane: 48-mil thick membrane consisting of a glass fiber carrier coated on both sides with liquid PVC-P Plastisol, and laminated to polyester fleece.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
   1. 1. Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
   1. Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      b. Compac Corp.; 110 and 111.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
      d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
      b. Compac Corp.; 130.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
      d. Venture Tape; 1506 CW NS.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   4. Adhesion: 64 ounces force/inch in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
   1. Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
      b. Compac Corp.; 120.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
      d. Venture Tape; 3520 CW.
   2. Width: 2 inches.
   3. Thickness: 3.7 mils.
   4. Adhesion: 100 ounces force/inch in width.
   5. Elongation: 5 percent.
   6. Tensile Strength: 34 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:
   1. Products:
      a. Childers Products; Bands.
      b. PABCO Metals Corporation; Bands.
      c. RPR Products, Inc.; Bands.
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
   3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
   4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
      a. Products:
         1) AGM Industries, Inc.; CWP-1.
         2) GEMCO; CD.
         3) Midwest Fasteners, Inc.; CD.
         4) Nelson Stud Welding; TPA, TPC, and TPS.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
      a. Products:
         1) AGM Industries, Inc.; CWP-1.
         2) GEMCO; Cupped Head Weld Pin.
         3) Midwest Fasteners, Inc.; Cupped Head.
         4) Nelson Stud Welding; CHP.
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Products:
         1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
         2) GEMCO; Perforated Base.
         3) Midwest Fasteners, Inc.; Spindle.
      b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
      c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-

inch- diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products:
      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
   b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates
   e. indicated without damaging insulation, hangers, and substrates.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inchthick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Manufacturers:
      1) GEMCO.
      2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers:
   a. ACS Industries, Inc.
   b. C & F Wire.
   c. Childers Products.
   d. PABCO Metals Corporation.
   e. RPR Products, Inc.

2.14 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 EXECUTION

3.1 EXAMINATION

A. Refer to the Division 01 specifications for coordination and project conditions.

B. Verify piping, equipment and ductwork has been tested before applying insulation materials.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Install insulation continuously through hangers and around anchor attachments.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at

anchors and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive selfsealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

N. Cut and install insulation in a manner to avoid compressing insulation more than 25 percent of its original nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. Replace insulation on existing piping, and equipment where indicated on the drawings. Match insulation type and thickness indicated by the insulation schedule at the end of this section.

R. Replace insulation on new and existing piping, and equipment where insulation is damaged during construction or removed for testing and balancing work.

S. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

7. Unions.
8. Flanges.
9. Expansion joints.

T. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

U. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

V. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.

3.4 BUILDING PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire

damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

2. Pipe: Install insulation continuously through floor penetrations.

3.5 DUCT AND PLENUM INSULATION INSTALLATION

A. Provide Blanket Insulation Installation on Ducts and Plenums: Secure with SMACNA recommended anti-sag insulation pins for the bottom of ductwork over 24″ wide.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Protect exposed corners with secured corner angles.
   4. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Fittings shall be insulated to same thickness as the adjoining insulation. Apply fittings per fitting manufacturer's instructions. When required by specification, a hard insert of sufficient length shall be utilized to avoid compression of the insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a

design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not

staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and

sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
   1. Where rubber membrane jackets are indicated, install the membrane using the manufacturer's recommended adhesive. Before use thoroughly stir the adhesive. Replace the container lid when work is interrupted. If required thin the adhesive as recommended by the manufacturer.
   2. Using a sheepskin or similar roller apply a primer coat of adhesive to the roof surface, priming only the area of roof where the membrane will be laid the same day. Allow adhesive to dry.
   3. Unroll the membrane and fold back approximately half its length.
   4. Apply adhesive with a sheepskin or similar roller to the underside of the membrane ensuring the weld area is kept free of adhesive and allow to touch dry.
   5. Carefully roll out the membrane over the previously primed surface and roll with water filled roller.
   6. Fold back other half of the roll of membrane and repeat the procedure.
   7. Unroll the next roll of membrane, ensuring the end laps are staggered and the side overlaps the previously installed sheet by 2 inches.
   8. Repeat the adhering process.
   9. Fully hot air weld the 2-inch side lap, allow to cool completely.
   10. Mechanically check the integrity of the cooled weld by running a 3/16-inch wide screwdriver (with rounded edges) along the seam applying pressure into the

seam.

11. Install Peel Stop and PVC Welding Cord at all perimeters, penetrations and changes of roof direction.

3.10 FINISHES

A. Finish Duct, Equipment, and Pipe Insulation with ASJ, Glass Cloth, or Other Paintable Jacket Material. Clad-Type Jacketing such as Venture RediKlad or Venture Clad may be utilized.

B. Flexible Elastomeric Thermal Insulation: after adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 INSULATION APPLICATION SCHEDULE

A. Acceptable insulation materials, thickness and vapor retarder requirements are identified for each application and size range. If more than one material is listed for an application and size range, selection from the materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Fire-suppression piping.
2. Below-grade piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
4. General exhaust ductwork (Not including kitchen exhaust ductwork and elevator relief ductwork which is required to be insulated).
5. Factory-insulated flexible ducts.
6. Factory-insulated plenums and casings.
7. Flexible connectors.
8. Vibration-control devices.
9. Factory-insulated access panels and doors.

C. All supply and outside air ductwork with internal sound lining shall be externally insulated.

3.12 HVAC PIPING INSULATION APPLICATION SCHEDULE:

HVAC SERVICE	TYPES OF INSULATION MATERIAL	INSULATION THICKNESS REQUIRED	VAPOR RETARDER REQUIRED
INDOOR REFRIGERANT SUCTION, HOT GAS PIPING AND ALL REFRIGERENT PIPING CONNECTED TO THE VRF SYSTEM (Refer to Note 1)			
All sizes, Generally	Flexible Elastomeric	½″	Yes
All sizes, Unconditioned Space (Refer to Note 1)	Flexible Elastomeric	1-1/2″	Yes

OUTDOOR REFRIGERANT SUCTION, HOT GAS PIPING AND ALL REFRIGERENT PIPING CONNECTED TO THE VRF SYSTEM			
All sizes	Flexible Elastomeric	1″	Yes

3.13 HVAC DUCTWORK INSULATION APPLICATION SCHEDULE

HVAC SERVICE	TYPES OF INSULATION MATERIAL	INSULATION THICKNESS REQUIRED	VAPOR RETARDER REQUIRED
SUPPLY-AIR DUCTS AND PLENUMS			
Indoor Service: (Refer to Note 1)			
Concealed	Mineral-Fiber Blanket	1-1/2″	Yes

Kitchen hood exhaust air ductwork and accessories	Type of Insulation Material	Vapor Retarder Required	Insulation Thickness Required
Concealed (Indoor)	Fire Rated Blanket	No	As required for fire rating
Exposed (Indoor)	Fire Rated Board	No	As required for fire rating
Attic and unconditioned spaces (Indoor)	Fire Rated Board	No	As required for fire rating

Schedule Notes:

1. Where rigid pipe insulation (cellular glass, etc.) is scheduled, provide mineral fiber through and 6 inches beyond pipe sleeves, to allow for pipe expansion.
2. **All diffuser cones shall be insulated.**

3.14 FIELD APPLIED JACKET APPLICATION SCHEDULE

SERVICE	FIELD APPLIED JACKET TYPE
Indoor concealed piping	None
Outdoor exposed piping	Aluminum
SERVICE	**FIELD APPLIED JACKET TYPE**
Equipment, generally (Refer to Notes 1)	Woven Glass Fiber Fabric

Equipment, Cold surface (Refer to Notes)	PVC

Jacket Application Schedule Notes:

1. Including factory insulated equipment without factory applied jacket.

END OF SECTION

SECTION 15400

COMMON WORK FOR PLUMBING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this and the other sections of Division 15.

1.2 SUMMARY

A. Section includes:
1. General administrative and procedural requirements, as well as the following basic plumbing materials and methods.
2. Submittals.
3. Coordination drawings.
4. Record documents.
5. Operation and Maintenance manuals.
6. Rough-ins.
7. Plumbing installations.
8. Cutting and patching.
9. Concrete equipment base construction requirements.
10. Equipment nameplate data requirement.
11. Non-shrink grout for equipment installations.
12. Field-fabricated metal and wood equipment supports.
13. Installation requirements common to equipment specification Sections.
14. Plumbing demolition.
15. Touchup painting and finishing.

1.3 ACRONYMS

A. The following list of abbreviations are utilized within the specifications and are provided as a reference:

ADA	-	American Disability Act
AGA	-	American Gas Association
ANSI	-	American National Standards Institute
ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
AWWA	-	American Water Works Association BOCA
	-	Building Officials and Code Administrators CS
	-	Commercial Standard
IBR	-	Institute of Boiler and Radiator Manufacturers IEEE
	-	Institute of Electrical and Electronics Engineers
FBCM	-	Florida Building Code – Mechanical
FBCP	-	Florida Building Code - Plumbing
MSSP	-	Manufacturers Standards Society of the Valve and Fittings Industry

NEC - National Electrical Code
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
OSHA - Occupational Safety and Health Administration SMACNA - Sheet Metal and Air Conditioning Contractors National Association
TEMA - Tubular Exchanger Manufacturers Association UL - Underwriters' Laboratories
FBC - Florida Building Code

1.4 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: Changes proposed by Contractor in products, materials, equipment, and methods of construction required by the Contract Documents.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named, or a product is 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. Extended 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.

1.5 SYSTEM DESCRIPTION

A. Design Requirements: Contract drawings are generally diagrammatic and do not indicate all offsets, fittings, transitions, access panels and other specialties required.
1. Furnish and install all items as may be required at no additional cost to fit the work to the conditions encountered.
2. Arrange piping, equipment and other work generally as shown on the contract drawings, providing proper clearances and access.

3. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawing submittal for approval in accordance with Submittals specified below.
4. Subject to the provisions of Division 01, Architect may make reasonable changes in location of equipment piping and ductwork up to the time of rough-in or fabrication.

1.6 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the contract and Division 00 and Division 01 Specification Sections.

B. Shop Drawings and Product Data:
1. Clearly identify all submittals:
   a. Indicate intended application, location, etc.
   b. Each submittal shall indicate the associated specification section, and paragraphs. Do not combine product data and shop drawing submittals from different spec sections into a single submittal package, even though they may be the same distributor, vendor or part of a single material order.
   c. Clearly indicate the exact type, model number, size and special features of the proposed item.
   d. Include catalog spec sheets to completely describe proposed equipment.
   e. Factory order forms only showing the required capacities are not acceptable.
   f. Identify all options furnished to meet specifications.
   g. If product is within system supplying fixture intended to dispense potable water for human consumption, including drinking and cooling, submittals shall indicate that product is “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
   h. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead.
   i. The Architect shall not select equipment ratings and/or options. Submittals not properly marked shall be returned without review.

C. Product Substitutions: Comply with requirements of Division 01.

D. Comparable Products Submission:
1. Document each request for a proposed comparable product with supporting data substantiating compliance of proposed product with Basis-of-Design product.
2. Use the attached “Comparable Product Submittal Form” in addition to the requirements specified herein.
3. Comparable products will not be reviewed without completion of the attached form.

E. Coordination Drawings
1. Prepare coordination drawings to a scale of 1/4" = 1’-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   a. Indicate the proposed locations of piping, valving, ductwork, equipment, and materials. Include the following:
   b. Planned piping layout, including valve and specialty locations and valve stem movement.

c. Planned piping systems layout, including valves and accessories.
d. Clearances for installing and maintaining insulation.
e. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
f. Equipment connections and support details.
g. Clearances at electrical components in accordance with the National Electric Code.
h. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
i. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. Show all wall mounted access doors for plumbing devices.
j. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, cable trays, sprinklers, access doors and other ceiling mounted items.
k. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, cable trays, sprinklers, access doors and other ceiling mounted items.
l. Coordination drawings shall at a minimum include coordination with Division, 15 and Division 16 installers. Include fire protection piping, domestic water piping (cold water, hot water and hot water re- circulation), sanitary piping, sanitary vent piping, closed loop supply and return piping, ductwork, flexible duct, ceiling mounted air devices, lights, ceiling and building structural members (floor slabs, beams, joists, etc.). Coordination drawings shall be provided at a minimum for:
    1) First Floor Corridor. Provide floor plans and at least two sections.

F. Closeout Submittals:
1. Record Drawings: Prepare record documents in accordance with the requirements in the Division 01 specifications. In addition to the requirements specified in Division 01, indicate the following installed conditions:
    a. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
    b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
    c. Approved substitutions, Contract Modifications, Responses to Contractor's Request for Information, and actual equipment and materials installed.
    d. Record the locations and invert elevations of underground installations.
2. Operation and Maintenance Data: Prepare operation and maintenance data in accordance with Division 01 specifications. In addition to the requirements specified in Division 01, include the following information for equipment items:
    a. List of systems and equipment requiring service manuals.
    b. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
    c. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating

instructions.
d. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
e. Servicing instructions and lubrication charts and schedules.
f. Systems and Equipment test reports.
3. Commissioning Report

G. Color Selection: Color of finishes shall be as selected by the Architect. Submit colors of factory finished equipment for acceptance prior to ordering.

H. Products and Materials:
1. Submit complete descriptive data for all materials as follows:
a. Material specifications.
b. Data sheets.
c. Samples.
d. Capacity ratings.
e. Performance curves.
f. Operating characteristics.
g. Catalog cuts.
h. Dimensional drawings.
i. Wiring diagrams.
j. Lead Free, for potable water service.
k. Installation instruction.
l. Any other information necessary to indicate compliance with contract documents.
2. Edit submittal data specifically for application to this project.
3. Submit actual operating conditions and characteristics for all equipment.
4. Catalogs or catalog cuts are not acceptable unless the particular item and all relative data has been marked in such a manner as to be clearly defined.
5. Color of finishes shall be as selected by the Architect. Submit colors of factory finished equipment for acceptance prior to ordering.
6. No plumbing item shall be fabricated, purchased, delivered to the site or installed, until reviewed by the Architect/Engineer
a. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect.
7. Provide shop drawing and product data submittals as indicated under individual specification sections.
8. Provide any other equipment requested by the Architect/Engineer.

1.7 QUALITY ASSURANCE

A. Underwriter's Laboratory (UL) Requirements: All equipment containing electrical components and provided under Division 15 shall bear the Underwriter's Laboratory (UL) label, as a complete packaged system.
1. Equipment not provided with a UL label shall be tested in the field, certified and provided with a listed label at the installer's expense.
a. Field testing shall be performed by a testing agency approved by the authority having jurisdiction.
b. Provide services of a UL recognized, independent Electrical Testing Laboratory (ETL) to provide field inspection and testing. Provide and ETL Label on all such equipment.

B. Fire Safe Materials: Unless otherwise indicated, materials shall conform to UL, National Fire

Protection Agency (NFPA) or American Society for Testing and Materials (ASTM) standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 01 specifications.
1. Deliver, store, and handle products according to manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
2. Schedule delivery to minimize long-term storage at Project Site and to prevent overcrowding of construction spaces.
3. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
4. 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.
5. Inspect products upon delivery to ensure compliance with Contract Documents and to ensure that products are undamaged and properly protected.
6. Store products in manner that will facilitate inspection and measurement.
7. Store materials in a manner that will not endanger project structure.
8. Store products subject to damage by elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation.
9. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather protection requirements for storage.

1.9 PROJECT CONDITIONS

A. Existing Conditions: Prior to preparing the bid, visit the site and become familiar with all existing conditions. Make all necessary investigations as to locations of utilities and all other matters, which can affect the work. No additional compensation will be made for failure to determine the conditions under which the work will be performed.

B. Outages
1. All plumbing outages which will interfere with the normal use of the building in any manner shall be done at such times as shall be mutually agreed upon with the Owner.
2. Unless otherwise specified, outages of any services in adjacent buildings required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled with the Owner at least fourteen days (14) days in advance. All such outages shall be coordinated with the owner in writing.
The owner reserves the right to partially occupy the building. Provide all necessary bypasses, isolation and other means and methods to limit the amount of time the building is without services.
3. The bid price shall include the cost of all premium time required for outages and other work which interferes with the normal use of the building.
4. The operation of valves or switches required to achieve an outage shall be accomplished by the Contractor in the Owner’s presence. Unauthorized operation of valves, power switches, or other control devices shall not be permitted.

1.10 SEQUENCING

A. Coordinate plumbing equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where plumbing items requiring access are concealed behind finished surfaces.

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

1.11 PRODUCT WARRANTIES

A. Comply with all requirements contained in the Division 01 Specifications and all requirements contained herein and other sections of Division 22.

B. 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.

C. 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. Refer to Divisions 02 thru 48 Sections for specific content requirements and particular requirements for submitting special warranties.

D. Submittal Time: Comply with requirements in the Division 01 Specifications.

1.12 DISCREPANCIES

A. Comply with the requirements set forth in the Division 01 specifications and contained herein.

B. Where discrepancies occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Architect shall decide on the item and manner in which the work shall be provided, based on the design intent of the documents.

PART 2 PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with Contract Documents that are undamaged and new at time of installation.
   1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and intended use and effect.
   2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Where products are accompanied by the term as selected, Architect will make selection.
   4. Where products are accompanied by the term match sample, sample to be matched is Architect's.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. General Compliance Requirements: Compliance requirements for individual products, as indicated in Contract Documents, are multiple in nature and may include generic descriptions, performance requirements, compliance with reference standards, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.

C. Procedures for Selecting Products: Contractor's options for selecting products are limited by Contract Document requirements, and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects.

D. Products specified by Reference Standards, Codes and Regulations: Select from among products, which can be shown to comply with referenced documents.

E. Products specified by Naming Products and Manufacturers: Select from among products listed.

F. Products specified by Naming One Manufacturer's Product as the Basis-of-Design with Reference to Other Manufacturers: Select either the specified Basis-of-Design product or an approved comparable product by one of the other named manufacturers.
   1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named manufacturers.

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

H. Visual Selection Specification: Where Specifications include the phrase as selected from manufacturer's standard colors, patterns, textures or similar phrase, select a product that complies with other specified requirements. Architect will select color, pattern, and texture.
   1. 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.
   2. 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 COMPARABLE PRODUCTS

A. Where Basis-of-Design products are specified by name, submit the following, in addition to other required submittals, to obtain approval of a comparable product by one of the named manufacturers:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work. Use the attached Comparable Products Submittal Form in addition to requirements listed herein.
2. Detailed comparison of significant qualities of proposed product with the Basis-of-Design product in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, serviceability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

2.3 GROUT

A. Comply with requirements in the Division 03 Specifications and contained herein.

B. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B, "Packaged Dry, Hydraulic-Cement Grout (Nonshrink)".

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.50MPa), 28-day compressive strength.
3. Packaging: Premixed and factory-packaged.

2.4 ACCESS DOORS AND PANELS

A. Comply with the requirements set forth in the Division 08 Specifications and contained herein.

B. Provide manufactured steel door assemblies consisting of:

1. Hinged door.
2. Flush screwdriver camlocks and frame.

C. Doors shall be Milcor Metal Access doors. Provide key locks where indicated.

D. Design shall be provided for the following installations:

1. Masonry or Dry Wall: Style M.
2. Hard Finish Plaster: Style AP.
3. Fire rated dry wall ceilings: Style CFRAD, 1 hour combustible floor ceiling system, 1 hour non-combustible floor ceiling system, 3 hour non-combustible floor ceiling system.
4. Suspended ceilings: Style CT.

PART 3 EXECUTION

3.1 PREPARATION

A. Interface With Site Utility Companies:
1. Contact MISS UTILITY prior to any excavation or underground work.
2. Contact local utility companies (gas, water, sewer, etc.) immediately upon award of contract. Do not install related equipment until fully coordinated with appropriate utilities.
3. Provide all construction schedules, dates of requested services, outage windows, equipment locations, etc. necessary for utility work.
4. Water and Sewer Utilities:
   a. Coordinate flow, usage and pressure requirements with local water and sewer authorities as necessary to obtain services.

3.2 INSTALLATION

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where systems, materials and equipment are intended for overhead installation, and where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
10. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panel or doors where units or valves are concealed behind finished surfaces. Access panels and doors are specified in Division 08 and herein.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

B. Rough-In
1. Verify final locations for rough-ins with field measurements and with the

requirements of the actual equipment to be connected.

2. Refer to equipment specifications in other Divisions for rough-in requirements.

C. Housekeeping and Equipment Pads

1. Comply with the requirements in the Division 03 Specifications and contained herein.
2. Construct pads of dimensions indicated, but not less than 4 inches (100 mm) larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi (20.70MPa), 28-day compressive strength concrete and reinforcement bars.

D. Erection of Metal Supports and Anchorage

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1, "Structural Welding Code -Steel".

E. Erection of Wood Supports and Anchorage

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
2. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
3. Attach to substrates as required to support applied loads.

F. Grouting

1. Install nonmetallic non-shrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
2. Clean surfaces that will come into contact with grout.
3. Provide forms for placement of grout, as required.
4. Avoid air entrapment when placing grout.
5. Place grout to completely fill equipment bases.
6. Place grout on concrete bases to provide a smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout according to manufacturer's printed instructions.

G. Lintels

1. Lintels shall be provided for openings in masonry, brick, concrete, etc. walls to accommodate work of this division.
   a. Lintels shall be provided under this division when not being provided under other divisions. Lintels shall be approved by the Architect.

H. Water Heaters:

1. Installation of water heaters, expansion tanks and all other pressure vessels shall be made in compliance with all state code requirements.

3.3 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with the Division 01 Specifications. In addition to the requirements specified in Division 01, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of plumbing equipment and materials required to:
   1. Uncover Work to provide for installation of ill-timed Work.
   2. Remove and replace defective Work.
   3. Remove and replace Work not conforming to requirements of the Contract Documents.
   4. Remove samples of installed Work as specified for testing.
   5. Install equipment and materials in existing structures.
   6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

C. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

D. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

E. Patch finished surfaces and building components using new materials specified for the original installation and using experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.4 PAINTING AND FINISHING

A. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

B. Do not paint manufacturer's labels or tags.

3.5 CONSTRUCTION

A. Cutting, Welding, Burning
   1. If required, before commencing any cutting, welding, burning, brazing (pipe sweating), obtain a hot work permit from Environmental Health and Safety.
   2. If required, the hot work permit copy shall remain on the job site at the hot work location until such work is completed at which time the permit shall be returned to Environmental Health and Safety.

3.6 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction.

B. Furnish and install drains, curbs, vent assemblies, sleeves, flashing, etc. specifically designed for application to the particular construction. Install system in accordance with the roofing manufacturer's instructions.

3.7 EXCAVATION AND BACKFILLING

A. General
   1. Perform all necessary excavation, for installation of work under this division in accordance with FBCP and Division 02.

3.8 CLEANING

A. Clean surfaces prior to application of insulation, adhesives, coating, and paint.

B. Provide factory applied finish where specified.

C. Protect all finishes, and restore all finishes to their original condition if damaged as a result of work.

D. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces.

E. General: General cleaning during construction is required by the General Conditions and included in Section Temporary Facilities.

F. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

G. Remove all plumbing clipping, wiring, nuts, bolts, etc. left on top of ceilings and ceiling tiles.

3.9 PROTECTION

A. Protect work, material and equipment from weather and construction operations before and after installation.

B. Properly store and handle all materials and equipment.

C. Cover temporary openings in piping, ductwork and equipment to prevent the entrance of water, dirt, debris, and other foreign matter.

3.10 LUBRICATION

A. All bearings, motors and all equipment requiring lubrication shall be provided with accessible fittings.

B. Before turning over the equipment to the Owner, provide the following:
1. Fully lubricate each item of equipment.
2. Provide 1 year's supply of lubricant for each type of lubricant.
3. Provide complete written lubricating instructions, together with diagram locating the points requiring lubrication.

C. Motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal extended grease fittings and drain plugs.

3.11 ELECTRICAL WORK

A. It is the intent to provide a complete and operational system. The work between Division 15 and 16 is complementary and is meant to produce a single and operating system. Contractor shall make its own determination as to the distribution of responsibility among the various trades.

B. All electrical work performed under Division 15 shall be provided in accordance with Division 16.

3.12 PROVISIONS FOR ACCESS

A. Furnish and install adequate access to all plumbing components. The following list shall be used as a guide only:
   1. Plumbing equipment.
   2. Valves.
   3. Cleanouts.
   4. Traps.

B. Access shall be adequate as determined by the Architect.

C. Refer to contract drawings where panels have been specifically located.

D. Provide additional panels for adequate access as indicated in paragraph A above.

E. Where access is by means of liftout ceiling tiles or panels mark each panel using small color-coded or numbered tabs. Provide an index chart for identification. Place markers in corner of tile.

3.13 OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing and balancing.

B. Do not operate equipment unless all proper safety devices or controls are operational.

C. Provide all maintenance and service for equipment, which is operated during construction.

D. Where specified and otherwise required, provide the services of a manufacturer's factory trained service organization to start the equipment.

E. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Architect.
   1. Where such authorization is granted, temporary use of equipment shall not limit or otherwise affect warranties or guarantees of the work.

F. Upon completion of work, clean and restore all equipment to new conditions and replace all filters.

3.14 DEMONSTRATION

A. Demonstrate operation and maintenance of equipment and systems to Owner’s personnel a minimum two (2) weeks prior to date of final inspection.
   1. For equipment requiring seasonal operation, perform instructions for other seasons at the same time.
   2. Training period shall be performed within 1 - two week period.

B. Use operation and maintenance manuals and video as basis of instruction. Review contents of manual and video with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate the following:
   1. Start up.
   2. Operation.
   3. Control.
   4. Adjustment.
   5. Trouble shooting.
   6. Servicing.
   7. Maintenance.
   8. Shutdown.

D. Provide at least 40 hours of instruction to the operating personnel.
   1. This instruction period shall consist of not less than five-8 hour days.
   2. Time of instruction shall be designated by the Owner.
   3. This instruction shall be in addition to instructional requirements of specific equipment specified elsewhere in Division 15.
   4. Record all training sessions. Provide the owner with three (3) copies of the recordings in digital versatile disk (DVD) format.

3.15 WALL AND FLOOR PENETRATION

A. All penetrations of partitions, walls and floors by ducts, piping or conduit under Division 15 shall be sealed and caulked. Provide U.L. listed fire stopping systems at penetrations through all fire rated assemblies.

3.16 EQUIPMENT PROVIDED UNDER ANOTHER DIVISION AND BY OTHERS

A. Make all system connections required to equipment furnished and installed under another division and by others.

B. It shall be the responsibility of the Contractor to coordinate all necessary data from the equipment supplied under other Divisions.

3.17 PROJECT PUNCH OUT

A. Architect/Engineer will perform punch out reviews and will provide the Contractor with a list of punch list items to be completed before contract close out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer will not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed by the Contractor and the Architect/Engineer determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at his regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer. Reimbursement will be made by deducting the Architect/Engineer fee from the Contractor's final payment.

COMPARABLE PRODUCT SUBMITTAL FORM

Table of Compliance (Sample)
Shop Drawing and Product Data Submittal

The Contractor shall prepare a Table of Compliance Form similar in format to the sample shown below to facilitate and expedite the Shop Drawing and Product Data Review. Failure to comply with this requirement will be basis for rejecting the Submittal.

The Table of Compliance Form will list and compare the performance parameters as the submitted equipment to that listed on equipment schedule and specifications as basis of design. All non-compliance items (differences) must be explained in full, indicating their impact, if any, on maintainability, durability, energy use, operating costs, code compliance and environmental considerations.

(Sample)
TABLE OF COMPLIANCE

EQUIPMENT: _____ SPEC. SECTION: _____

BASIS OF DESIGN SAMPLE ITEMS	DRAWINGS	SUBMITTED	EXPLANATION
Flow (Cfm Or Gpm)			
Ext. Static Press.			
Head (Ft.)			
Electrical Requirements			
Cooling Capacity			
Heating Capacity			
Discharge Air Temp.			
Filter Type & Eff.			
Equipment Eff. (Eer)			
Sound Data			
Weights			
Etc.			
Specifications:			
A. Quality assurance compliance (ARI)			
(ASHRAE)			
(AMCA)			
(UL)			
B. Specifications: List each and every specification paragraph			
C. Etc.			
Other:			

END OF SECTION

SECTION 15410

PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:
1. Domestic water piping, within 5 feet of building.
2. Sanitary sewer piping, within 5 feet of building.
3. Storm water piping within 5 feet of building.
4. Air conditioning condensate, equipment drains, and over flows.
5. Unions and flanges.
6. Natural gas piping.
7. Foundation drain piping
8. Piping Specialties and Accessories.
9. Limited Pipe Fittings.

B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Section 15400- "Common Work Results for Plumbing."
2. Section 15440 - "Hangers and Supports for Plumbing Piping and Equipment": Product requirements for hangers and supports for placement by this section.
3. Section 15446- "Vibration Controls for Plumbing Piping and Equipment": Product requirements for vibration isolation for placement by this section.
4. Section 15445 - "Identification for Plumbing Piping and Equipment."
5. Section 15075 – Mechanical HVAC Identification": Product requirements for piping insulation for placement by this section.
6. Section 15490 - "Plumbing Piping System Cleaning and Treatment."
7. Section 15411 - "Plumbing Fixtures": Product requirements for equipment requiring water and sanitary connections.
8. Section 15995 - "Testing, Adjusting, and Balancing for Plumbing."

1.3 DEFINITIONS

A. Point of Delivery is the outlet of the service meter assembly, or the outlet of the service regular (service shutoff valve when no meter is provided).

B. Domestic Water Systems: A system conveying domestic potable or non-potable water, such as Cold Water, Hot Water, Hot Water circulating, etc.

C. Gravity Drainage Systems: A system of gravity fed effluent conveying storm water, sanitary, etc.

D. Lead Free:
1. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be "lead free", containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.

2. Solder and flux for soldered joints in potable water piping shall be "lead free", containing not more than 0.2% lead free.

1.4 REFERENCES
(Unless otherwise noted, references apply to "latest editions.")

A. ANSI (American National Standards Institute)
1. ANSI B16.39, "Malleable Iron Threaded Pipe Unions".
2. ANSI/ASME B1.20.1, "Pipe Threads, General Purpose (Inch)".
3. ANSI/ASME B16.3, "Malleable Iron Threaded Fittings".
4. ANSI/ASME B16.5, "Pipe Flanges and Flanged Fittings".
5. ANSI/ASME B16.21, "Non-metallic Flat Gaskets for Pipe Flanges".
6. ANSI/ASME B16.22, "Wrought Copper and Copper Alloy Solder Joint Pressure Fittings".
7. ANSI/ASME B16.29, "Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings (DWV)".
8. ANSI/AWS B2.1, "Standard Specification for Welding Procedure and Performance Qualification".
9. ANSI/AWS D10.12, "Guide for Welding Mild Steel Pipe".
10. ANSI/AWWA C104, "American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water".
11. ANSI/AWWA C110, "American National Standard for Ductile-Iron and Gray-Iron Fittings, 3in. Through 48in., for Water and Other Liquids.
12. ANSI/AWWA C111, "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings".
13. ANSI/AWWA C151, "American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water".
14. ANSI/AWWA C153, "American National Standard for Ductile-Iron Compact Fittings, 3in. Through 24in., and 54in. Through 64in, for Water Service".

B. ASME (American Society of Mechanical Engineers)
1. ASME A112.1.2, "Air Gaps in Plumbing Systems".
2. ASME A112.14.1, "Back Water Valves".
3. ASME A112.21.2M, "Roof Drains".
4. ASME A112.36.2M, "Clean-outs".
5. ASME B16.1, "Cast Iron Pipe Flanges and Flanged Fittings".
6. ASME B16.4, "Cast Iron Threaded Fittings".
7. ASME B16.5, "Pipe Flanges and Flanged Fittings".
8. ASME B16.20, "Metallic Gaskets for Pipe Flanges- Ring-Joint, Spiral-Wound, and Jacketed".
9. ASME B16.21, "Nonmetallic Flat Gaskets for Pipe Flanges".
10. ASME B16.24, "Cast Copper Alloy Pipe Flanges and Flanged Fittings".
11. ASME B18.2.1, "Square and Hex Bolts and Screw- Inch Series".
12. ASME B18.10, "Track Bolts and Nuts".
13. ASME B31.1, "Power Piping".
14. ASME B31.9, "Building Services Piping".
15. ASME B40.1, "Gauges- Pressure Indicating Dial Type- Elastic Element".
16. ASTM/ASME B16.22, "Wrought Copper and Copper Alloy Solder Joint Pressure Fittings".
17. ANSI/ASME B1.20.1, "Pipe Threads, General Purpose (Inch,".
18. ANSI/ASME B16.3, "Malleable Iron Threaded Fittings".
19. ANSI/ASME B16.5, "Pipe Flanges and Flanged Fittings".
20. ANSI/ASME B16.18, "Cast Copper Alloy Solder Joint Pressure Fittings".
21. ANSI/ASME B16.22, "Wrought Copper and Copper Alloy Solder Joint Pressure Fittings".

22. ASME B16.25, "Butt-Welding Ends".
23. ANSI/ASME B16.29, "Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings (DWV)".
24. ANSI/AWA C606, "Grooved and Soldered Joints".

C. ASSE (American Society of Sanitary Engineers)
1. ASSE 1001, "Hose Connection Vacuum Breakers".
2. ASSE 1010, "Water Hammer Arresters".
3. ASSE 1013, "Reduced Pressure Principle Backflow Preventors".
4. ASSE 1015, "Double Check Backflow Prevention Assembly".
5. ASSE 1019, "Vacuum Breaker Wall Hydrants, Frost Resistant Automatic Draining Type".

D. ASTM (American Society for Testing and Materials)
1. ASTM A36, "Standard Specification for Carbon Structural Steel".
2. ASTM A47, "Standard Specification for Ferritic Malleable Iron Castings".
3. ASTM A53, "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless".
4. ASTM A74, "Standard Specification for Cast Iron Soil Pipe and Fittings".
5. ASTM A126, "Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings".
6. ASTM A167, "Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip".
7. ASTM A182, "Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service"
8. ASTM A183, "Standard Specification for Carbon Steel Track Bolts and Nuts.
9. ASTM A193, "Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service".
10. ASTM A194, "Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both".
11. ASTM A216, "Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service".
12. ASTM A234, "Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High-Temperature Service".
13. ASTM A276, "Standard Specification for Stainless Steel Bars and Shapes".
14. ASTM A278, "Standard Specification for Gray Iron Castings for Pressure Containing Parts".
15. ASTM A351, "Standard Specification for Stainless Steel Bars and Shapes".
16. ASTM A536, "Standard Specification for Ductile Iron Castings".
17. ASTM A564, "Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes".
18. ASTM A582, "Standard Specification for Free-Machining Stainless Steel Bars".
19. ASTM A780, "Standard Practice for Repair of Damaged and Un-coated Areas of Hot-Dip Galvanized Coatings".
20. ASTM B16, "Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines".
21. ASTM B32, "Standard Specification for Soldered Metal".
22. ASTM B62, "Standard Specification for Composition Bronze or Ounce Metal Castings".
23. ASTM B88, "Standard Specification for Seamless Copper Water Tubes".
24. ASTM B124, "Standard Specification for Copper and Copper Alloy Forging Rod, Bar and Shapes".
25. ASTM B148, "Standard Specification for Aluminum-Bronze Sand Castings".
26. ASTM B306, "Standard Specification for Copper Drainage Tube (DWV)".
27. ASTM B584, "Standard Specification for Copper Alloy Sand Castings for General

Applications".
28. ASTM C33, "Standard Specification for Concrete Aggregates".
29. ASTM C150, "Standard Specification for Portland Cement".
30. ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrinking)".
31. ASTM C1540, "Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
32. ASTM D2321, "Standard Practice for Thermoplastic Pipe for Sewers and Other Gravity- Flow Applications".
33. ASTM D635, "Standard Test Method for Rate of Burning and/or Extent and Time of Burning Plastics in a Horizontal Position".
34. ASTM D2464, "Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings".
35. ASTM D2564, "Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems".
36. ASTM D2665, "Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings".
37. ASTM D2729, "Standard Specification for Poly (Vinyl Chloride) PVC) Sewer Pipe and Fittings".
38. ASTM D2846, "Standard Specification for Chlorinated Polyvinyl Chloride (CPVC) Plastic Hot- and Cold-Water Distribution Systems".
39. ASTM D3138, Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly Vinyl Chloride (PVC) Non-Pressure Piping Components".
40. ASTM E1, "Standard Specification for ASTM Thermometers".
41. ASTM F402, "Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners used for Joining Thermoplastic Pipes and Fittings".
42. ASTM F493, "Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings".
43. ASTM F656, "Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Pipe and Fittings".
44. ASTM F844, "Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use".
45. ASTM F2618, "Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems".

E. AWS (American Welding Society)
1. AWS D1.1, "Structural Welding Code- Steel".
2. ANSI/AWS B2.1, "Standard Specification for Welding Procedure and Performance Qualification".
3. ANSI/AWS D10.12, "Guide for Welding Mild Steel Pipe".

F. AWWA (American Water Works Association)
1. AWWA C600, "Standards for Insulation of Ductile-Iron Water Mains and their Appurtances".
2. AWWA C700, "Standard for Cold-Water Meters- Displacement Type, Bronze Main Case".
3. AWWA C702, "Cold-Water Meters- Compound Type".
4. ANSI/AWWA C104, "American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water".
5. ANSI/AWWA C110, "American National Standard for Ductile-Iron and Gray-Iron Fittings, 3in. Through 48in., for Water and Other Liquids".
6. ANSI/AWWA C111, "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings".
7. ANSI/AWWA C151, "American National Standard for Ductile-Iron Pipe,

Centrifugally Cast, for Water".
8. ANSI/AWWA C153, "American National Standard for Ductile-Iron Compact Fittings, 3in. Through 24in., and 54in. Through 64in, for Water Service".
9. ANSI/AWWA C606, "Grooved and Shouldered Joints".

G. CISPI (Cast Iron Soil Pipe Institute)
1. CISPI 301-11, "Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications".
2. CISPI 310-09, "Specification for Couplings for use in connection with Cast Iron Soil Pipe for sanitary and storm drain, waste and vent piping applications."

H. CS (Commercial Standard)

I. IEEE (Institute of Electrical and Electronics Engineers)

J. FBCM (Florida Building Code Mechanical)

K. FBCP (Florida Building Code Plumbing)

L. NEC (National Electrical Code)

M. NEMA (National Electrical Manufacturers Association)

N. NFPA (National Fire Protection Association)
1. NFPA 70, "National Electrical Code".

O. OSHA (Occupational Safety and Health Administration)

P. PHCC (National Standard Plumbing Code)

Q. UL (Underwriters' Laboratories)

R. FBC (Florida Building Code, Sixth Edition)

1.5 SUBMITTALS

A. General: Submit each item in this Section according to the Conditions of the Contract and the Division 01 Specification Sections.

B. Maintenance data to be included in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing. Include data for the following:
1. Pipe Materials
2. Flow Measuring Systems
3. Plumbing Specialties

C. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

D. Certification of compliance with ASTM, ASME and ANSI manufacturing requirements for pipe, fittings, and specialties.

E. Submit flange gasket bolt tightening sequence and torque requirements for review as part of gasket submittals.

F. Product Data: Submit data on each type of pipe material and fittings. Submit manufacturer's catalogue information.

G. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable grooved system manufacturer's style or series number.

1.6 QUALITY ASSURANCE

A. ASME (American Society of Mechanical Engineers) Compliance; comply with:
1. ASME B31.9, "Building Services Piping," latest edition.
2. ASME B31.1, "Power Piping," latest edition.

B. Qualify welding processes and welding operators according to AWS D1.1, "Structural Welding Code—Steel".
1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Regulatory Requirements: Comply with the requirements of the following additional codes:
1. Florida Building Code Plumbing (FBCP), Sixth Edition.
2. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.
3. PHCC - National Standard Plumbing Code, latest edition.
4. HB 372 "Business Occupations and Professions – Plumbers – Lead Free Materials".
5. Florida Building Code Mechanical (FBCM)
6. Florida Building Code (FBC)

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years experience.

B. Installer: Company specializing in performing work of this section with minimum 5 years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

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

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

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 SEQUENCING AND SCHEDULING

A. Notification of Interruption of Service: Provide notification for all utility outages.

B. Work Interruptions: When interruptions in work occur while repairs or alterations are being made to an existing piping system, leave the system in safe condition.

C. Coordinate the installation of pipe sleeves for foundation wall penetrations.

D. Coordinate the size and location of concrete pads. Cast anchor bolt inserts into pad.

E. Coordinate the installation of roof piping support, and roof penetrations.

PART 2 PRODUCTS

2.1 PIPE AND TUBE MATERIALS AND APPLICATION SCHEDULE

System	Pipe Material	Fitting Material	Joint Material
All Domestic Hot Water, Cold Water, Above ground within building	Copper Tube: ASTM B88, Type L, Seamless, Water Tube, hard-drawn temper.	Copper Tube: ASME B16.22, wrought copper, or copper alloy, solder joint, 150 lb.	For Pipe Sizes of 4″ or less: ASTM B32, alloy Sb5 (95 percent tin and 5 percent antimony), with 0.2 percent maximum lead content. For Pipe Sizes over 4″: Joints shall be silver soldered.
Sanitary, and Sanitary Vents, Above Ground within	Cast Iron; no hub, CISPI-301-11. All pipe and fittings shall bear the Collective Trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.	Cast Iron; no hub, CISPI-301. All pipe and fittings shall bear the Collective Trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.	Couplings; Heavy Duty Type 300 Series Stainless Steel, ASTM C-1540 neoprene gasket, 3" wide for less than 5" pipe, 4" wide for 5-10″, 5 ½″ wide for 12″ pipe and larger.
	Poly Vinyl Chloride (PVC); DWV pipe, ASTM D2665, Schedule 40, plain ends.	Socket ASTM D2665	Solvent Cements, per ASTM D2564.
Sanitary, and Vents, Below Ground to 5 feet beyond building	Cast Iron; Service Weight, hub and spigot, ASTM A74. All pipes shall bare CISPI, collective trademark of CISPI and NSF.	Cast Iron; Service Weight, hub and spigot, ASTM A74. All pipes shall bare the collective trademark of CISPI and NSF.	Neoprene rubber gaskets and lubricant, ASTM C-564.
	Poly Vinyl Chloride (PVC); DWV pipe, ASTM D2665, Schedule 40 solid wall, plain ends.	Socket: ASTM D2665	Solvent Cements, per ASTM D2564.

Air Conditioning Condensate and Equipment Drains	Copper Drainage Tube; DWV, ASTM B306.	Wrought copper and bronze drainage fittings, ASNI B16.29.	Soldered; ASTM B32, Alloy Sb5 (95 percent tin and 5% antimony), with 0.2 percent maximum lead content.

2.2 PIPING SPECIALTIES

A. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents:
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8″ (3mm) maximum thickness, except where thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125 cast-iron and cast bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
2. ASME B16.20, for grooved, ring joint, steel flanges.
3. AWWA C110, rubber, flat face, 1/8 inch (3 mm) thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

B. Flange Bolts and Nuts:
1. ASME B18.2.1, carbon steel, except where other material is indicated.

C. Plastic Pipe Flange Bolts, Washers and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated. Flat washers must be used under nuts and bolts. Gaskets to be full face, 1/8th inch thick, 70 durometer and of a material recommended for the application by the manufacturer.

D. Unions: Lead Free, ANSI B16.39, Class 150, malleable iron; female pattern; brass to iron seat; ground joint. Threads shall conform to ANSI/ASME B1.20.1. Unions in copper piping shall be sweat fittings with bronze seats designed for 200 psig working pressure.

E. Dielectric Unions: Lead Free, provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

F. Dielectric Fittings: Lead Free, provide dielectric fittings with appropriate end connections and piping materials. Dielectric fittings shall be as manufactured by Victaulic Style 47, Legend Valve Company Model T-575 or acceptable comparable product.

G. Recessed Non-freeze Wall Hydrants:
1. Refer to plumbing fixture schedule on the contract drawings for requirements.

H. Vacuum Breakers:
1. Pipe Applied, Atmospheric Vacuum Breaker shall conform to ASSE 1001, with floating disc and atmospheric vent.
2. Hose connection vacuum breakers shall conform to ASSE Standard 1011, with finish to match hose connection.
3. Laboratory Faucet Vacuum Breakers: ASSE 1035, chrome plated; consisting of primary and secondary checks, intermediate vacuum breaker, threaded ends, 1/4″ or 3/8″ size as required, for continuous pressure application.
4. Vacuum breakers shall be lead free.

I. Reduced Pressure Backflow Preventers:
1. Reduced pressure type backflow preventers shall be lead free and shall be

manufactured by Ames, Watts, Zurn/Wilkins, or an acceptable comparable product.

2. Reduced-pressure-principle assembly consisting of shutoff valves on inlet and outlet and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between 2 positive seating check valves and comply with requirements of ASSE Standard 1013. Shut-off valves shall be provided in accordance with valves as specified in this section.
3. Shut-off and check valves shall be the same model as provided for system in which backflow preventer is being installed.

J. Double Check Valve Backflow Preventers:
1. Double check valve backflow preventers shall be lead free and shall be manufactured by Watts, Spence, or Wilkins.
2. Double check backflow assemblies, conforming to ASSE 1015, consisting of shut-off valves on inlet and outlet and strainer on inlet. Include test cocks with 2 positive seating check valves for continuous pressure application.

K. Water Hammer Arresters:
1. Water hammer arresters shall be manufactured by Zurn, Josam, Precision Plumbing Products or JR Smith.
2. ASSE 1010, or PDI WH-201, "Water Hammer Arresters," bellows or piston type with pressurized cushioning chamber. Sizes are based on water- supply fixture units, sizes "A" through "F" and PDI WH-201, sizes "A" through "F."
3. Water Hammer Arresters shall be lead free when used with lead-free end user devices and piping that are required by Virginia law to be lead free.

L. Welding Materials: Comply, with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

M. Drainage System Specialties
1. Horizontal Backwater Valves: ASME A112.14.1, cast iron body, with removable bronze swing check valve, threaded or bolted cover, as manufactured by Josam, JR Smith, or Zurn.
   a. Extension: Full size, service class, cast iron soil pipe extension to field installed cleanout at floor.
2. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
3. Cleanouts: ASME A112.36.2M, cast-iron body with straight threads and gasket seal or taper threads for plug flashing flange and clamping ring, and a brass closure plug. Cleanouts for installation in floors not having membrane waterproofing may be furnished without clamping ring.

Cleanouts in Concrete Floors	Zurn Model No. Z-1400 style to suit floor finish with round scoriated top.
Cleanouts in Finished Floors	Zurn Model No. ZN-1400 style to suit floor finish with recessed top for tile or carpet.
Cleanouts in Piping	Zurn Model No. ZN-1450-7 with bronze plug.
Cleanouts in Walls	Zurn Model No. Z-1440-1 style to suit all finish, with vandalproof screws.

4. Floor Drains: Floor drains shall be as manufactured by Zurn, Jay R. Smith,

Josam or Wade. See schedule.

a. Floor Drains (Sanitary Waste): Dura coated cast iron body with no hub type 3 inch outlet, combination invertible membrane clamps, adjustable type 'B' 6 inch diameter nickel bronze strainer, trap primer connection and 3 inch no hub type deep seal trap.

b. Floor Sinks: Cast iron body, slotted grate, porcelain enamel interior and top, aluminum interior dome strainer, 1/2" trap primer connection.

5. Deep Seal Traps: Cast iron or bronze, with inlet and outlet matching connected piping, cleanout where indicated, and trap seal primer valve connection. See schedule.
   a. 2-Inch Size: 4-inch-minimum water seal.
   b. 2 1/2 Inches and Larger: 5-inch-minimum water seal.
6. Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
7. Air Gap Fittings: ASME A112.1.2, cast iron or cast bronze, with fixed air gap, inlet for drain pipe or tube, and threaded or spigot outlet.

N. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
1. Inside Diameter: Closely fit around pipe, tube, and insulation.
2. Outside Diameter: Completely cover opening.
3. Cast Brass: One-piece, with set-screw.
4. Cast Brass: Split casting, with concealed hinge and set-screw.
   a. Finish: Rough brass.
   b. Finish: Polished chrome plate.
5. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
6. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
7. Cast-Iron Floor Plate: One-piece casting.

O. Dielectric Fittings: Lead free assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig (1725kPa) minimum working pressure at a 180°F (82°C) temperature.
4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig (1035kPa or 2070kPa) minimum pressure to suit system pressures.
5. Dielectric-Flange Insulation Kits: Materials for flange isolation kits on pipes containing drinking/potable water (up to 280°F, 138°C) shall consist of the following components:
   1) The full faced, NSF 61 certified, isolating and sealing gasket shall be LineBacker ®61™ Sealing Gasket (LB61) – Type "E", 1/8" thick, G-10 retainer containing a precision tapered groove to accommodate the controlled compression of a EPDM quad-ring sealing element. Sealing element placement shall accommodate either flat, raised face or RTJ flanges.
   2) The quad-ring seal shall be pressure energized. The G-10 retainer shall have a 550 volts/mil dielectric strength and a minimum 50,000 psi compressive strength.
   3) The full faced flange isolating gasket (weld-neck) shall be equal to or slightly smaller than the bore of the flange; (slip-on) shall be

equal to or smaller than the I.D. of mating pipe.

b. Full Length Bolt Isolating Sleeves:
   1) One full length G-10 Sleeve (extending half way into both steel washers) for each flange bolt. The G-10 shall be a 1/32 inch thick tube with a 400 volts/mil dielectric strength and water absorption of 0.10% or less.

c. Washers:
   1) Two, 1/8 inch thick, G-10 isolating washers for each bolt. Their compressive strength shall be 50,000 psi, dielectric strength 550 volts/mil and water absorption 0.10% or less.
   2) Two, 1/8 inch thick zinc plated, hot rolled steel washers for each bolt. The I.D. of all washers shall fit over the isolating sleeve and both the steel and isolating washers shall have a same I.D. and O.D.

d. Quality:
   1) Flange isolating kits shall be manufactured at a facility that has a registered ISO 9001:2008 Quality Management System. Submittals shall include copy of valid ISO registration and NSF 61 certification.

e. Basis of Design:
   1) Flange gasket kits shall be manufactured by PSI-Pipeline Seal and Insulator, Inc., Houston, Texas. Comparable products shall be submitted as required under Section Product Requirements for comparable product review. Products should be submitted to engineer 10 days prior to bid due date.

6. Dielectric Couplings: Lead free galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig (2070kPa) minimum working pressure at 225°F (107°C) temperature.

7. Dielectric Nipples: Lead free electroplated steel or ductile nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig (2070kPa) working pressure at 230 °F (110°C) temperature. Victaulic Style 47.

P. Pipe Guides:
1. Systems greater than 70°F operating temperature: Provide Erico (formerly known as Michigan) Model No. 650, or an acceptable comparable product.
2. Systems less than 70°F operating temperature: Provide Erico (formerly known as Michigan) Model No. 651, or an acceptable comparable product.

Q. Pipe Anchors:
1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.
   a. Stud: Threaded, zinc-coated carbon steel.
   b. Expansion Plug: Zinc-coated steel.
   c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened Portland cement concrete, and tension and shear capacities appropriate for application.
   a. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy

resin suitable for surface temperature of hardened concrete where fastener is to be installed.
b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
c. Washer and Nut: Zinc-coated steel.
6. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 03 Specifications for formwork, reinforcement, and concrete.
7. Grout: Refer to Division 15000 HVAC

R. Thermometers, General
1. Scale Range: Temperature ranges indicated in degrees Fahrenheit shall be provided for services listed as follows:
a. Domestic Hot Water: 30 to 180°F, with 2-degree scale divisions.
b. Domestic Cold Water: 0 to 100°F, with 2-degree scale divisions.
2. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.
3. Liquid-in-glass Thermometers
a. Provide as manufactured by H.O. Trerice, Weiss Instruments, or Weksler Instrument Corp.
b. Description: ASTM E1, liquid-in-glass thermometer.
c. Case: Die-cast and aluminum-finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.
d. Adjustable Joint: Finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.
e. Tube: Red-reading, organic liquid-filled instead of mercury-filled, with magnifying lens.
f. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
g. Stem: Copper-plated steel, aluminum, or brass for a separable socket of length to suit installation.
4. Direct-mounting Filled-system Dial Thermometers
a. Provide as manufactured by H.O. Trerice Co., Weiss Instruments, Inc., or Weksler Instrument Corp.
b. Description: Vapor-actuated universal-angle dial thermometer.
c. Case: Drawn steel or cast aluminum, with 4-1/2-inch -diameter glass lens.
d. Adjustable Joint: Finish to match case, 180° adjustment in vertical plane, 360° (6.3rad) adjustment in horizontal plane, with locking device.
e. Thermal Bulb: Copper with phosphor-bronze Bourdon pressure tube.
f. Movement: Brass, precision geared.
g. Scale: Progressive satin-faced nonreflective aluminum with permanently etched markings.
h. Stem: Copper-plated steel, aluminum, or brass for a separable socket of length to suit installation.
5. Remote-reading, Filled-system Dial Thermometers
a. Provide as manufactured by H.O. Trerice Co., Weiss Instruments, Inc., or Weksler Instrument Corp.
b. Description: Vapor-actuated remote-reading dial thermometer.
c. Case: Drawn steel or cast aluminum, with 4 1/2 -inch -diameter glass lens.
d. Movement: Brass, precision geared.
e. Scale: Progressive satin-faced nonreflective aluminum with permanently etched markings.
f. Tubing: Bronze double-braided armor-over-copper capillary of length to suit installation.
g. Bulb: Copper with separable socket for liquids; averaging element for air.
6. Thermometer Wells

a. Description: Brass or stainless-steel thermometer well, with heat conducting compound.
b. Pressure Rating: Not less than piping system design pressure.
c. Stem Length: To extend 2 inches into fluid or center of pipe, whichever is shorter.
d. Extension for Insulated Piping: 2 inches nominal, but not less than thickness of insulation.
e. Threaded Cap Nut: With chain permanently fastened to well and cap.

S. Pressure Gages, General
1. Provide as manufactured by H.O. Trerice Co., Weiss Instruments, Inc., or Weksler Instrument Corp.
a. Description: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gage, with bottom connection.
b. Case: Drawn steel, brass, or aluminum with 4 1/2 -inch (115mm) -diameter glass lens.
c. Connector: Brass, 1/4" inch NPS.
d. Scale: White-coated aluminum, with permanently etched markings.
e. Accuracy: Plus or minus 1 percent of range span.
f. Range: Conform to the following:
1) Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
2) Fluids Under Pressure: From zero to two times operating pressure.
g. Snubbers: 1/4" inch brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.
h. Needle Valve: Exceed pressure and temperature rating of installation.

T. Test Plugs:
1. Provide as manufactured by Flow Design, Inc., Peterson Equipment Co., or H.O. Trerice.
2. Description: Nickel-plated brass-body test plug in 1/2" inch fitting.
3. Body: Length as required to extend beyond insulation.
4. Pressure Rating: 500 psig minimum.
5. Core Inserts: 2 self-sealing valve types, suitable for inserting a 1/8" inch (3mm) outside-diameter probe from a dial thermometer or pressure gage.
6. Core Material: According to the following for fluid and temperature range:
a. Air, Water, Oil, and Gas: 20°F to 200°F, neoprene rubber.
b. Air and Water: Minus 30°F to 275°F (minus 35 to 136° C), ethylene-propylene-diene-terpolymer (EPDM) rubber.
7. Test-Plug Cap: Gasketed and threaded cap, with retention chain.
8. Test Kit: Provide test kit consisting of 1 pressure gage and gage adapter with probe, 2 bimetal dial thermometers and a carrying case.
9. Pressure Gage and Thermometer Ranges: Approximately 2 times systems operating conditions.

Z. Thermostatic Mixing Valve (MV-2.2-1)
1. Digital Mixing Center (DMC)
a. Digital Re-Circulating Valve shall be supplied pre-piped and pressure tested as a lead free Digital Mixing Center complete with inlet hot water, inlet cold water, outlet mixed water, inlet re-circulation return water and outlet return to heater water connections.
b. DMC shall comprise check valves, strainers, thermometers, pressure gauges, ball valves, inlet hot water to outlet mixed water by-pass and shall be mounted onto an enameled steel frame.
2. DIGITAL RE-CIRCULATING VALVE (DRV)

a. Re-Circulating Valve shall be digital of lead free stainless steel/polymer construction.
b. DRV shall deliver a mixed water flow and have no minimum system draw off requirement.
c. DRV shall have all of the following operational capabilities:
   1) +/- 2F water temperature control
   1) 2F minimum inlet to outlet water temperature differential
   2) Automatic shutoff of hot water flow upon cold water inlet supply failure.
   3) Automatic shutoff of hot water flow in the event of a power failure
   4) Programmable set point range of 81-158°F (27-70°C)
   5) Programmable thermal disinfection mode
   6) Programmable 1st level hi/lo temp alarm display
   7) Programmable temperature error level for safety shutdown
d. DRV shall have all of the following connectivity capabilities:
   1) SPCO relay outputs which are energized during operation.
   2) LCD display which indicates: set point, delivered temperature, error codes and alarm conditions.
   3) MODBUS 485 port for remote set point adjustment and remote operating temperature visibility.
   4) RS485 Serial Port for connection to a performance matched hot water monitoring system.
e. DRV shall be compliant with ASSE Standard 1017 and CSA B125 and so certified and identified.
f. DRV shall be UL listed and identified.

2.3 SLEEVE PENETRATION SYSTEMS

A. General: Provide protective sheathing or wrapping between metal pipes and sleeves to prevent pipes from corroding.

B. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, structure members or other building parts. Sleeves through walls and floors shall be standard weight galvanized iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through freely with space for movement for all piping which passes through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.

C. Sleeves through floors shall be flush with the floor except for sleeves passing through Mechanical Rooms which shall extend ¾" above the floor. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves.

D. Sleeves through walls and floors shall be sealed.

E. Penetrations through fire rated walls and floors.
   1. All plumbing pipe and fixture penetrations through fire rated floors and walls shall be provided and firestopped using UL classified through penetration firestop devices as manufactured by ProSet Systems, Inc. or equal. The fire rating of the firestop device shall be equivalent or greater than the fire rating of the floor or wall penetrated. All firestop devices shall be provided in accordance with manufacturer's instructions.
      a. Penetrations by hot and cold domestic water lines shall be provided using firestop devices.

b. Penetrations by cast iron drain, waste and vent piping, bathtub drains, water closet openings, shower drains and floor drains shall be provided using firestop devices.

2. All penetrations by fire protection water lines through fire rated floors and walls shall be provided and firestopped using UL classified through penetration firestop devices.
   a. The fire rating of the firestop device shall be equivalent to or greater than the fire rating of the floor or wall penetrated.
   b. All firestop devices shall be provided in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations and trenches are ready to receive piping.

B. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of installed devices. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

D. Examine substrates and conditions under which pipe expansion joints, pipe alignment guides, and pipe anchors are to be installed. Do not proceed until unsatisfactory conditions have been corrected.

E. Do not enclose, cover, or put into operation any piping system until it has been inspected by the authority having jurisdiction and tested as specified herein.

3.2 PREPARATION

A. Preparation For Testing: Prepare water piping and condensate piping in accordance with ASME B31.9, and as follows:
   1. Test for leaks and defects in new piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of system tested.
   2. Leave joints including welds un-insulated and exposed for examination during the test.
   3. Provide temporary restraints for expansion joints, which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
   4. Flush system with clean water. Clean strainers.
   5. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
   6. Install relief valve set at a pressure no more than one-third higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.

3.3 EXCAVATION

A. Refer to Division 2 specifications for additional requirements.

B. Excavation for Utility Trenches
1. Excavate trenches to indicated gradients, lines, cross sections, elevations and subgrades.
2. Excavate trenches to uniform widths to provide the following clearance on each side of pipe.
   a. Clearance: 8 inches (200 mm) minimum each side of pipe.
3. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, etc. Remove projecting stones and sharp objects along trench subgrade.
   a. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, hand-excavate trench bottoms and support pipe on an undisturbed subgrade.
   b. For pipes 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tampered sand backfill.
   c. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

C. Unauthorized Excavation
1. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation.

D. Backfill
1. Place and compact backfill in excavations promptly, but not before completing the following:
   a. Construction below finish grade including, where applicable, subdrainage, damp proofing, water proofing and perimeter insulation.
   b. Surveying locations of underground utilities for Record Documents.
   c. Testing and inspecting underground utilities.
   d. Removing concrete formwork.
   e. Removing trash and debris.
   f. Removing temporary shoring and bracing, and sheeting.
   g. Installing permanent or temporary horizontal bracing on horizontally supported walls.
   h. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the utility pipe.
      1) Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping to avoid damage or displacement of piping. Coordinate backfilling with utilities testing.
   i. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
   j. Place and compact final backfill of satisfactory soil to final subgrade elevation.
   k. Install detectable warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade

under pavement and slabs.

E. Compaction of Soil Backfills and Fills
1. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
2. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
3. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
   a. Under structure, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 92 percent.
   b. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.
   c. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) subgrade and compact each layer of backfill or fill soil material at 85 percent.
   d. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.
   e. Against foundation walls, scarify and recompact with and operated equipment within 3 feet of wall to avoid overstressing the wall at 95 percent.

3.4 INSTALLATION OF PIPING, GENERAL

A. Piping
1. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
2. Install concentric reducers where pipe is reduced in size in the direction of flow, with bottoms of both pipes and reducer flush.
3. Connect branch piping to mains from top of main, unless specific otherwise for specific systems.
4. Install supports in accordance with Specification Section 15440 - Hangers and Supports for Plumbing Piping and Equipment.
5. Make changes in directions and branch connections using fitting, pull tees shall not be permitted.
6. Install flanges, flange kits, and unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
7. Install dielectric unions where piping of dissimilar metals are joined.
8. Install flanges on valves, apparatus, and equipment having 2 1/2" inch and larger connections.
9. Install flexible connectors at inlet and discharge connections to pumps and other vibration producing equipment.
10. Install strainers on the supply side of each control valve, pressure regulating valve, and elsewhere as indicated. Install ¾" inch NPS nipple and ball valve in blow

down connection of strainers. Use same size nipple and valve as blow-off connection of strainer.

11. Anchor piping to ensure proper direction of expansion and contraction. Anchors shall attach to the building structure to prevent pipe movement. Anchors shall be installed in such a manner to prevent damage to the building structure. Anchors shall be securely welded to the piping being anchored. Install expansion loops and joints as indicated on the Drawings.
12. Install pipe sleeves at all wall and floor penetrations. Provide protective sheathing or wrapping between metal pipes and sleeves to prevent pipes from corroding.
13. Seal pipe penetrations of fire separations specified in Division 07 Specifications.
14. Hanger, supports, and anchors are specified in Specification Section 15440 - "Hangers and Supports for Plumbing Piping and Equipment."
15. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, ¾″ ball valve, and short ¾″ threaded nipple and cap.
16. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.
17. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
18. In concealed locations where piping, other than cast iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1 ½″ from the nearest edge of the member, the pipe shall be protected by steel shield plates. The plates shall be made of gage 16 and shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2″ above sole plates and below tip plates.

B. Joint Construction

1. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ANSI/ASME B1.20.1.
   a. Cut threads full and clean using sharp dies.
   b. Ream threaded ends to remove burrs and restore full inside diameter.
   c. Apply pipe joint lubricant or sealant, suitable for the service for which the pipe is intended, on the male threads at each joint.
   d. Tighten joint to leave not more than 3 threads exposed.
   e. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   f. Align threads at point of assembly.
   g. Apply appropriate tape or thread compound to the external pipe threads.
   h. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
   i. Damaged Threads: Do not use pipe with threads which are corroded or damaged.
   j. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
2. Welded Joints: Weld pipe joints in accordance with ASME B31.9 and ASME B31.1, where required.
3. Brazed Joints: For copper tube and fittings, braze joints in accordance with ASME B31, "Standard Code for Pressure Piping" and AWS "Brazing Manual."
   a. Remove stems, seats, and packing of valves and accessible internal

parts of valves before brazing.

b. Braze joints in accordance with ASME B31.1.

c. Fill the tubing and fittings during brazing with nitrogen under a continuous purge to prevent formation of scale.

d. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

e. Heat joints to proper and uniform temperature.

f. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Provide adequate ventilation and avoid breathing fumes.

4. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

3.5 INSTALLATION OF THREADED CONNECTIONS

A. Align threads at point of assembly.

B. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

C. Assemble joint, wrench tight.

3.6 INSTALLATION OF FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.7 INSTALLATION OF METERS, GAGES, THERMOMETERS, ETC.

A. Meters/Gages

1. General: Where indicated, install meters and gages of types, sizes, capacities, and with features indicated.
2. Install meters, gages, and accessories according to manufacturers' written instructions for applications where used.
3. Install thermometers and adjust vertical and tilted positions.
4. Remote-Reading Dial Thermometers: Install in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
5. Thermometer Wells: Install in vertical position in piping tees where thermometers are indicated.
   a. Install wells with stem extending minimum of 2 inches (50 mm) into fluid.
   b. Install wells with stem extending to center of pipe.
   c. Fill wells with oil or graphite and secure caps.

B. Pressure Gages
1. Install pressure gages in piping tee with pressure gage face located on pipe at most readable position.
2. Install in the following locations and elsewhere as indicated:
   a. At suction and discharge of each pump.
   b. At building water service entrance.
   c. On expansion tanks.
3. Needle Valves: Provide ¼" needle valve in piping tee, with snubber.

C. Installation - Test Plug
1. Install test plugs in piping tees where indicated, located on pipe at most readable position. Secure cap.

D. Installation - Flow-measuring System, Flow Element And Meter
1. General: Install flow meters for piping systems located in accessible locations at most readable position.
2. Locations: Install flow measuring elements and meters at discharge of each pump and elsewhere as indicated.
3. Differential-Pressure-Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as prescribed by the manufacturer's installation instructions.
4. Install connection fittings for attachment to portable flow meters in readily accessible locations.
5. Permanently Mounted Meters for Flow Elements: Install meters on walls or brackets in accessible locations.
6. Install connections, tubing, and accessories between flow elements and meters as prescribed by manufacturer's written instructions.

E. Connections - Meters
1. Install meters and gages adjacent to machines and equipment to allow servicing and maintenance.
2. Connect flow-measuring-system elements to meters.
3. Connect flow-meter transmitters to meters.
4. Make electrical connections to power supply and electrically operated meters and devices.

F. Adjusting and Cleaning - Meters
1. Calibrate meters according to manufacturer's written instructions, after installation.
2. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.
3. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

G. Portable Meters

1. Turn-over portable meters to the Owner upon completion of the project.

3.8 INSTALLATION OF PIPING SPECIFIC TO DRAINAGE AND VENT SYSTEMS

A. Service Entrance Piping
1. Extend building storm drain piping and connect to building storm sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building storm drain and building storm sewer.

2. Extend building sanitary drain piping and connect to sanitary sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building sanitary drain and building sanitary sewer.
3. Install sleeve and mechanical sleeve seal at service penetrations through foundation wall for watertight installation.

B. General

1. Install cast-iron soil pipe and cast-iron soil pipe fittings according to the latest version of the CISPI "Cast Iron Soil Pipe and Fittings Handbook, "Installation of Cast Iron Soil Pipe and Fittings."
2. Make changes in direction for drainage and vent piping using appropriate Y branches, Y branches with 1/8 bends, and long-sweep 1/4, 1/5, 1/6, 1/8, and 1/16 bends. Sanitary tees and short-sweep quarter vends may be used on vertical stacks of drainage lines where change in direction of flow is from horizontal to vertical. Use long-turn double-Y-branch and 1/8-bend fittings where 2 fixtures are installed back to back or side by side and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Make no change in direction of flow greater than 90°. Where different sizes of drainage pipes and fittings are connected, use proper size standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
3. Lay buried building drains beginning at low point of each system, true to grades and alignment indicated, with unbroken continuity of invert. Place hub or bell ends of piping facing upstream. Install required gaskets according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in piping and pull past each joint as completed.
4. Install drainage and vent piping at the following minimum slopes, except where another slope is indicated:
    a. Sanitary Building Drain: 1/4" inch per foot (2 percent) for piping 3 inches and smaller; 1/8" inch per foot (1 percent) for piping 4 inches and larger.
    b. Horizontal Sanitary Drainage Piping: 1/4" inch per foot (2 percent).
    c. Storm Building Drain: 1/8" inch per foot (1 percent).
    d. Horizontal Storm Drainage Piping: 1/4" inch per foot (2 percent).
    e. Vent Piping: 1/8" inch per foot (1 percent).
    f. Install underground PVC drainage piping according to ASTM D2321.Rigid plastic and hubless drainage piping, including offsets and jumps, shall rest on a continuous bed of sand, gravel or crushed stone, a minimum of four (4) inches deep below the pipe; maximum aggregate size shall be three-quarter (3/4) inches (MD #6 and smaller). Bedding material shall be placed on both sides of the pipe equal in depth to the pipe diameter and hand compacted to prevent deformation of pipe from top loading. Piping shall be laid in a trench, except where soil conditions or grade do not permit such practices.
    g. Drainage piping above grade and not fully confined within a trench shall rest on bedding material at least thirty (30) inches wide. Horizontal and vertical alignment of piping shall be maintained by three-eighths (3/8) inch minimum diameter steel "J" hooks, "U" hooks or equivalent hold-down devices driven into the ground every eight (8) feet, at changes of direction 45° or more, and at ends of runs. The length of hold-down devices shall be sufficient, depending on soil type, to prevent easy removal, but not less than twenty-four (24) inches long.
5. Sleeves are not required for cast-iron soil pipes passing through concrete slab, without membrane waterproofing, on grade.
6. Install PVC drainage pipe and fittings according to ASTM D2665.

7. Install all buried plastic pipe in accordance with ASTM D2321.
8. Joint Construction
   a. Cast-Iron Soil Pipe and Cast-Iron Soil Pipe Fitting Joints: Make joints according to recommendations in the latest version of the CISPI "Cast Iron Soil Pipe and Fittings Handbook, Volume I," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
      1) Compression Joint: Make with neoprene gasket matching class of pipe and fittings.
      2) Hubless Joint: Make with neoprene gasket and sleeve or clamp.
   b. PVC DWV Pipe: Join PVC drainage pipe and fittings according to ASTM D2665.
   c. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F402, for safe handling during joining of plastic pipe and fittings with solvent cements.
9. Pipe Attachments:
   a. Riser Clamps: MSS Type 8 or Type 42 for vertical runs.
   b. Adjustable Steel Clevis Hangers: MSS Type 1 for individual straight horizontal runs 100 feet and less.
   c. Adjustable Roller Hangers: MSS Type 43 for individual straight horizontal runs longer than 100 feet.
   d. Spring Cushion Rolls: MSS Type 49, where indicated, for individual straight horizontal runs longer than 100 feet.
   e. Pipe Rolls: MSS Type 44 for multiple straight horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
   f. Spring Hangers: MSS Type 52 for support of base of vertical runs.
10. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to the manufacturer's written instructions.
11. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

C. Connections
1. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts, with approved trap, of sizes indicated, but not smaller than required by plumbing code, to plumbing fixtures and drains.
2. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.
3. Supply Runouts to Fixtures: Install hot- and cold-water supply piping runouts to fixtures of sizes indicated, but not smaller than required by plumbing code.
   a. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but not smaller than required by plumbing code.
   b. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.
   c. Interceptor Connections: Connect piping, flow control fittings, and accessories as indicated.
      1) Grease Interceptors: connect inlet and outlet to unit, and flow control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff type unit.
   d. Electrical Connections: Power wiring and disconnect switches are specified in Division 16000.
      1) Grounding & Bonding for Electrical Systems: Connect unit components to ground according to the National Electrical Code and Specification Section "Grounding."

D. Protection
1. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
2. Place plugs in ends of uncompleted piping at end of day or when work stops.
3. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water-based latex paint.

E. Drainage And Vent System Specialties
1. Install backwater valves in building drain piping as indicated. For interior installation, provide cleanout deck plate (cover) flush with floor and centered over backwater valve cover and of adequate size to remove valve cover for service.
2. Install expansion joints on vertical risers, stacks, and conductors as indicated.
3. Cleanouts
   a. Install cleanouts in above-ground piping and building drain piping as indicated, and where not indicated, according to the following:
      1) Size same as drainage piping up to 4-inch size. Use 4-inch size for larger drainage piping except where larger size cleanout is indicated.
      2) Locate at each change in direction of piping greater than 45°.
      3) Locate at minimum intervals of 50 feet for piping 4 inches and smaller and 100 feet for larger piping.
      4) Locate at base of each vertical soil or waste stack.
   b. Install cleanout deck plates (covers), of types indicated, with top flush with finished floor, for floor cleanouts for piping below floors.
   c. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
   d. Install flashing flange and clamping device with each stack and cleanout passing through floors having waterproof membrane.
4. Floor Drain Installation
   a. Install floor drains according to manufacturer's written instructions, in locations indicated.
   b. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
   c. Trap drains connected to sanitary building drain. Provide trap primers for all traps.
   d. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
   e. Position drains for easy accessibility and maintenance.
5. Interceptor Installation
   a. General: Comply with unit manufacturer's written instructions and with local authority for trapping and venting.
   b. Install units with clear space for servicing.
   c. Install waste piping, flow control fitting, vent piping, and accessories as indicated.
6. Flashing Installation
   a. Refer to Division 07 Specifications for requirements.

3.9 FIELD QUALITY CONTROL

A. Testing shall be performed by Installer of system being tested in presence of the Owner's representative. Provide seven (7) day advance notice prior to testing of systems.

B. Inspection of Piping Systems:
1. Do not enclose, cover, or put into operation any piping system until it has been inspected and approved.

2. During progress of installation, notify the authority having jurisdiction seven (7) days prior to time such inspection must be made.
   a. Roughing-In Inspection: Arrange for inspection of piping system after system roughing-in, before concealing, and prior to setting fixtures.
   b. Final Inspection: Arrange for final inspection to observe tests specified below and to ensure compliance with requirements.
3. Re-inspections: Make required corrections and arrange for reinspection when piping system fails to pass test or inspection.
4. Reports: Prepare and submit inspection reports for approval.

C. Test domestic water, sanitary waste, vent, piping systems in accordance with all applicable codes and the local authority hand ving jurisdiction.

D. Leak Testing
1. Domestic Water
   a. Perform tests prior to installation of piping insulation.
   b. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.
   c. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.
   d. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
   e. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the ASE value in Appendix A of ASME B31.9, "Code For Pressure Piping, Building Services Piping."
   f. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
   g. Test backflow preventors in accordance with the local plumbing code and requirements of the authority having jurisdiction.
2. Drainage And Vent Piping Systems
   a. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to 10 feet head of water. Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
   b. Finished Plumbing Test Procedure: After plumbing fixtures have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves the building and introduce air into the system equal to pressure of 1-inch water column. Use a U tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

c. Repair leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
d. Prepare reports for tests and required corrective action.

3.10 CLEANING (Refer to Specification Section 15490 - "Plumbing Piping System Cleaning and Treatment.")

3.11 PAINTING

A. Touching Up: Clean field welds and abraded areas of paint. Use same materials as used for shop painting. Comply with SSPC-PA 1, "Shop, Field, and Maintenance Painting," requirements for touching up field painted surfaces.
1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

C. Plastic Pipe shall be painted with Exterior Grade Latex Paint. DO NOT USE EPOXY OR OIL BASE PAINTS ON PLASTIC PIPE.

END OF SECTION

SECTION 15415

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and all sections of Division 15.

1.2 SUMMARY

A. Section Includes:
1. Painted Identification Materials.
2. Plastic Pipe Markers.
3. Underground-Type Plastic Line Marker.
4. Valve Tags.
5. Valve Schedule Frames.
6. Engraved Plastic-Laminate Signs.
7. Plastic Equipment Markers.
8. Plasticized Tags.

B. Related Sections The following Sections contain requirements that relate to this Section:
1. Section 15400 - “Common Work Results for Plumbing.”
2. Section 15410 - “Pipes and Tubes for Plumbing Piping and Equipment.”
3. Section 15420 - “General Duty Valves for Plumbing Piping.”
4. Section 15450 - “Plumbing Fixtures.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American Society of Mechanical Engineers:
1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the Contract and Division 01 specification sections.

B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

C. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

D. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8 1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. Furnish copies for Maintenance Manuals as specified in the Division 01 Specifications.

E. Maintenance Data: Include product data and schedules in maintenance manuals, in accordance with requirements of Division 01.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:
1. ANSI Standards: Comply with ANSI A13.1, for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Equipment Lettering and Graphics:
1. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.
a. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification, which indicates individual system number as well as service (for example; Water Heater No. 3).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering identification materials which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide plumbing identification materials of one of the following:
1. Brady (W.H.) Co.; Signmark Div.
2. Industrial Safety Supply Co., Inc.
3. Seton Name Plate Corp.

2.2 MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

B. Painted Identification Materials:
1. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes not less than 1 1/4" high for ductwork and not less than 3/4" high for access door signs and similar operational instructions. Stencils shall not be utilized on piping and plumbing equipment.
2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
3. Identification Paint and Background Color; Standard identification enamel

of colors indicated or, if not otherwise indicated for piping systems and plumbing equipment comply with ANSI A13.1 for colors.

C. Plastic Pipe Markers:
1. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, UV-resistant color-coded pipe markers, complying with ANSI/ASME A13.1
2. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   b. Adhesive lap joint in pipe marker overlap.
   c. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1 1/2".
3. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
   a. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
4. Provide pipe markers with the following background colors and designations:

SERVICE	STENCIL DESIGNATION	LETTER COLOR	BACKGROUND COLOR
Sanitary/Vent	Sanitary Sewer/Vent	White	Safety Green
Domestic Cold Water	Domestic Cold Water	White	Safety Green
Domestic Hot Water	Domestic Hot Water	Black	Safety Green
Condensate Drain	Drain Water	White	Safety Green

D. Underground-type Plastic Line Marker:
1. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
   a. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

E. Valve Tags:
1. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
   a. Provide 1 1/2" sq. black tags with white lettering, except as otherwise indicated.
   b. Provide size, shape and color combination as specified or scheduled for each piping system.
2. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.
   a. Provide 1 1/8" sq. white tags with black lettering.
   b. Provide size, shape and color combination as specified or scheduled for each piping system.
3. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper

attachment of tags to valves, and manufactured specifically for that purpose.

4. Ceiling Grid and Access Panel Markers: Provide Kroy type clear adhesive printed labels with 3/16" high letters to identify the type of concealed plumbing devices.

F. Engraved Plastic-laminate Signs:

1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/8", except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
4. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
5. Size: Provide approximate 2 1/2" x 4" markers for control devices, dampers, and valves; and 4 1/2" x 6" for equipment.

G. Plasticized Tags:

1. General: Manufacturer's standard pre-printed or partially pre- printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 1/4" x 5 5/8", with brass grommets and wire fasteners, and with appropriate pre- printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

A. General:

1. Coordination: Where identification is to be applied to surfaces, which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
2. Confined Spaces: Provide labels and signs on all duct and equipment doors, plenums, etc. to indicate service and provide operator warnings as required by OSHA, NFPA, and authority having jurisdiction.

B. Piping System Identification:

1. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
   a. Plastic pipe markers, with application system as indicated under "Materials" in this section.

2. Locate pipe markers and color bands as follows on all piping in occupied spaces, above ceilings, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   a. Near each valve and control device.
   b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
   c. Near locations where pipes pass through walls or floors/ ceilings, or enter non-accessible enclosures.
   d. At access doors, manholes and similar access points, which permit view of concealed piping.
   e. Near major equipment items and other points of origination and termination.
   f. Spaced intermediately at maximum spacing of 25' along each piping run, except reduce spacing to 10' in congested areas.

C. Underground Piping Identification:
   1. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

D. Valve Identification:
   1. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures. List each tagged valve in valve schedule for each piping system.

E. Equipment Identification:
   1. General: Install engraved plastic laminate sign on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
      a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
      b. Water meters and flow meters.
      c. Fuel-burning units.
      d. Pumps, compressors, and similar motor- driven units.
      e. Heat exchangers, expansion tanks, and similar equipment.
      f. Tanks and pressure vessels.
      g. Filters, water treatment systems and similar equipment.
      h. Domestic water heater, etc.
   2. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
   3. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety precautions, and warn of hazards and improper operations.

3.3 ADJUSTING

A. Adjusting: Relocate any identification device, which has become visually blocked by work of this division or other divisions.

3.4 CLEANING

A. Cleaning: Clean face of identification devices.

3.5 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
   1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

SECTION 15420

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and all sections of Division 22.

1.2 SUMMARY

A. Section includes:
1. Check valves.
2. Ball valves.
3. Drain valves.
4. Valving specialties.
5. Trap priming systems.
6. Multi-purpose valves.

B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Section 15400 - "Common Work Results for Plumbing."
2. Section 15440 - "Hangers and Supports for Plumbing and Equipment": Product and installation requirements for pipe hangers and supports.
3. Section 15446 - "Vibration and Seismic Controls for Plumbing Piping and Equipment."
4. Section 15415 - "Identification for Plumbing Piping and Equipment": Product and installation requirements for labeling and identification.
5. Section 15430 - "Plumbing Insulation": Product and installation requirements for insulation for valves.
6. Section 15470 - "Plumbing Pumps."
7. Section 15410 - "Pipes and Tubes for Plumbing and Equipment": Product and installation requirements for piping materials applying to various system types.
8. Section 15490 - "Plumbing Piping System Cleaning and Treatment."
9. Section 15450 - "Plumbing Fixtures."
10. Section 15995 - "Testing, Adjusting, and Balancing for Plumbing."

1.3 REFERENCES
(Unless otherwise noted, references apply to "latest editions.")

A. References listed in this section:
1. ANSI (American National Standards Institute)
   a. ANSI/ASME B16.34, "Valves-Flanged, Threaded, and Welding End".
2. ASME (American Society of Mechanical Engineers)
   a. ASME A112.14.1, "Back Water Valves".
   b. ASME B16.10, "Face to Face and End to End Dimensions of Valves".
3. ASSE (American Society of Sanitary Engineers)
   a. ASSE 1013, "Reduced Pressure Principle Backflow Preventors".
   b. ASSE 1015, "Double Check Backflow Prevention Assembly".
4. ASTM (American Society for Testing and Materials)
   a. ASTM A126, "Standard Specification for Gray Iron Castings for Valves,

Flanges, and Pipe Fittings".

b. ASTM A182, "Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service".

c. ASTM B61, "Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service".

5. BOCA (Building Officials and Code Administrators)
6. IEEE (Institute of Electrical and Electronics Engineers)
7. FBCM (Florida Building Code – Mechanical)
8. FBCP (Florida Building Code - Plumbing)
9. MSSP (Manufacturers Standards Society of the Valve & Fittings Industry)
   a. MSSP SP-25, "Standard Marketing System for Valves, Fittings, Flanges and Unions".
   b. MSSP SP-45, "Bypass Drain Connections".
   c. MSSP SP-55, "Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components".
   d. MSSP SP-61, "Pressure Testing of Steel Valves".
   e. MSSP SP-71, "Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings".
   f. MSSP SP-72, "Ball Valves with Flanged Fitting".
   g. MSSP SP-80, "Bronze Gate, Globe, Angle and Check Valves".
   h. MSSP SP-85, "Cast Iron Globe and Angle Valves, Flanged and Threaded Ends".
   i. MSSP SP-110, "Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends".
10. NEC (National Electrical Code)
11. NEMA (National Electrical Manufacturers Association)
12. OSHA (Occupational Safety and Health Administration)
13. PHCC (National Standard Plumbing Code)
14. UL (Underwriters' Laboratories)
15. FBC – (Florida Building Code)

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

C. Manufacturer's Installation Instructions: Submit hanging, support methods, and joining procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Maintenance data to be included in the operation and maintenance manual specified in Division 01.

1.6 QUALITY ASSURANCE

A. Valves shall be provided by the same manufacturer when applicable.

B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

C. Lead Free:

1. Valves in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooling, shall be "lead free" containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. Solder and flux for soldered joints in potable water piping shall be "lead free", containing not more than 0.2% lead.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years experience.

B. Installer: Company specializing in performing work of this section with minimum 5 years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Prepare for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Set ball valves open to minimize exposure of functional surfaces.
3. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Store indoors and maintain temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store off the ground in watertight enclosures.

1.9 ENVIRONMENTAL REQUIREMENTS

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

1.10 SEQUENCING AND SCHEDULING

A. Notification of Interruption of Service: Provide notification for all utility outages.

1.11 DEFINITIONS

A. Lead Free:
1. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be "lead free", containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. Solder and flux for soldered joints in potable water piping shall be "lead free", containing not more than 0.2% lead.

PART 2 PRODUCTS

2.1 VALVES - BASIC, COMMON FEATURES

A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

B. Sizes: Same size as upstream pipe, unless otherwise indicated.

C. Operators: Use specified operators and handwheels, except provide the following special operator features:
1. Lever Operators: Ball and butterfly valves 10" and less.

D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

E. Threads: ANSI/ASME B1.20.1.

F. Flanges: ASME B16.1, ASME B16.5, and ASME B16.24.

G. Hexagonal Threaded Packing Adjustment: All ball valves.

H. Bypass and Drain Connections: Comply with MSS SP-45.

I. Memory Stops: Provide memory stops for all “Balancing” valves.

2.2 VALVE APPLICATION SCHEDULE:

A. Domestic Water:
1. Check Valves:
a. Horizontal Swing ¼″ through 2″:
1) Check valves shall be class, 200# WOG, horizontal swing check, body with 5° integral seat. Body, cap, & Disc shall be of ASTM, B584 C89833 cast bronze. (Disc on ¼″ through ¾″ ASTM B16) Lever, retaining ring, and Hinge Pin shall be stainless steel. Plug shall be ATSM B16, Lever, MSS SP-80, Type 3.
2. Ball Valves:
a. ¼″ through 2":

1) Ball valves shall be 600 WOG, ASTM B584 C89833, cast bronze two piece adapter loaded single reduced bore with chrome plated solid ASTM B16, brass tunnel drilled ball, blow-out proof brass stem, RPTFE 15% glass filled seats & thrust washer, PTFE packing, hexagonal threaded packing nut of ASTM B16, brass, Lever handle of Zinc plated steel with vinyl handle grip, MSS SP-110. Fed. Spec. WW-V-35C II, BZ, 3.
3. Hose End Drain Valves ½″ and ¾″:
a. Hose end drain valves shall be class 600# WOG, ASTM B584, cast bronze two piece adapter loaded single reduced bore with chrome plated solid ASTM B16, brass tunnel drilled ball, blow-out proof brass stem, RPTFE 15% glass filled seats & 25% glass filled thrust washer, PTFE packing, hexagonal threaded packing nut of ASTM B16, brass, Lever handle of Zinc plated steel with vinyl handle grip, ASTM B16, brass tail piece with standard hose end threads, brass bead chain and Zinc die cast cap, MSS

SP-110, Fed. Spec. WW-V-35C II, BZ, 3.

B. Water Service Drains:
1. Piping Hose Bibbs:
a. All valves at low points in piping systems used for drain valve duty shall be provided with brass or bronze valve body with threaded end connections, chromium plated ball, brass stem, RPTFE seats, seals and stuffing box ring, adjustable packing gland, valve handle, and three quarter (3/4) inch hose connection with cap and chain.

2.3 VALVING SPECIALTIES

A. Pressure Reducing Valves:
1. Pressure reducing valves shall be lead free.
2. Domestic Water Systems: Provide 125 pound, cast iron ASTM A126, Class B, fused epoxy coated inside and outside, stainless steel seat, stainless steel stem, suitable for dead-end service.

B. Safety Relief Valves:
1. Provide 125 psig working pressure and 250°F maximum operating temperature; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code.
2. Valve body shall be cast-iron.
3. Valve shall have forged copper alloy disc, fully enclosed cadmium plated steel spring with adjustable pressure range and positive shut-off.
4. Factory set valves to relieve at 10 psi above operating pressure.

C. Trap Priming Systems:
1. Pressure Differential Valve Type:
a. Trap Primers shall be pressure drop activated and be of all brass construction with ½" male NPT inlet and ½" female NPT discharge. Internal components shall consist of a stainless steel debris screen, brass piston and brass discharge jet. Trap primers shall be installed on fresh cold water lines of 1 ½" diameter or less and shall be located where they will be subject to frequent pressure drops of 5 to 10 psi. Working pressure shall be 20 to 80 psi and valves shall be listed to ASSE 1018.
b. Primer valves shall be capable of serving up to 4 floor drains, utilizing distribution unit models.
c. Series primer valves shall be capable of serving up to 2 floor drains, utilizing distribution units.

D. Multi-Purpose Valves:
1. Valves shall be with spring loaded check valve feature, isolation/shut off valve feature, and a calibrated balancing valve with nameplate and memory stop/button.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

A. Valves shall be placed in such manner as to be easily accessible for smooth and easy operation and maintenance.

B. Install valves in piping where shown and where listed herein:
1. To balance flows in water piping systems.
2. To isolate all items of equipment.
3. To isolate branch lines and risers at mains.
4. To drain low points in piping systems.
5. To drain pipe risers.
6. To drain equipment.

C. Where piping or equipment may be subsequently removed, provide valves with bodies having integral flanges or full lugs drilled and tapped to hold valve in place so that downstream piping or equipment can be disconnected and replaced with blank-off plate while valve is still in service.

D. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

E. Install valves in a position to allow full handle movement.

F. Installation of Check Valves: Install for proper direction of flow as follows:
1. Swing Check Valves: Horizontal position with hinge pin level.
2. Install check valves as required to control flow direction.

G. Install drain valves at low points in mains, risers, branch lines, and everywhere else required to permit drainage of the entire system.

H. Provide balancing valves as shown on drawings and as required to permit complete balancing of all systems.

3.3 INSTALLATION OF THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.4 INSTALLATION OF FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.5 INSTALLATION OF VALVING SPECIALTIES SPECIFIC TO WATER SYSTEMS

A. Install pressure-regulating and reducing valves with inlet and outlet shutoff valves and balance valve bypass. Install pressure gage on valve outlet and install valved bypass where indicated. Install unions at inlet and outlet connections.

B. Install hose bibbs with integral or field-installed vacuum breaker.

C. Install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of 1/8" inch per foot (1 percent) and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow.

D. Adjusting
1. Adjust operation and correct deficiencies discovered during commissioning.

a. Electrical Connections: Power wiring and disconnect switches are specified in Division 1600.
b. Grounding & Bonding for Electrical Systems: Connect unit components to ground according to the National Electrical Code and Specification Section "Grounding."

3.6 ADJUSTING VALVES

A. VALVES: Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION

SECTION 15430

PLUMBING INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplemental Conditions and Division 01 Specifications, apply to this section and all sections of Division 15.

1.2 SUMMARY

A. This section Includes:
1. Insulation Materials:
a. Flexible elastomeric.
2. Adhesives.
3. Mastics.
4. Field-applied jackets.
5. Tapes.
6. Securements.
7. Corner angles.
8. Insulation for handicapped fixtures.

B. Related Sections: The following sections contain requirements that relate to this section.
1. Section 15410 – "Pipes and Tubes for Plumbing Piping and Equipment:" Product requirements for piping and valves.
2. Section 15445 – "Expansion Fittings and Loops for Plumbing Piping:" Product requirements for expansion loops.
3. Section 15420 – "General Duty Valves for Plumbing Piping.:" Product requirements for valves.
4. Section 15440 – "Hangers and Supports for Plumbing Piping and Equipment:" Product and Execution requirements for inserts at hanger locations.
5. Section 15446 – "Vibration and Seismic Controls for Plumbing and Piping Equipment:" Product requirements for vibration isolators.
6. Section 15415 – "Identification for Plumbing Piping and Equipment:" Product requirements for plumbing piping and equipment identification.

1.3 REFERENCES
(Unless otherwise noted, references apply to "latest editions.")

A. ASTM International:
1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
4. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

5. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
6. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
7. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
8. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
9. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
10. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
11. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
12. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
13. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the Contract and Division 01 specification sections.

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

C. Samples: Submit two samples of representative size illustrating each insulation type.

D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

B. Perform Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

C. Maintain one copy of each document on site.

D. Fire-Test-Response Characteristics: Insulation and related materials shall have fire- test response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

E. Insulation materials shall be tested and rated according to ASTM Test Method C-177 to determine k-factors. ASTM C 335 is for pre-formed pipe insulation. Note: C177 is for flat slab materials such as board products, etc.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience, and service facilities within 50 miles of the project.

B. Applicator: Company specializing in performing Work of this section with minimum three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping. Remove and replace any wet or damaged unsatisfactory insulation at the architect's direction.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature during and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Furnish five year manufacturer warranty for man made fiber.

1.11 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15440 – "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.12 DEFINITIONS

A. PVDC: Polyvinylidene chloride.

B. SSL: Self-sealing lap.

C. PSK: Poly Scrim Kraft.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

2.2 INSULATION MATERIALS

A. Refer to Part 3 execution: schedule for requirements regarding where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, mercury compounds, or formaldehyde.

C. Insulation products shall contain no formaldehyde-based binders.

D. When product to be in contact with austenitic stainless steel is tested according to ASTM C795 (which includes ASTM C692 and ASTM C871), the PH of the leach water from the specific material supplied shall be greater than 7.0 but not greater than 11.7 at 77°F (25°C). An acceptable proportion of sodium plus silicate ions to the chloride ions as found by leaching from the insulation is shown in the "plot point" of figure 6 in ASTM C795.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Closed-cell polyolefin/polyethylene insulation is not acceptable as a substitution for ASTM C534 closed-cell rubber materials.
1. Products:
   a. Aeroflex USA Inc.: Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. Nomaco; K-Flex Pipe
2. Water Vapor Permeability: 0.02 perm-inch per ATM E96 Procedure A.
3. Warranty: 25 year warranty against breakdown of the membrane due to
4. ultraviolet radiation.
5. Seal Tape: Thermoplastic rubber membrane backed with pressure sensitive adhesive.
6. Joint adhesive: air drying, solvent-based contact adhesive of the same manufacturer. As the flexible elastomeric insulation chosen for the project.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II,Class I.
   1. Products:
      a. Armacell LCC; 520 BLV Adhesive.
      b. Foster Products Corporation, H. B. Fuller Company; 85-60.

C. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products:
      a. Dow Chemical Company (The); 739, Dow Silicone.

2.4 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mil thickness; roll stock Ready for shop or field cutting and forming.
   1. Products:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto PVC Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: white.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps and mechanical joints minimum 20 mil thickness.
   5. Factory-fabricated tank heads and tank side panels.

2.5 TAPES

A. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
      b. Compac Corp.; 130.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
      d. Venture Tape; 1506 CW NS.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   4. Adhesion: 64 ounces force/inch in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

2.6 SECUREMENTS

A. Bands:
   1. Products:
      a. Childers Products; Bands.
      b. PABCO Metals Corporation; Bands.

c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers:
a. ACS Industries, Inc.
b. C & F Wire.
c. Childers Products.
d. PABCO Metals Corporation.
e. RPR Products, Inc.

2.7 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

2.8 HANDICAPPED WHEEL/CHAIR PLUMBING FIXTURE PIPING INSULATION

A. Manufacturer:
1. TRUEBRO, INC.

B. Product:

1. ADA-conforming, wheelchair accessible lavatory P-trap and angle valve assemblies shall be covered with white, molded, antimicrobial TRUEBRO, INC. Lav Guard 2 under sink pipe covers. Cover shall have internal, E-Z Tear-To-Fit trim feature for square, clean trimming-internal ribs-and built-in, concealed E-Z Grip fasteners (no cable-tie fasteners allowed.)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify piping and equipment to be insulated has been tested before applying insulation materials.

B. Verify surfaces to be insulated are clean and dry, with foreign material removed.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Install insulation continuously through hangers and around anchor attachments.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at anchors and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive selfsealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape as recommended by insulation material

manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut and install insulation in a manner to avoid compressing insulation more than 25 percent of its original nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.
7. Unions.
8. Flanges.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

D. Insulation Installation at Floor Penetrations:
1. Install insulation continuously through floor penetrations.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Fittings shall be insulated to same thickness as the adjoining insulation. Apply fittings per fitting manufacturer's instructions. When required by specification, a hard insert of sufficient length shall be utilized to avoid compression of the insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   7. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   8. Stencil or label the outside insulation jacket of each union with the word UNION." Match size and color of pipe labels.

C. Install removable insulation covers at locations indicated. Installation shall conform to the following:
   1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
   2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
   3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
   4. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus

twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials, unless jacketing with self-sealing laps are used.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

1. Where rubber membrane jackets are indicated, install the membrane using the manufacturer's recommended adhesive. Before use thoroughly stir the adhesive. Replace the container lid when work is interrupted. If required thin the adhesive as recommended by the manufacturer.
2. Using a sheepskin or similar roller apply a primer coat of adhesive to the roof surface, priming only the area of roof where the membrane will be laid the same day. Allow adhesive to dry.
3. Unroll the membrane and fold back approximately half its length.
4. Apply adhesive with a sheepskin or similar roller to the underside of the membrane ensuring the weld area is kept free of adhesive and allow to touch dry.
5. Carefully roll out the membrane over the previously primed surface and roll with water filled roller.
6. Fold back other half of the roll of membrane and repeat the procedure.
7. Unroll the next roll of membrane, ensuring the end laps are staggered and the side overlaps the previously installed sheet by 2 inches.
8. Repeat the adhering process.
9. Fully hot air weld the 2-inch side lap, allow to cool completely.
10. Mechanically check the integrity of the cooled weld by running a 3/16-inch wide screwdriver (with rounded edges) along the seam applying pressure into the seam.
11. Install Peel Stop and PVC Welding Cord at all perimeters, penetrations and changes of roof direction.

3.9 FINISHES

A. Finish Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Refer to Division 09 painting Sections.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

E. Technology may be utilized as long as it is installed per the manufacturer's installation procedures.

3.10 INSULATION APPLICATION SCHEDULE

A. Acceptable insulation materials, thickness and vapor retarder requirements are identified for each application and size range. If more than one material is listed for an application and size range, selection from the materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Below-grade piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

3.11 PLUMBING PIPING INSULATION APPLICATION SCHEDULE:

SERVICE	INSULATION MATERIAL	INSULATION THICKNESS	VAPOR RETARDER REQUIRED
DOMESTIC HOT WATER PIPING			
Indoor Service:			
1 ¼″ diameter and smaller	Flexible Elastomeric	1″	No
1 ½″ diameter and larger	Flexible Elastomeric	1 1/2″	No
DOMESTIC COLD WATER PIPING			
Indoor Service:			
1 ¼″ diameter and smaller	Flexible Elastomeric	½″	Yes
1 ½″ diameter and larger	Flexible Elastomeric	1″	Yes

AIR CONDITIONING CONDENSATE DRAIN, EQUIPMENT DRAIN, & HUMIDIFIER DRAIN PIPING			
All sizes	Flexible Elastomeric	½″	Yes
ABOVE FLOOR DRAINS, TRAPS AND DRAIN PIPING WITHIN 10 FEET OF DRAIN RECEIVING CONDENSATE AND EQUIPMENT DRAIN WATER BELOW 60 DEGREES F			
All sizes	Flexible Elastomeric	1″	Yes
EXPOSED SANITARY DRAINS AND DOMESTIC WATER SUPPLIES AND STOPS FOR FIXTURES FOR THE DISABLED			
Supply pipes and drain pipes – all sizes	TrueBro® LAV-Guard®-2	-	Yes
INDOOR ABOVEGROUND HOT SERVICE DRAINS AND VENTS (Insulation for Personnel Protection)			
All sizes	Flexible Elastomeric	1-1/2″	No

3.12 FIELD APPLIED JACKET APPLICATION SCHEDULE

SERVICE	FIELD APPLIED JACKET TYPE
Indoor, exposed insulated piping within 12 feet of floor, for service temperatures 200 degrees F and below.	PVC
Indoor, exposed insulated piping greater than 12 feet above floor, generally.	None
Indoor concealed piping	None
Indoor, All Locations, Fittings and valves in piping systems at service temperatures 200 degrees F and below.	Factory Fabricated PVC covers

END OF SECTION

SECTION 15440

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 15.

1.2 SUMMARY

A. General Requirements:

1. Incorporate in construction pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular production components, parts, and assemblies.
2. Comply with maximum load ratings with consideration for allowable stresses prescribed by ASME B31.1 or MSS SP-58.
3. Provide support, guides and anchors that do not transmit unacceptable heat and vibration to building structure.
4. Installation of pipe hangers and supports shall be based upon the overall design concept of the piping system. The support system shall provide for an control the free movement of piping including its movement in relation to that connected equipment.
5. Provide for vertical adjustments after installation of supported material and during commissioning, where feasible, to ensure pipe is at design elevation and slope.

1.3 SECTION INCLUDES

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Acoustical Sealant
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Firestopping relating to plumbing work.
9. Firestopping accessories.

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

1. Section 15400 - "Common Work Results for Plumbing".
2. Section 15420 - "General Duty Valves for Plumbing Piping".
3. Section 15430 - "Plumbing Insulation".
4. Section 15410 - "Pipes and Tubes for Plumbing Piping and Equipment": Execution requirements for placement of hangers and supports specified by this section.

1.2 DEFINITIONS

A. Terminology used in this Section is defined in Manufacturer's Standardization Society Specification - 90, "Valve and Fittings Standards".

1.3 REFERENCES

(Unless otherwise noted, references apply to "latest editions.")

A. American Society of Mechanical Engineers:
   1. ASME B31.5 - Refrigeration Piping.
   2. ASME B31.9 - Building Services Piping.

B. ASTM International:
   1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
   2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
   3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
   4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:
   1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:
   1. UL 263 - Fire Tests of Building Construction and Materials.
   2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
   3. UL 1479 - Fire Tests of Through-Penetration Firestops.
   4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
   5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product data for each type of hanger and support.

C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support, including loads.

D. Welder certificates signed by Contractor certifying that welders comply with requirements

specified under the "Quality Assurance" Article.

E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

F. Submit following in accordance with Conditions of Contract and Division 01 Specifications:

1. Shop drawings of items.
2. Complete description of products to be supplied including product data, dimensions materials of construction and specifications.
3. Installation instructions for each product.
4. Layout of piping to be isolated including vertical risers showing:
   a. Support points.
   b. Weight at support points.
5. Special details at large scale and other necessary information to convey understanding of work.

G. Submission of samples may be requested for each type of hanger device. After approval, samples shall be returned for installation at job site.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code - Steel".

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. NFPA Compliance: Comply with NFPA 13, "Installation of Sprinkler Systems," for hangers and supports used as components of fire protection systems.

D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70 "Definitions."

1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.

E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

F. Supply and install incidental materials needed to meet requirements, even if not expressly specified or shown on drawings without claim for additional payment.

G. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

H. Should any rotating equipment cause excessive noise or vibration, rebalance, realign or do other remedial work to reduce noise and vibration levels. Excessive is defined as exceeding manufacturer's specifications for unit in question.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with a minimum of five years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 01 Specifications, Section 15 – Common Work Results for Plumbing and information contained herein for requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Specifications: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is not in accordance with the manufacturer's installation procedures.

C. Maintain manufacturer's required temperature before, during, and after installation of firestopping materials for minimum periods of time as required by the manufacturer.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel: ASTM A 36/A 36M, "Carbon Structural Steel," steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, "Track Bolts and Nuts," steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, "Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use," steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)," non-shrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is

recommended for both interior and exterior applications.
2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers, Supports, and Components: Provide factory-fabricated products as manufactured by B-Line, AITT Grinnel, Pipe Shields, Inc., or Michigan Hanger. Basis of Design shall be B-Line.
1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal-Hanger Shield Inserts: 100-psi (690kPa) average compressive strength, waterproofed calcium silicate or treated lumber inserts, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

E. Upper attachments to structures shall have an allowable load not exceeding 3 of the failure (proof test) load but are not limited to the specific methods indicated.

F. Horizontal Non-Insulated Vent Piping Hangers:
1. Two inch and smaller: Figure No. B3170.
2. Two and one-half inch and larger: Figure No. B3100.

G. Horizontal Non-Insulated Copper Piping Hangers:
1. Two inch and smaller: Figure No. B3104 CTC.
2. Two and one-half inch and larger: Figure No. B3104 CT.

H. Insulated Horizontal Piping Hangers: Cold and Hot Water (Domestic)
1. Two inch and smaller: Figure No. B3108 with metal shield, Figure No. B3151.
2. Two and one-half inch and larger: Figure No. B3108 with metal shield, Figure No. B3151.

I. Vertical Piping Riser Clamps:
1. Copper Pipe: Figure No. B3373CT.
2. Steel Pipe: Figure No. B3136 and B3137.

J. PVC and CPVC Piping:
1. Figure No. B3106 with No. B3106V channel, plastic-coated.
2. For piping 1 inch and smaller, use continuous support system only.

K. Hangers for Brass Piping or to Eliminate Electrolytic Action:
   1. Figure No. B3104C.

L. Beam Clamps and Attachments:
   1. For bolt-on locations to structure, Figure Nos. B3291, B3036, or B3050.
   2. Welded beam attachments, Figure No. B3083.

M. Concrete Inserts:
   1. For concrete spot inserts at single locations for casting into structure, Figure No. B3014 for pre- determined rod size and Figure No. B2500 for universal use.
   2. For continuous slot concrete insert at multi-locations for casting into structure, Figure No. B2505.

N. Brackets:
   1. For equipment and piping adjacent to walls or steel columns, Figure Nos. B3066, B3063 and B3067 depending on weight to be supported.

O. Pipe Rests:
   1. For pipes close to floor where no expansion provision is required, Figure No. B3088T base stand with B3093 adjustable pipe saddle support.

P. Hanger Rods:
   1. Hanger rod, Figure No. B3205.
   2. Continuous threaded rod, Figure No. ATR.
   3. Eye rods, Figure No. B3210 or B3211, depending on load supported.

Q. Trapeze Hangers - Direct Mounting Hangers:
   1. Grinnell, Figure No. 46.

R. Protection Saddles:
   1. Cast iron pipe, insulated, Figure No. B3108 with metal shield, Figure No. B3151.
   2. For high temperature steel pipe, insulated, No. B3160, B3161, B3162, B3163, B3164, or B3165.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material. Install damming materials to arrest liquid material leakage.

B. Remove incompatible materials affecting bond.

C. Drilling or cutting of structural members shall be as detailed / directed by structural engineer.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Comply with MSS SP-69, "Pipe Hangers and Supports C Selection and Application," and SP-89, "Pipe Hangers and Supports -- Fabrication and Installation Practices". Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. Piping shall be supported independently from

equipment connections. Supports shall not interfere with removal of equipment.

B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

C. Install supports with maximum spacings complying with MSS SP-69, "Pipe Hangers and Supports C Selection and Application," and as specified in Section 15440 - "Pipes and Tubes for Plumbing Piping and Equipment."

D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69,"Pipe Hangers and Supports C Selection and Application," 1996. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts in new construction prior to placing concrete. Install reinforcing bars through openings at top of inserts.

F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36, "Carbon Structural Steel," 2001, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1, "Structural Welding Code - Steel".

I. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.

L. Insulated Piping: Provide continuous insulation and vapor barrier through hangers and supports. Comply with the following installation requirements.

1. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9. Insulate clamps on piping with insulation and vapor barrier.
2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees (3.1 rad) and have dimensions in inches (mm) not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4 to 3 1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105

4. Pipes 4 Inches (200 mm) and Larger: Include treated wood inserts.
5. Insert Material: Length to equal to the length of the protective shield.

M. Conform to the table below for maximum spacing of supports and rod sizes:
1. Steel and Copper Pipe:

Nom. Pipe Size – In.	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. – In.
Up to 3/4	7	5	3/8
1	7	6	3/8
1 1/4	7	7	3/8
1 1/2	9	8	3/8
2	10	8	3/8

Nom. Pipe Size – In.	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. – In.
2 1/2	11	9	1/2
3	12	10	1/2
3 1/2	13	11	1/2
4	14	12	5/8 (1/2 for copper)
5	16	13	5/8 (1/2 for copper)
6	17	14	3/4 (5/8 for copper)

a. Support vertical steel pipe and copper tube at each floor.
2. Drain Piping:

Pipe Material	Horizontal In Feet	Vertical In Feet
Cast-Iron Soil Pipe	5	15
PVC Plastic Pipe	4	4

a. Support plastic pipe and tubing in accordance with manufacturer's recommendations.
b. Support cast-iron piping at each hub.

N. Equipment Supports:
1. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
2. Grouting: Place grout under supports for equipment and concrete bases. Make a smooth bearing surface.

O. Metal Fabrication:
1. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
2. Fit exposed connections together to form hairline joints. Field-weld connections

that cannot be shop-welded because of shipping size limitations.

3. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercut or overlap.
   c. Remove welding flux immediately.
   d. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

P. Painting:
   1. Touching Up: Clean field welds and abraded areas of factory paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for factory painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
      a. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
   2. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of factory paint on miscellaneous metal is specified in Division 9 Section "Painting."
   3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

Q. Field Quality Control
   1. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

3.3 APPLICATIONS FOR HANGER AND SUPPORT

A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

B. Comply with MSS SP-69, “Pipe Hangers and Supports C Selection and Application,” for pipe hanger selections and applications that are not specified in piping specification Sections.

3.4 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

C. Seal floor drains and floor sinks watertight to adjacent materials.

3.5 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.6 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.7 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Adjust for pipe alignment and final equipment connections. Flexible connections shall not be used for adjustment of alignment.

END OF SECTION

SECTION 15450

PLUMBING FIXTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section, and all sections of Division 15.

1.2 SUMMARY

A. Requirements for plumbing fixtures. Plumbing fixture specifications are located on the contract drawings.

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

1. Section 15400 - "Common Work Results for Plumbing."
2. Section 15410 **-** "Pipes and Tubes for Plumbing Piping and Equipment": Supply connections to plumbing fixtures.
3. Section 15420 – "General Duty Valves for Plumbing Piping:" Valve requirements.
4. Section 15490 – "Plumbing Piping Systems Cleaning and Treatment:" Requirements with regards to plumbing fixture installation and piping sterilization.

1.3 REFERENCES
(Unless otherwise noted, references apply to "latest editions.")

A. Florida Building Code
1. FBCP – Florida Building Code Plumbing
2. FBCM – Florida Building Code Mechanical
3. FBCB - Florida Building Code Building
4. FBCEC – Florida Building Code Energy Conservation

B. American National Standards Institute:
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

C. Air-Conditioning and Refrigeration Institute:
1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.

D. American Society of Mechanical Engineers:
1. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2. ASME A112.18.1 - Plumbing Fixture Fittings.
3. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
4. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
5. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
6. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.

1.4 SUBMITTALS

A. General – Submit each item in this section according to the conditions of the Contract and Division 01 specifications sections.

B. Product Data: Submit catalog illustrations of fixtures, sizes, [rough-in dimensions,] utility sizes, trim, and finishes.

C. Manufacturer's Installation Instructions: Submit installation methods and procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Provide Closeout documentation in accordance with execution and closeout requirements of the Contract and Division 01 specification sections.

B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

B. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., and/or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 50 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years' experience, approved by manufacturer and with service facilities within 50 miles of project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.9 WARRANTY

A. Furnish five year manufacturer warranty for plumbing fixtures.

1.10 EXTRA MATERIALS

A. Refer to Division 01 specifications for additional spare parts and maintenance products.

B. Furnish two sets of: faucet washers flush valve service kits lavatory supply fittings, shower heads, and toilet seats.

1.11 DEFINITIONS

A. Lead Free:
1. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be "lead free", containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. Solder and flux for soldered joints in potable water piping shall be "lead free", containing not more than 0.2% lead free

PART 2 PRODUCTS

2.1 PLUMBING FIXTURES

A. Furnish and install all fixtures and trim necessary to complete fixture installation. Provide approved stop valve, to match fittings, on both hot and cold water supplies to each fixture, all fixtures requiring hot and cold water shall have cold water faucets on right and hot water faucets on left. Exposed metal work shall be chrome plated red brass. Fixtures shall be white, unless otherwise specified. (Note: The letter identification symbol with each fixture identified type shown on drawings and as indicated on "Plumbing Fixture Schedule" on drawing.) Where fixtures tailpieces, traps and stop valves are not indicated, same shall be provided to suit fixture.

B. Coordinate mounting heights for all plumbing fixtures with the locations of grab bars; refer to Architectural Contract Drawings for exact grab bar locations.

C. Refer to Architectural Drawings for mounting heights of all fixtures.

D. All exposed bolts, screws, fasteners, etc. shall be vandal proof.

E. Utilize Sani-Sett setting compound for fixtures.

F. All plumbing materials, equipment and fixtures shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.

G. Provide supports necessary to adequately and substantially hang and set fixtures. Supports shall be Zurn, Josam or J.R. Smith and shall be suitable for wall types and thicknesses and piping arrangements shown, and as required for installation.
1. Wall mounted, urinal supports, type with cast iron headers, box steel stanchions, block type cast iron feet with bearing plate.
2. Support for wall mounted, urinals, lavatories, sinks, water coolers, etc.:
a. Where fixtures are supported from concrete or cinder block walls, install No. 10 USSG steel plate on the opposite side of the wall and bolt hangers or supports through plate. Where opposite side of wall is exposed to

view, place bolts in core of blocks and fill core with cement.

b. Were lavatories with wall hangers have been specified and fixtures are supported from metal stud frame partitions, fixture brackets or mounting lugs shall be through bolted to steel channel crosspieces not less than 1 ½" wide anchored to studs. Bolt heads shall be welded to channel web.

c. Concealed arm type lavatory supports, with cast iron headers, box steel stanchions, block type cast iron fee and header and chrome plated cast brass threaded escutcheons for slab type lavatories.

H. Plumbing fixtures shall be caulked at walls and floors with silicone caulking material of same color as fixture(s).

I. Locate countertop sinks and/or under counter sinks furnished under this Division. Furnish templates to the countertop fabricator for cutting of required holes.

J. For sinks and fixtures specified under other divisions or other contracts and not provided with faucets, tailpieces, traps, stop valves and supply tubes, provide necessary fittings and completely connect the sinks and fixtures.

K. Where sensor operated flush valves and faucets are specified hereinafter, furnish transformer(s) to serve the maximum recommended number of fixtures per the fixture manufacturer's recommendations. Each transformer shall be suitable for a 120v primary voltage. Wiring shall be installed under Division 16.

L. Hot and cold water connections to fixtures shall be provided with a stop valve, stop valves, risers, etc. Stop valves and risers shall be light commercial grade: as manufactured by Brasscraft, Central Brass or an acceptable comparable product. Commercial/Institutional grade: as manufactured by Chicago Faucet, Brass Craft, McGuire or an acceptable comparable product.

M. Refer to contract drawings for additional plumbing fixture specifications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Refer to Division 01 Specifications for Coordination and project conditions.

B. Verify walls and floor finishes are prepared and ready for installation of fixtures.

C. Verify electric power is available and of correct characteristics. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

B. Install each fixture with trap, easily removable for servicing and cleaning.

C. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall supports or wall carriers and bolts as recommended by fixture manufacturer.

F. Seal fixtures to wall and floor surfaces with Sani Sett setting compound. Color to match fixture.

G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

H. For ADA accessible water closets, install flush handle with handle to wide side of stall.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

A. Refer to Division 01 Specifications for execution requirements for Testing, adjusting, and balancing requirements.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Refer to Division 01 specifications for final cleaning requirements.

B. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Refer to Division 01 Specifications for protecting installed construction.

B. Do not permit use of fixtures before final acceptance.

3.8 SCHEDULES

A. Refer to contract drawings for plumbing fixture schedule.

B. Fixture Rough-in: Refer to plumbing fixture schedule on contract drawings, and manufacturer's requirement.

END OF SECTION

SECTION 15490

PLUMBING PIPING SYSTEMS CLEANING AND TREATMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:
1. Potable Water Systems
2. Gravity Drains

B. Related Sections

1. The following Sections contain requirements that relate to this Section:
a. Section 15410 - "Pipes and Tubes for Plumbing Piping and Equipment:" Piping and valving construction requirements.
b. Section 15420 - "General Duty Valves for Plumbing Piping:" Valving requirements for piping.
c. Section 15450 - "Plumbing Fixtures:" Requirements for plumbing fixtures and mixing valves.

1.3 DEFINITIONS

A. Point of Delivery is the outlet of the service meter assembly, or the outlet of the service regular (service shutoff valve when no meter is provided).

B. Domestic Water Systems: A system conveying domestic potable or non-potable water, such as Cold Water, Hot Water, Hot Water circulating, etc.

C. Gravity Drainage Systems: A system of gravity fed effluent conveying storm water, sanitary, etc.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product data for each type of product specified. Include manufacturer's technical product data, rated capacities of selected equipment clearly indicated, water-pressure drops, weights (shipping, installed, and operating), furnished specialties, accessories, and installation and startup instructions. Provide a list of all chemicals and quantities, including material safety data sheets.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. System diagram showing all piping, valving, tubing, treatment equipment, etc.

E. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

F. Field test reports indicating and interpreting test results relative to compliance with specified requirements.

G. Maintenance data for chemical water treatment to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions and parts list for each item of equipment, control, and accessory. Include troubleshooting maintenance guide.

1.5 QUALITY ASSURANCE

A. Qualifications: A recognized chemical water treatment supplier with warehousing facilities within 30 miles from the project. The supplier shall employ an experienced consultant, available at reasonable times during the course of the Work to consult with Contractor, Architect, and Owner about water treatment.

1. Provide a list of at least five (5) projects of similar size and type, which have been in operation for at least 5 years.
2. Supplier shall provide 24-hour emergency service, and shall be capable of being on-site within 4 hours notice.

B. Chemical Standards: Meet state and local pollution-control regulations.

C. Comply with NFPA 70, “National Electrical Code,” for components and installation.

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. Provide cleaning of the piping systems and submit a certificate of compliance with the specification.

1.6 MAINTENANCE

A. Extra Materials

1. Furnish the following extra materials, matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. Chemical Water Treatment Products:
   a. Arc Water Treatment Co.
   b. Aqua-Chem, Inc.
   c. Ecolab.
   d. Olin Water Services

PART 3 EXECUTION

3.1 INSTALLATION

A. Install treatment equipment level and plumb, according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.

B. Connections

1. Piping installation requirements are specified in other Division 15 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   a. Install piping adjacent to equipment to allow servicing and maintenance.
   b. Piping: Conform to applicable requirements of Section 15410 - "Pipes and Tubes for Plumbing Piping and Equipment."
2. Electrical: Conform to applicable requirements of Division 16 Sections for connecting electrical equipment.
   a. Install electrical devices furnished with boiler but not specified to be factory mounted.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Provide the services of a qualified independent testing agency to perform field quality control testing.

3.3 STERILIZATION OF DOMESTIC WATER SYSTEMS

A. Sterilization:

1. After final testing for leaks, all new potable water lines shall be thoroughly flushed by plumbing contractor to remove foreign material. Before placing the systems in service, contractor shall engage a qualified service organization, Arc Water Treatment Company of Maryland, Inc. or approved equal, to sterilize the new water lies in accordance with the following procedure:
   a. Through a ¾" hose connection in the main entering the building pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Plumbing contractor shall provide plumbing connections and power for pumping chlorine into the system.
2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.
3. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 ppm chlorine, retain this water in the system for four (4) hours. CAUTION: Over-concentration of chlorine and more than four (4) hours of retention may result in damage to piping system.
4. At the end of the retention period, no less than 100 ppm of chlorine shall be present at the extreme end of the system.
5. Proceed to open all faucets and taps and thoroughly flush all new lines until the

chlorine residual in the water is less than 1.0 ppm.

6. Obtain representative water sample from the system for analysis by a recognized bacteriological laboratory.
7. If the sample tested for coliform organism is negative, a letter and laboratory report shall be submitted by the service organization to the contractor, certifying successful completion of the sterilization.
8. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.

3.4 SPECIAL TESTING

A. Waterborne Pathogens

1. Sample collection procedures: Select a minimum of three (3) distal sites from every floor of a Residential Building and four (4) random samples from each Community Building. The random samples (faucets or showers) should represent the water distribution system (i.e., sites on each floor and wing). Take samples (water or swab) from each distal site as described below.
2. Sample bottles and swabs can be obtained from Special Pathogens Lab listed below. Testing should occur within two (2) weeks of building occupancy.

B. Collection Procedure

1. Potable Water
   a. Fill out SPL Chain of Custody
   b. Use waterproof pen to label bottle and swab with sample location, description and date.
   c. Swab collection:
      1) Remove aerator if present.
      2) Moisten the outlet by turning on the hot water – briefly.
      3) Insert swab into faucet opening rotating four times against the inner surface as it moves up into the opening (for shower head, rotate the swab over the entire surface of showerhead four times).
      4) Replace swab in transport tube.
   d. Water collection:
      1) Turn on hot water and immediately fill the bottle.
      2) Close bottle and invert to mix the sodium thiosulfate neutralizer.
   e. Repeat steps 2-5 with next sample location

2. Hot Water Storage Tanks
   a. Open the drain valve at the base of the heater or tank and immediately fill bottle.
   b. Let the water continue to drain for 15-30 seconds to flush out residual water within the drain pipe.
   c. Fill a second sample bottle.
   d. Submit both samples, labeled Immediate and Post Flush.

END OF SECTION

SECTION 15651

REFRIGERATION PIPING SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Division-15 sections that apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Extent of refrigeration piping systems work is indicated on drawings and schedules, and by requirements of this section.

B. Applications for refrigeration piping systems include the following:

1. Refrigerant suction line piping between compressors and cooling coils.
2. Refrigerant liquid line piping between liquid receivers and cooling coils.

C. Refer to appropriate Division-15 sections for insulation required in connection with refrigeration piping; not work of this section.

D. All refrigerant piping to be installed per Manufacturer recommendations per specified length. Install with longer Run Kit if needed.

1.03 QUALITY ASSURANCE

A. Requirements of the latest revision of the Florida Building Code and Florida Mechanical/Plumbing Code.

B. Manufacturers: Firms regularly engaged in the manufacture of refrigeration piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

C. Installer: A firm with at least 3 years of successful installation experience on projects with refrigeration piping system work similar to that required for project.

D. ANSI Code Compliance: Comply with applicable provisions of ANSI B31.5 and ANSI B31.5a, "Refrigeration Piping", and extend applicable lower pressure limits to pressures below 15 psig.

E. Safety Code Compliance: Comply with applicable portions of ANSI/ASHRAE 15, "Safety Code for Mechanical Refrigeration".

F. Brazing: Comply with applicable requirements of ANSI B31.5, and ANSI B31.5a, "Refrigeration Piping", pertaining to brazing of refrigeration piping for shop and project site locations.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data for refrigeration piping systems materials and products.

B. Brazing Certification: Certify brazing procedures, brazers and operators in accordance with ASME standards (ANSI B31.5).

C. Shop Drawings: Submit scaled layout drawings of installed refrigeration pipe and fittings including, but not necessarily limited to, pipe sizes, locations, elevations and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between piping and proximate equipment.

PART 2 - PRODUCTS

2.01 REFRIGERATION PIPING MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for refrigeration piping where applicable, base pressure rating on refrigeration piping system maximum design pressures.

B. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in refrigeration piping systems. Where more than one type of material or product is indicated, selection is Installer's option.

2.02 BASIC IDENTIFICATION

A. General: Provide identification complying with Division-15 Basic Materials and Methods section, "Mechanical Identification", in accordance with the following listing:

1. Refrigeration Piping: Plastic pipe markers.

2.03 BASIC PIPE, TUBE AND FITTINGS

A. General: Provide pipe, tube and fittings complying with Division-15 in accordance with the following listing:

1. Tube Size 4-1/8" and Smaller: Copper tube.
   a. Wall Thickness: Type ACR, hard drawn temper.
   b. Fittings: Wrought-copper, solder-joints.
   c. Joints: Soldered, silver-lead solder, ANSI/ASTM B 32, Grade 96 TS.
2. Tube Size 3/4" and Smaller: Copper tube.
   a. Wall Thickness: Type ACR, soft annealed temper.
   b. Fittings: Cast copper-alloy for flared copper tubes.
   c. Joints: Flared.
3. Tube Size 7/8" through 4-1/8": Copper tube.
   a. Wall Thickness: Type ACR, soft annealed temper.
   b. Fittings: Wrought-copper, solder joints.
   c. Joints: Soldered, silver-lead solder, ANSI/ASTM B 32, Grade 96 TS.

2.04 BASIC PIPING SPECIALTIES

A. General: Provide piping specialties complying with Division-15 in accordance with the following listing:

1. Pipe escutcheons
2. Pipe sleeves

2.05 BASIC SUPPORTS, ANCHORS AND SEALS

A. General: Provide supports, anchors and seals complying with Division-15 in accordance with the following listing:

1. Adjustable steel clevises, adjustable roller hangers, and adjustable pipe roll stands for horizontal piping hangers and supports.
2. Two-bolt riser clamps for vertical piping supports.
3. Concrete inserts, C-clamps and steel brackets for building attachments.
4. Protection shields for insulated piping support in hangers.
5. Copper flashing for piping penetrations.

2.06 SPECIAL REFRIGERATION VALVES

A. General: Special valves required for refrigeration piping systems include the following types:

1. Globe and Check Valves:
   a. Globe and Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300° F (149° C) temperature rating, 500 psi working pressure.
   b. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250° F (121° C) temperature rating, 500 psi working pressure.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering globe and check valves that may be incorporated in the work include the following:

1. Henry Valve Co.
2. Parker Hannifin Corp., Refrigeration & Air
3. Conditioning Div
4. Sporlan Valve Co.
5. Or equal

C. Solenoid Valves:

1. Two-way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, 24 volt, 60 hertz, UL-listed, 1/2" conduit adapter, 250° F (121° C) temperature rating, 400 psi working pressure.

D. Manual Operator: Provide manual operator to open valve.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering solenoid valves which may be incorporated in the work include the following:

1. Alco Controls Div., Emerson Electric Co.
2. Automatic Switch Co.
3. Sporlan Valve Co.
4. Or equal

2.07 REFRIGERATION ACCESSORIES

A. Refrigerant Strainers: Brass shell end and connections, brazed joints, monel screen, 100 mesh, UL-listed, 350 psi working pressure.

B. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL-listed 200° F (93° C) temperature rating, 500 psi working pressure.

C. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.

D. Evaporator Pressure Regulators: Provide corrosion-resistant, spring-loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.

E. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL-listed.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering refrigeration accessories which may be incorporated in the work include the following:
1. Alco Controls Div., Emerson Electric Co.
2. Henry Valve Co.
3. Parker-Hannifin Corp., Refrigeration & Air Conditioning Div.
4. Sporlan Valve Co.
5. Or equal

PART 3 - EXECUTION

3.01 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division-15.

3.02 INSTALLATION OF REFRIGERATION PIPING

A. General: Install refrigeration piping in accordance with Division-15 in compliance with equipment manufacturer's recommendations.

B. Pitch refrigerant piping in direction of oil return to compressor. Provide oil traps and double section risers where indicated, and where required to provide oil return.

C. Insulate suction line with ½" Armaflex.

D. Provide aluminum jacket for exposed lines.

3.03 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with requirements of Division-15.

3.04 INSTALLATION OF SUPPORTS, ANCHORS AND SEALS

A. Install supports, anchors and seals in accordance with requirements of Division-15.

3.05 INSTALLATION OF SPECIAL REFRIGERATION VALVES

A. General: Install refrigeration valves where indicated, and in accordance with manufacturer's instructions. Remove accessible internal parts before soldering or brazing, replace after joints are completed.

1. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards.
    a. Wiring of solenoid valves is specified in applicable Division-15000 Sections, and is included as work of this section.

3.06 INSTALLATION OF REFRIGERATION ACCESSORIES

A. Refrigerant Strainers: Install in refrigerant lines as indicated, and in accessible location for service.

B. Moisture-Liquid Indicators: Install as indicated on refrigerant liquid lines, in accessible location.

C. Refrigerant Filter-Dryers: Install in refrigerant lines as indicated, and in accessible location for service.

D. Evaporator Pressure Regulators: Install in refrigerant suction lines or evaporator outlets as indicated. Adjust, if required, for proper evaporator pressure.

E. Refrigerant Discharge Line Mufflers: Install as indicated, in horizontal or downflow portion of hot-gas lines, immediately after leaving compressor; not in riser.

3.07 EQUIPMENT CONNECTIONS

A. General: Connect refrigerant piping to mechanical equipment in manner shown, and comply with equipment manufacturer's instructions where not otherwise indicated.

3.08 FIELD QUALITY CONTROL

A. Refrigerant Piping Leak Test: Prior to initial operation, clean and test refrigerant piping in accordance with ANSI B31.5 and ANSI B31.5a, "Refrigeration Piping". Perform initial test with dry nitrogen, using soap solution to test all joints. Perform final test with 27" vacuum, and then 200 psi using electronic leak detector. System must be entirely leak-free.

B. Repair or replace refrigerant piping as required to eliminate leaks, and retest as specified to demonstrate compliance.

END OF SECTION

SECTION 15757
DUCTLESS MINI-SPLIT SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

1.02 DESCRIPTION OF WORK

A. This section includes the providing and installing of all materials, equipment and incidentals necessary and/or required for a complete installation of all mini-split heat pumps as specified herein.

1.03 RELATED WORK

A. Programmable Thermostat

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 15000.

B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Submit electrical requirements for power supply wiring. Include diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

D. Submit manufacturer's installation instructions under provisions of Section 15000.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 15000.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver product to site in factory-fabricated protected containers, with factory-installed shipping skids and lifting lugs

B. Store in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not operate unit for any purpose, temporary or permanent, until system has been cleaned and tested under observation.

1.08 WARRANTY

A. For a period of one (1) year after owner acceptance of project, the manufacturer and vendor shall correct product defects due to the following:

1. Failure to comply with specifications.

2. Faulty materials, equipment, applications, and other items.
3. Faulty workmanship.

B. Defects corrected after energizing shall be accomplished at a time agreeable to owner.

C. Product defects shall be replaced or corrected without charge to owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Mitsubishi (Basis of Design)

B. Carrier

C. Panasonic

2.02 SYSTEM DESCRIPTION

A. The system shall be capable of providing heating and cooling in a two-to-one, three-to-one, four-to-one, or five-to-one configuration.

2.03 COOLING OPERATING RANGE

A. The operating range in the cooling mode shall be -13°F – 122°F.

2.04 HEATING OPERATING RANGE

A. The operating range in the heating mode shall be -13°F – 86°F.

2.05 REFRIGERANT PIPING

All refrigerant piping shall be installed in accordance with manufacturer's recommendations. No additional sight glasses or filter/dryers shall be required. All field installed refrigerant piping shall be applied using nitrogen ACR copper tubing and shall be meet ASTM B280.

Fully serviceable brass service valve shall prevent corrosion and provide access to refrigerant system. Flare connection lines shall be located on side of unit cabinet. Shut-off valve and 2-way service valve (with service port) may be accessed to manage refrigerant charge while servicing system. Refrigerant lines shall be individually insulated to prevent sweating and bundled in line set with UV-rated tape.

The system shall be capable of the following refrigerant piping lengths.

A. Single-Zone Mini-Split System
   1. Maximum line set length: 213 ft *
   2. Maximum line set elevation from outdoor unit to indoor unit, when outdoor unit is above: 98 ft *
   3. Maximum line set elevation from outdoor unit to indoor unit, when outdoor unit is below: 98 ft *

*depends on model

2.06 SINGLE ZONE OUTDOOR UNIT

A. General
1. The MPB single-zone outdoor unit shall be factory assembled and pre-wired with all controls necessary for operation.
2. All refrigerant piping lines shall be insulated separately in accordance with the adopted state or local energy code requirements.
3. Outdoor unit sound pressure level for an individual condensing unit module shall not exceed 63 dB(A).
4. The system shall be capable of automatically restarting operation when power is restored after a power failure.
5. The unit shall have a terminal strip furnished for easy wiring connections.
6. The unit shall have an automatically enabled function to defrost the unit when frost build-up is detected. Outdoor and indoor blower operations terminate and status is displayed on the indoor unit panel.
7. The unit shall be equipped with a 4-way interchange reversing valve to implement rapid changes in direction of refrigerant flow to result in quick changeover from heating to cooling and vice versa. Valve operates on pressure differential between outdoor unit and indoor unit.
8. The unit shall be equipped with a base pan heater.

B. Unit Cabinet
1. The outdoor unit cabinet shall be constructed of heavy gauge steel and shall be finished with a weatherproof and corrosion resistant baked enamel finish.
2. The unit shall have access covers for power and control wiring connections.
3. The unit shall have access covers for service valves.
4. The outdoor unit shall utilize a base pan heater to prevent build-up of ice during heating operation.
5. The unit shall feature tabs on base to allow secure mounting to slab.
6. Condensate drain outlets shall be furnished on unit base. Drain shall be field furnished.

C. Fan
1. The outdoor unit direct fan drive moves large air volumes uniformly through entire outdoor coil for high refrigeration capacity.
2. The outdoor unit fan motor shall be powered by an inverter drive capable of 5 steps of fan speed control.
3. An outdoor unit fan guard shall be provided.

D. Condenser Coil
1. The condenser coil shall be manufactured from copper tubes with aluminum fins.
2. A wire grille guard shall be provided.
3. The condenser coil shall be factory coated with a hydrophilic treatment for increased corrosion resistance.

E. Compressor
1. The unit shall have a compressor that features high-efficiency operation.
2. The compressor shall be balanced to reduce vibration and promote quiet operation.
3. The brushless DC motor shall use powerful Neodymium magnets, 15-20 times stronger than the ferrite magnets within conventional AC compressors.
4. The unit shall utilize a compressor crankcase heater to protect against refrigerant migration that can occur during low ambient operation.

F. Controls
1. The system utilizes DC inverter control to provide continuous operation while adjusting capacity according to room temperature. The system's accurate sensing of heating and cooling loads prevents frequent changes in capacity and ensures efficient, economical operation.
2. The microprocessor shall control the electronic expansion valve. It shall also assist the automatic compressor timed-off protection feature, indoor fan-on delay in heating mode after coil is warm, and 4-way reversing valve.

G. Electrical
1. The power supply to the outdoor unit shall be 208-230 volts, single phase, 60 Hz, or 115 volts, single phase, 60 Hz.
2. Dedicated communication cables will be required by the 3 and 4 ton units. The control wiring to the indoor unit requires 18 gauge, 2 core, stranded, and shielded wire. Unshielded communication wire shall not be accepted. Control wire shielding shall be grounded in accordance with manufacturer's recommendations.

H. Refrigerant
1. Refrigerant shall be R-410A.
2. Each unit shall be pre-charged from the factory with a holding charge. Additional refrigerant shall be added in the field in accordance with manufacturer's recommendations.
3. Flare refrigerant connection lines shall be located on side of unit cabinet.
4. The unit shall have a fully serviceable brass service valve to prevent corrosion and provide access to refrigerant system. Shut-off valve may be fully shut off while 2-way service valve with port may be accessed to manage refrigerant charge while servicing system.
5. The refrigerant oil shall be VG74 ester oil or VG74 Polyolester (POE).

2.07 WALL MOUNTED NON-DUCTED INDOOR UNIT

A. General
1. The wall-mounted non-ducted indoor unit shall be completely factory assembled and tested. The unit shall include all wiring, piping, electronic expansion valve, and printed circuit boards necessary for operation.
2. The unit shall be capable of a heating set temperature of 46°F to prevent space from freezing.
3. The unit shall have a pre-heat function to delay fan operation until the indoor coil has reached a field-adjustable temperature.
4. The unit will allow compensation for temperature due to installation height and ground height differentials.
5. The unit shall allow use of remote controller temperature sensor rather than indoor unit temperature sensor.
6. The unit will have a turbo mode to allow unit to initially operate at maximum output to reach set temp as quickly as possible.
7. The unit shall utilize a large diameter cross flow fan and evaporator temperature to minimize the sound level by lowering fan speed.
8. The unit shall have a self-cleaning function to allow drying and cleaning of unit interior to prevent mold and bacteria growth.
9. The unit will have a sleep mode to allow a slow increase or decrease in temperature before shutting off after a delay.
10. The unit shall have a low charge detection function to alert the user when refrigerant leakage is detected.

11. The unit will have an intelligent defrost mode that can vary the defrosting time according to the current system state.
12. The unit must allow continuation of operation in the event of a temperature sensor error.
13. The unit shall allow for restriction to heating operation only.
14. The unit shall restart automatically after power failure after 3 minutes with prior settings.
15. The unit will be paired with a wireless remote controller; a wired controller may be purchased separately.
16. The unit must be compatible with primary VRF provider's product line.
17. The unit shall have a timer that allows the user to automatically turn on or turn off the unit up to 24 hours later.
18. The indoor until shall include motor-driven louvers and shall support automatic vertical swing functionality.
19. The unit shall include a factory-provided LED readout display and infrared receiver panel. The LED display shall indicate the current operational set point of the indoor unit, operation status, and codes for maintenance and servicing.

B. Unit Cabinet
1. The front panel of the unit may be raised for wiring and maintenance accessibility.

C. Fan
1. The fan motor shall be a DC motor capable of operating at 3 fan grades: low, medium, and high.
2. The fan motor shall be thermally protected.

D. Connections
1. The unit shall be equipped with liquid and gas flare fittings for quick and secure piping.
2. The unit shall have refrigerant piping and drainage hose connections on the right and left side.
3. The unit shall offer 3 access points for refrigerant outlet pipes in the right, left, or rear sides.
4. The indoor unit coil shall be rifled copper tubing with hydrophilic coated aluminum fins.
5. The coil shall have a design pressure of 550 psi.

E. Filter
1. The unit shall be equipped with a cold catalyst filter to reduce odors and presence of volatile organic compounds.
2. The unit shall include an easily removable, washable mesh filter.

F. Electrical
1. The power supply to the indoor unit shall be 115 volts, single phase, 60 Hz, or 208-230 volts, single phase, 60 Hz.

2.08 MINI-SPLIT LOCAL CONTROLLERS

A. Non-Programmable Wired Remote Controller

1. The non-programmable wired remote controller shall be provided with ducted indoor units. The wired remote controller may be separately ordered for non-ducted indoor units.

2. The wired remote controller shall control the following options: On/Off, Operation Mode (auto, cool, dry, heat and fan), and fan speed setting (auto, low, medium, high). The wireless remote controller shall be capable of setting indoor unit on or off via a timer function.
3. The wired remote controller shall have LCD backlight for easier visibility
4. The wired remote controller shall be connected with 5-wire shielded cable

PART 3 — EXECUTION

3.01 INSTALLATION

A. Install according to manufacturer's requirements, shop drawings, and Contract Documents.

B. Coordinate electrical installation with electrical contractor.

C. Coordinate controls with control contractor.

D. Provide all material required to ensure fully operational and functional heat pumps.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 15.

1.2 SUMMARY

A. Coordinate work of this section with all trades.

B. Work covered in this Section shall be performed after completion of work specified in all Divisions as they related to this work.

C. Review of design drawings and specifications, and comment on potential problem areas.

D. Site inspections of ongoing sheet metal installation with written report from each visit.

E. Air leak testing of ductwork system. See Section 15800.

F. Measurement and setting of all air, and hydronic (closed loop supply and return) water provided or specified in accordance with these contract documents, recording data, making tests, and preparing reports, all as hereinafter specified.

G. Coordinate with all trades to provide all incidental items not indicated on drawings or in specifications that belong to work described or are required for complete systems balancing, at no additional cost to Owner.

H. Refer to paragraph “Closeout Submittals” in Section 15010 - “General Mechanical Provisions.”

1.3 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the Contract and Division 01 specification sections.

B. Agency Data:

1. Submit proof that proposed testing, adjusting, and balancing agency meets the qualifications specified within 30 days of award of contract.

C. Engineer and Technicians Data:

1. Submit proof that Test and Balance Engineer assigned to supervise procedures, and technicians proposed to perform procedures meet qualifications specified within 30 days of award of contract.

D. Procedures and Agenda: Submit synopsis of testing, adjusting, and balancing procedures and

agenda proposed to be used for this project within 90 days of award of contract.

E. Document Review:
1. Submit certification in writing that all design drawings and specifications have been reviewed, and comment on potential problems within 90 days of award of contract.

F. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 01.

G. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of Test and Balance Engineer. Reports shall be certified proof that systems have been tested, adjusted, and balanced in accordance with referenced standards; are an accurate representation of how systems have been installed; are true representation of how systems are operating at completion of testing, adjusting, and balancing procedures; and are accurate record of final quantities measured, to establish normal operating values of the systems. Follow procedures and format specified below:

1. Report Format: Report forms shall be those standard forms prepared by referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with project identification and a title descriptive of contents. Divide contents of binder into divisions listed below, separated by divider tabs:
   a. General Information and Summary
   b. Air Systems
   c. Automatic Temperature Controls
   d. Special Systems
   e. Sound and Vibration Systems
2. Report Contents: Provide following minimum information, forms and data:
   a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Include certification sheet containing seal and name address, telephone number, and signature of Certified Test and Balance Engineer. Include in this division listing of the instrumentations used for the procedures along with proof of calibration.
   b. Remainder of the report shall contain appropriate forms containing as minimum, information indicated on standard report forms prepared by AABC and NEBB, for each respective item and system. Prepare schematic diagram for each item of equipment and system to accompany each respective report form.

H. Final submittal shall include but not be limited to following:

1. List of equipment used to perform test and procedures.
2. Equipment performance data and equipment curves with actual points of performance indicated on curves as compiled during balancing.
3. Air Devices
4. Duct traverse readings during balancing.
5. Room sound power levels where requested by Owner or Architect.
6. On balance report documents record date and time of reading.

1.4 QUALITY ASSURANCE

A. Agency Qualifications:

1. Employ services of independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance the building heating, ventilating and air conditioning systems to produce design objectives. Services shall include checking installations for conformity to design, measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications, and recording and reporting results.
2. Certified by National Environmental Balancing Bureau (NEBB) or by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in State in which services are to be performed, certified by NEBB or AABC as Test and Balance Engineer.

B. Work shall be accomplished in accordance with specifications. Procedures specified shall be followed and, if not specifically described herein, in general, shall be in accordance with Associated Air Balance Council's National Standards or National Environmental Balancing Bureau's Procedural Standards.

C. Design Review

1. Review all design drawings and specifications. Review shall include:
   a. Duct pressure classification
   b. Control device location and balancing devices location in duct systems and piping systems.
   c. Indicate additional balancing devices required for proper balancing.
   d. Specifications on all devices required for balancing.
   e. Note any potential noise problems.
2. Within 90 days of award of contract, meet with the Architect, Mechanical Contractor, and Building Automation System Contractor to review procedures and agenda and comments on design documents as to potential problem areas.

D. Shop Drawing Review

1. Review “Instrumentation and Control for HVAC” shop drawing submittals noting any potential balancing problems. Note comments on submittal, sign, stamp and return to General Contractor. All “Instrumentation and Control for HVAC” submittals must be reviewed by balancing agency prior to review by Architect.

E. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct conference with Architect and representatives of installers of mechanical systems. Objective of conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

F. During construction, balancing agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of heating, ventilating, and air conditioning systems. Inspections shall be performed periodically as work progresses. Minimum of two inspections are required as follows: (1) when 60 percent of ductwork is installed; (2) when 90 percent of equipment is installed. Balancing agency shall submit brief written report of each inspection to Owner and Architect.

G. Standards:

1. Associated Air Balance Council (AABC) Publication:
   a. National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems, Latest Edition.
2. American Society of Heating, Refrigeration and air Conditioning Engineers (ASHRAE) Publications:
   a. "ASHRAE Research Report No. 1162, "Air Flow Measurements at Intake and Discharge Openings and Grilles," ASHVE Transactions, Volume 46.
   b. ASHRAE Handbook of Fundamentals, Latest Edition.
3. American National Standards Institute (ANSI) Publications:
4. National Environmental Balancing Bureau (NEBB)
   a. Procedural Standards for Testing-Balancing- Adjusting of Environmental Systems, Latest Edition.
5. Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA) - Air Duct Leakage Test Manual, Latest Edition.

1.5 OWNER'S INSTRUCTIONS

A. Balancing contractor's technician along with his balancing engineer shall provide to Owner's engineers on balancing methods, procedures and equipment. Record instruction sessions. Provide the owner three copies of the recordings in digital versatile disk (DVD) format.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SYSTEM BALANCE - GENERAL REQUIREMENTS

A. Balance heating, ventilating, and air conditioning to obtain air and water quantities indicated and required for proper operation of system.

B. Field work performed under this Section shall be provided under direct supervision of a Registered Professional Engineer.

C. Furnish services for complete adjustment of water systems and air handling and exhaust systems, water, and air distribution and controls.

D. During all tests, it shall be demonstrated that systems shall be free from leaks and all parts of system will operate correctly. If not, report deficiencies to Contractor and Owner. Balancing Firm shall make final adjustments to equipment as may be required for proper operation, maintaining correct temperatures in all parts of the building. Controls shall be adjusted by "Instrumentation and Control for HVAC" technicians in conjunction with Balancing Firm. Coordinate setpoints and adjustments with "Instrumentation and Control for HVAC."

E. Preliminary Work:

1. Inspect project site prior to starting adjustments to verify completion of trades, including general construction, piping system, ductwork system, building automation systems, and electrical systems, as they relate to balancing work. Verification shall include but not be limited to following:
   a. Ductwork System:
      1) Duct joints sealed.
      2) Witness leakage tests required under sheet metal section.
      3) Dampers and control devices installed.
   b. Proper direction of rotation for motor-driven equipment and for proper

speed on multi-speed motors.
c. Balancing devices are installed and accessible.
d. Control device connections.
e. Note problems in general construction of the building that might effect systems performance such as sealing of windows, building joints, exhaust shafts, etc.
f. Problems discovered during this inspection shall be reported to General Contractor and Owner.

F. Balancing of exhaust systems to achieve air quantities specified at range hood and exterior wall brick vent shown on plans at proper conditions of static pressure and temperature differential.

G. Study and report on excessive noise conditions, which may develop during system balancing. Report shall be sent to Engineer.

3.2 AIR SYSTEM BALANCE

A. In conjunction with "Instrumentation and Control for HVAC", equipment shall be started per design sequence. Determine fan airflow at rated speed. If airflow is not within 10% of design capacity at rated speed, review system conditions, procedures, and recorded data. Check and installed system for any anomalies that would indicate excessive pressure loss or leakage. Resolve problems with appropriate contractor. If systems are properly operating, and airflow is still unacceptable, adjust fan drive in accordance with manufacturer's recommendations to obtain proper airflow and static pressure. Systems shall be balanced and operated at lowest feasible static pressure with allowance for filter loading. Record fan suction pressure, fan discharge pressure, amperage and airflow measurement. Correct fan curves to indicate new points of balance. Fan motor shall not be overloaded.

B. Perform following tests and compile following information:

1. Range Hood Equipment
   a. Design Conditions
      1) Exhaust Airflow
      2) Static and Total Pressure
      3) Motor rating
      4) Fan speed
      5) Outlet Velocity
   b. Installed Equipment
      1) Manufacturer
      2) Motor serial number
      3) Motor type and efficiency, rating, voltage, phase, full-load amperes.
   c. Field Test
      1) Fan speed
      2) No-load operating amperes
      3) Fan motor operating amperes
      4) Calculated motor output
   d. Test for Total Air
      1) Sum of exhaust ducts.
      2) Number and locations of velocity readings taken.
      3) Duct average velocity
      4) Total airflow
   e. Test system for minimum and maximum exhaust airflow. Provide fan operating information in the final report.

3.3 ACOUSTICS AND NOISE CRITERIA

A. Verify that mechanical systems comply with noise criteria as specified and indicated in Division 15. Where compliance is questionable or where requested by Owner, Architect or Contractor, take sound power level reading and record. Diagnose equipment causing deviations and report deviations to appropriate trade contractor and Contractor. Resolve noise problems with Contractor and appropriate Installer.

3.4 CALIBRATION

A. During testing and balancing, inspect temperature sensors, pressure sensors, humidity gauges, digital indicators, and thermometers, provided under Division 15. Report discrepancies to the Contractor for replacement or recalibration.

3.5 RE-BALANCE

A. After Engineer's review of test and balance report submittal, make adjustment in any balancing point as required by Engineer, to correct discrepancies between balance report and design, at no additional cost.

3.6 FINAL BALANCE

A. Visit site within one year after building occupancy, if necessary, to adjust and rebalance to resolve any and all Owner complaints. After final balance, revise previous submittal and resubmit to Engineer for record purpose. Rebalance and resubmittals shall be done at no additional cost to Owner.

END OF SECTION

SECTION 15995
FIRE PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

1.02 DESCRIPTION OF WORK

A. This section includes the providing and installing of all materials, equipment and incidentals necessary and/or required for a complete installation of an Automatic Fire Sprinkler System as specified herein.

B. The extent of the fire protection work required shall be as follows: It is shall be the responsibility of the awarded contractor to provide system layout documents, shop drawings, hydraulic calculations, and other drawings, cut sheets, and submittal data required to complete the package as required by the building department and the AHJ (Authority Having Jurisdiction). These items (and any other requested supplementary data) signed and sealed by the engineer shall be submitted to the architect for a peer review prior to the submission to the aforementioned authorities. The peer review shall be by the registered professional engineer of the architect's choice. These reviewed and approved documents shall be submitted by the contractor to the appropriate authorities for permits and inspections as required. The person signing and sealing these documents shall be a Florida registered professional engineer in good standing with the board, compliant with all current requirements to practice engineering in the state of Florida. The contractor shall provide and install the system described in the architect approved drawings which shall also be in compliance with this specification.

C. Fire protection work shall include, but not limited to the following:

1. A backflow prevention device of the type approved by Public Utility. Sized by hydraulic calculation of system. General contractor shall provide concrete pad at grade for backflow prevention device. The pressure drop across this device shall not exceed 8 PSI at the design sprinkler flow or 12 PSI at 150% of the rated fire pump capacity (if required).
2. Excavation, trenching, backfill compaction and other associated materials and processes associated with proper burial of fire protection system piping.
3. Connection to city water main and associated underground piping to connect backflow preventer and system risers. As verified by hydraulic calculation.
4. A system riser or risers as described in the NFPA chapter 13 including pressure gauges, test and drain valve, check valve, and control valve(s), drain riser. As sized by hydraulic calculation.
5. A standpipe system executed and installed in accordance with the provisions of NFPA 14 (class 1, wet, automatic design) with 2 ½" hose connections provided with reducer couplings (1 ½") and caps. Reducers and caps shall be chained or otherwise permanently secured to the standpipe.
6. Fire department connections shall be provided for charging standpipes and the automatic sprinkler system.
7. Inspectors test stations and system drains as required to complete the system.

8. Associated main, cross main, branch, and other piping and fittings as sized by hydraulic calculation.
9. Sprinkler heads listed and approved for installation as will be indicated in the layout documents.
10. Thrust blocks, hangers, riser clamps, couplings, clamps, strapping, restraints, nipples, hose connections, nails, screws, bolts, nuts, inserts, rods, etc. as required to complete the system.
11. The calculated water velocity shall not exceed 20 feet per second in any segment of the designed system.

D. The following is not considered part of this Section
1. Wiring of flow switches and valve switches.
2. Fire extinguishers and cabinets.

1.03 DESIGN CRITERIA

A. System shall be designed in accordance with NFPA 1, 13, 13D, 13R, 14, 20, 24, 25, 101, 101A and 241. System shall also conform to all State and local requirements, including the Florida Fire Prevention Act.

B. System shall include all materials, piping, sprinklers, flow switches, tamper switches, control panels and other devices and appurtenances required and necessary to provide a 100% fire sprinklered building in accordance with NFPA 13.

1.04 QUALITY ASSURANCE

A. System conforming to Design Criteria in paragraph 1.02 above.

B. Manufacturers of Major Components: Company specialized in manufacturing of types of fire protection equipment and materials required for this Project and with minimum ten years documented experience.

C. Inspections: Comply with NFPA and local regulatory agencies.

1.05 WARRANTY

A. Submit under provisions of Section 01701.

B. Warranty: Include one year coverage for materials and workmanship.

1.06 CODES AND STANDARDS

A. Install fire protection systems in accordance with the following National Fire Protection Associations Standards:
1. NFPA 1 – Uniform Fire Code
2. NFPA 13 – Standard for the Installation of Sprinkler Systems
3. NFPA 13R – Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and including 4 Stories
4. NFPA 14 – Standard for the Installation of Standpipes and Hose Systems
5. NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection
6. NFPA 24 – Standard for the Installation of Private Fire Service Mains and their Appurtenances

7. NFPA 25 – Standard for the Inspection, Testing, and maintenance of Water Based Fire Protection Systems
8. NFPA 101 – Life Safety Code
9. NFPA 101A – Guide on Alternative Approaches to Life Safety
10. NFPA 241 – Standard for Safeguarding Construction, Alteration and Demolition Operations

B. Provide fire protection products which have U.L. listing or are listed in the "Factory Mutual Approval Guide." Preferred products shall be both U.L. and F.M. approved and listed.

C. Comply with Fire Department regulations for sizes hose threads and arrangement of connections for fire department equipment to standpipe fire department valves roof manifolds and siamese fire department connections and NFPA.

1.07 SUBMITTALS

A. Submit manufacturer's technical product data and installation instructions for protection materials and products.

B. Submit shop drawings, including all information as required by NFPA and other agencies to the local authority having jurisdiction for approval. Submit two (2) approved copies, bearing stamp of the local authority having jurisdiction before proceeding with fabrication and installation.

C. Submit "Contractor's Covering Materials and Installation" upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13, and NFPA 24 and also that system is operational, complete and has no defects.

D. At project closeout, submit record drawings of installed fire protection piping and products, in accordance with requirements of Section 01720.

E. Submit maintenance data and parts list for fire protection materials and products. Include this data, product data, shop drawings, approval drawings, approved calculations, certificate of installation and record drawings in maintenance manual, in accordance with requirements of Section 01730.

1.08 WATER SUPPLY

A. Flow test(s) shall be obtained in accordance with NFPA approved methodology from an approved source as directed by the Fire Marshal. This data shall be used in system design and hydraulic calculation.

B. Maximum allowable velocity in sprinkler system piping shall be 20 feet per second.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities to comply with installation requirements.

B. All materials and products shall be new and UL or FM listed for fire protection use.

C. Provide proper and appropriate identification signs and markings for piping, standpipe and riser control valves, inspector's test, drains and other necessary locations per NFPA except otherwise required.

2.02 MATERIALS

A. Piping

1. Piping 1″ to 2″ shall be schedule 40 black steel, ASTM specifications A53, A120 or A135.
2. Piping 2-1/2″ and larger shall be Schedule 10 black steel, ASTM specifications A53, A120 or A135.
3. All exposed piping shall be galvanized. Galvanized painting not acceptable.

B. Fittings

1. All fittings 2″ and smaller to be cast iron screwed.
2. All fittings 2-1/2″ and larger to be mechanical grooved couplings, Victaulic or equal.
3. All exposed fittings to be galvanized. Galvanized painting not acceptable.
4. Victaulic-FireLock™ Flange Adapter Style 744 - 2"-8" (DN50-DN200) for connection to ANSI CL 125 or CL 150 flanged components.
5. Victaulic Fire Protection Fittings
   a. Fittings for Grooved End Steel Pipe - Shall be cast of ductile iron conforming to ASTM A-395, Grade 65-45-15, and ASTM A-536, Grade 65-45-12, with grooved or shouldered ends for direct connection into grooved piping systems with steel pipe - prepared as in 2.03.B.1. Fittings may be standard dimension ductile iron/steel or FireLock™ type.
   b. Branch Outlets - Shall be made from Victaulic Style 920 and 920N Mechanical T's or Style 922 FireLock Outlet-T's with locating collar engaging into hole or equivalent. Grade "E" standard pressure-responsive gasket and zinc electroplated bolts/nuts. (Specify outlet/branch connection type - grooved, or female threaded, as available.) 2-1/2"-6" (DN65-DN150) No. 10 DR 90 degree elbow optional.
   c. Fittings for Plain End Schedule 10 through 40 and Specialty (Non-Schedule) Steel Pipe - Shall be Victaulic FIT® fittings sizes 1"-2" (DN25-DN50) with self-contained Grade "E" standard gaskets, internal pipe stop for uniform takeoff dimensions, plated 1/4-turn positive locking lugs of heat treated carbon steel with externally visible locked position indicator for easy inspection of plain end steel pipe connections prepared as in 2.03.B.1. FIT® products to be used in dry systems and all systems operating below 0 degrees F (-18 degrees C) shall have Grade "L" silicon gaskets.
   d. Reducing Outlet Tees - Shall be Victaulic FIT® Style 96 or equivalent with female threaded outlet. Specify ½″ (DN15), 3/4" (DN20) or 1" (DN25) outlet for direct sprinkler head, sprig, or drop nipple connections.

e. Reducing Run and Outlet Tees - Shall be Victaulic FIT® Style 969 or equivalent with female threaded outlet. Specify ½" (DN15), 3/4" (DN20), or 1" (DN25) outlet for direct sprinkler head, sprig or drop nipple connections.

f. 90 Degree Elbows - Shall be Victaulic FIT® Style 961 or equivalent.

g. FIT Outlet/Mechanical-T® - Shall be Victaulic FIT® Style 929 or equivalent with FIT® locking lug branch outlet. Specify 1-1/4" (DN32), 1-1/2" (DN40) or 2" (DN50) outlet for direct branch connections. May also be utilized for a cross connection.

h. Straight Tee - Shall be Victaulic FIT® Style 963 or equivalent with FIT® locking lug on all three outlets.

i. Coupling - Shall be Victaulic FIT® Style 960 or equivalent.

j. Reducing Elbows - Shall be Victaulic Style 966 or equivalent with female threaded reduction (specify ½" (DN15), 3/4" (DN20) or 1" (DN25) outlet) for direct sprinkler head, sprigs, or drop nipple.

C. Hangers: Type listed for fire protection use. All exposed hanger material to be corrosion resistant.

D. Valves: Self-indicating type, listed for fire protection use; Mueller or equal.

E Flow Switches and Tamper Switches – Notifier or equal.

F. Sprinklers – Central, Reliable, Viking.

1. Concealed sprinkler heads shall be used wherever possible throughout the finished spaces of this project. Cover plate color or chrome finish shall be approved in writing by the architect prior to purchase or installation of sprinkler units. Semi-recessed heads shall be the secondary choice for all finished spaces. Submit to architect for approval any and all sprinkler head colors and escutcheon finishes prior to purchase or installation.

2. Unfinished areas shall be permitted to be protected by rough finish brass sprinkler heads. Note all sprinklers in unconditioned spaces shall be provided with corrosion protection equivalent to wax or polyester coating.

3. Unfinished Ceilings – Brass upright.

4. Sprinkler Heads - Shall be Victaulic Model V, Underwriters Laboratories Listed (Canada and USA), with frame of die cast brass, Teflon encapsulated Belleville spring seal, and frangible glass bulb. The glass bulbs are available in standard and quick response with various temperature ratings according to application requirement.

a. Standard Commercial - For light and ordinary hazards, Quick response, in upright, pendent, recessed pendent, horizontal sidewall, or recessed horizontal sidewall configurations.
Standard Orifice (K = 5.6)
Large Orifice (K = 8.0)

b. Residential - Quick response, in pendent, recessed pendent, horizontal sidewall, recessed horizontal sidewall, adjustable flush pendent, low flow concealed pendent.

G. Fire Department Connection – Rough Brass Finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The fire protection system shall include all NFPA specified accessories including signs, test connections and drains.

B. Comply with requirements of NFPA 13 and NFPA 24 for installation of fire protection piping materials. Install piping products where indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that piping systems comply with requirements and serve intended purposes.

C. Coordinate with other work, including plumbing piping, as necessary to interface components of fire protection piping properly with other work.

3.02 TESTING

A. Hydrostatic Testing: After flushing system, test fire sprinkler piping hydrostatically, for a period of 2 hours, at not less than 200 psi. Check system for leakage at joints. Measure hydrostatic pressure at low point of each system or zone being tested. Any drop in pressure will not be permitted.

B. Repair or replace piping systems as required to eliminate leakage in accordance with NFPA standards and retest as specified to demonstrate compliance and to satisfaction of the Engineer and Owner.

END OF SECTION

SECTION 16010
SUPPLEMENTARY GENERAL CONDITIONS

PART 1 - GENERAL

1.01 RELATED WORK

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

1.02 QUALITY ASSURANCE

A. Supervisory Qualifications: The electrical work on the project shall be under the direct supervision of a licensed Journeyman.

B. Qualifications of Installers:

1. For the actual fabrication, installation, and testing of the work of this section, uses only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the installation recommendations of the manufacturers of the specified items.
2. In acceptance or rejection of installed electrical systems, no allowance will be made for lack of skill on the part of the installers.

1.03 DRAWINGS

A. The intent of the drawings and specifications is to obtain a complete and satisfactory installation. An attempt to separate and completely define the work of Division 16000 has been made. Separate divisional drawings and specifications shall not relieve the Electrical Contractor from full compliance of the work of his trade indicated on any drawings or in any section of the specifications.

B. Examine all drawings and specifications carefully prior to submitting a bid. The Electrical Contractor will be required to install, and/or connect with appropriate services all items or equipment furnished by others as shown on any of the drawings without additional expense to the owner.

C. Architectural drawings take precedence over Mechanical or Electrical drawings with reference to building construction. Mechanical and Electrical drawings are diagrammatic, but shall be followed as closely as actual building construction and work of other trades permit.

D. Changes from drawings necessary to make the work of the electrical contractor conform to the building as constructed, or to fit work of other trades, or to comply with the rules of bodies having jurisdiction, shall be made by the Electrical Contractor at his own expense.

E. Field coordinate with other trades in ample time to build all chases and openings, set all sleeves, inserts and concealed materials and provide clearances that may be required.

F. The term, “provide” used in this Section of the specifications, shall include all labor, materials and equipment necessary to install any item or system indicated on either plans or specifications, including items called for, implied or normally part of the equipment or system. The finished installation shall be complete and fully operational before final acceptance.

G. The Architect or Engineer reserves the right to make any reasonable changes (approximately six feet) in the location of outlets, fixtures, switches, receptacles, or equipment prior to the rough-in of such without any additional cost to the Owner.

H. The Electrical Contractor is responsible for and shall pay for all access panels required in the architectural finishes or surfaces to provide access to the junction and pull boxes, ballasts, terminal cabinets or other devices provided and located by the Electrical Contractor. The access panel shall be installed by the trade constructing the base to which the access panel will be installed.

I. The Electrical Contractor is responsible for design, fabrication and erection of all supplementary structural framing required for attachment of hangers or other devices to support electrical equipment.

1. Framing members shall be designed for their actual loads, with allowable stresses set forth in AISC specifications and the AISC code, without excessive deflection and with consideration for rigidity under vibration. Supplementary framing, including design loads, member size and location shall be clearly shown on shop drawings for construction of supplementary framing.
2. No cutting or drilling of holes in structural member will be permitted, except where written permission has been obtained from the Architect.

1.04 EXPLANATION TO BIDDERS

A. No oral explanations in regard to the meaning of drawings and specifications will be made and no oral instructions will be given before the award of the contract. Discrepancies, omissions or doubts, as to the meaning of drawings and specifications, should be communicated in writing to the Engineer for interpretation. Bidders should act promptly and allow sufficient time for a reply to reach them before the submission of their bids. Any interpretation made by the Engineer will be in the form of an addendum to the specifications, which will be forwarded to all bidders. Receipt of the addendum shall be acknowledged by the bidder on his bid form.

1.05 BID REQUIREMENTS

A. Before submitting his proposal, the bidder is required to visit the site of the proposed work and familiarize himself with the nature and extent of the work and any local conditions that may, in any manner, affect the work to be done or the equipment, materials and labor required, He is also required to carefully examine the plans and specifications and to inform himself thoroughly regarding any and all conditions and requirements that may, in any manner, affect the work to be performed under the contract. Ignorance on the part of the Contractor will in no way relieve him of the obligations and responsibilities assumed under the contract.

B. In assembling his bid, the Contractor shall assemble a price based on these specifications and drawings as shown, and with all materials and equipment exactly as specified. This figure shall be known as the "Base Bid". All prices must have this base bid clearly stated to be considered. Alternate equipment may be quoted as an "add" or "deduct" item from the base bid in accordance with the specifications on substitutions.

C. If asked, the Contractors bidding on this project shall show evidence of having recently completed a similar job of like size and complexity. If the low bid contractor does not have sufficient financial resource, skilled labor, technical competence, or experience, he shall be not awarded the contract.

1.06 SUBSTITUTIONS

A. Each bidder represents that his bid is based upon the materials and equipment described in this Division of the specifications.

1. No substitutions will be considered unless a written request has been submitted to the Architect for approval twenty days prior to receipt of bids. Substitutions requested after that date will receive no consideration. Submittal shall include the name of the materials or equipment for which it is to be substituted, substituted equipment model numbers, drawings, cuts, performance and test data and any other data or information necessary for the Architect to determine that the equipment meets all specifications and requirements. If the Architect approves any proposed substitutions, such approval will be set forth in writing.
2. Substituted equipment with all accessories installed or optional equipment where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Contractor's expense. Any modifications of related systems of this or other trades as a result of substitutions shall be made at the Contractor's expense and Contractor shall so state in his written request for substitution.
3. Approved equal manufacturers or products may be provided elsewhere in these specifications and drawings. These are manufacturers or items which are known to be functionally equivalent to basis of design manufacturers and equipment. These alternatives are provided to produce a competitive bidding yielding a better value for the consumer. These items may and often do vary in specific characteristics, connections, and required services. The contractor remains liable and responsible for all coordination of other related systems, equipment, services, etc. There are a number of possible ramifications from utilizing other than the design basis equipment outside of changes to connection sizes and styles. These changes will need to be performed by the electrical and other contractors or they will need to contract with the engineer(s) of record to provide new coordinated drawings. All of these associated costs for utilizing equipment not selected on drawings as basis of design are to be borne by the contractor.

1.07 BID ALLOWANCES

A. Provide allowances in Electrical subcontract bid as may be directed to provide and install the quantity of fixtures of type noted in the luminaire schedule at the unit material cost indicated, or for other items requested.

1.08 SUBMITTALS

A. Submit items for this Division as follows:

1. Submit all Division 16000 submittals per section at one time and in one integral group. Piece-by-piece submission of individual items will not be acceptable. The Architect/Engineer may check the contents of each submittal set upon initial delivery and if not complete as set forth herein, submittal sets may be returned to the Contractor without review and may not be accepted until made complete.
2. Any delays arising directly or indirectly from deliverance of submittals in a timely manner shall be the Contractor's responsibility. Allow ten (10) working days from date of receipt for Architect/Engineer's review.

B. Submittal items shall include materials, apparatus and equipment as indicated under each Section of this Division and in compliance with the General Conditions.

C. Shop drawings shall include sufficient information to indicate compliance with specifications. Data shall include illustrations, catalog sheets, drawings and certifications. Each sheet shall show the manufacturer's name or trademark.

D. At the time of each submission, the Contractor shall call the Architect/Engineer's attention to any deviations from the Contract Documents and shall plainly mark the deviations on the shop drawings.

E. Manufacturer's Names and Catalog Numbers: In some instances, specific references have been made to one or more manufacturers' name and catalog numbers. It should be noted that such use does not indicate that the material and equipment specified is necessarily an "off the shelf" item. Variances may be due to the requirement of a desired finish, material or other modification. The Electrical Contractor shall ascertain that such modifications are fully considered.

F. Submittal cover sheet shall bear the stamp of the General Contractor indicating the review of the submittal contents to meet the intent of the construction documents.

1.09 FAMILIARITY WITH LAWS AND CODES

A. The bidder is assumed to be familiar with all Federal, State and Local laws, ordinances, rules and regulations that in any manner affect the work. Ignorance on the part of the bidder will in no way relieve the bidder from responsibility to meet these requirements.

1.10 ORDINANCES AND REGULATIONS

A. All work shall conform with all Federal, State and Local laws, ordinances or regulations governing the installation of the specified equipment. If the work as laid out, indicated or specified is contrary to or conflicts with local laws, ordinances or regulations, the Contractor shall report these conflicts to the Architect/Engineer before submitting a bid. The Architect/Engineer will then issue instructions to all bidders to clarify the conflict.

B. If the Contractor fails to notify the Architect/Engineer of conflicts or omissions as noted above, all changes required to comply with local ordinances and regulations shall be made without additional expense to the Owner.

1.11 PERMITS AND FEES

A. The Electrical Contractor shall obtain all necessary permits and inspections required for the electrical portion of the work and shall pay all charges incidental thereto.

B. The Electrical Contractor shall deliver to the Architect/Engineer all certificates of inspection issued by Authorities Having Jurisdiction

1.12 CODES AND INSPECTIONS

A. The installation shall comply with all laws applicable to the electrical installations, which are enforced by the authority having jurisdiction. The codes applicable to this project are shown on the architectural documents.

B. In any specific case where different sections of any aforementioned codes or these plans and specifications specify different materials, methods of construction or other requirements, the most restrictive shall govern. In the case of any conflict between a general provision and a special provision, the special provision shall govern.

C. All materials shall be listed by a nationally recognized testing laboratory, as conforming to its standards, where such a standard has been established for the particular type of material in question.

D. Where Contract Document requirements are in excess of code requirements and are permitted under the code, the Contract Documents will govern.

1.13 SINGULAR AND PLURAL REFERENCES

A. Singular references in specifications shall not be construed as requiring one (1) device if multiple devices are indicated on the drawings.

1.14 MATERIALS

A. Materials and equipment shall be new and in good condition. The commercially standard items of equipment and the specific names mentioned herein are intended to fix the standards of quality and performance necessary for the proper functioning of the electrical work.

B. Since manufacturing methods vary, reasonable minor equipment variations are expected. However, performance and material requirements for the specified equipment are the minimum acceptable standards. The Architect/Engineer retains the right to judge equality of equipment that deviates from the specifications.

1.15 IDENTIFICATION OF EQUIPMENT

A. All electrical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic with letters at least 3/8" high.

B. Nameplate designations shall correspond to the identifications on the “record drawings”.

C. Refer also to Specification Sections 16160 for additional nameplate requirements.

1.16 OPERATING AND MAINTENANCE BOOKS

A. The Electrical Contractor shall provide the Owner’s Representative with operating instructions and maintenance data books for all equipment and materials furnished under this division. Provide Engineer with receipt of transfer to Owner.

B. The Electrical Contractor shall submit to the Architect/Engineer, final competition before final inspection, an electronic copy of operating and maintenance data in a single PDF file for review. All data shall be assembled and completely indexed into one volume and shall identify the size, model, and features indicated for each item.

C. The following information shall be included where applicable:
1. Identifying name and mark number
2. Locations (Where several similar items are used, provide a list.)
3. Complete nameplate data
4. Certified record drawings and shop drawings

5. Parts lists
6. Wiring diagrams
7. Manufacturers' operating and maintenance instructions, with all non-applicable information deleted.
8. Equipment warranties.

1.17 DATE OF COMPLETION AND TESTING OF MECHANICAL/ELECTRICAL SYSTEMS

A. The date for all the final acceptance tests by the Engineer shall be sufficiently in advance of the contract completion date to permit the execution of any adjustments and/or alterations which the final acceptance tests indicate as necessary for the proper functioning of all equipment. Any such modifications shall be completed within the number of days allotted for completion of the contract. Re-tests shall not relieve the Contractor for this Division of his contract completion date responsibility.

1.18 GUARANTEE AND SERVICE

A. In addition to the guarantee of equipment by the manufacturer of each piece of equipment specified herein, the Electrical Contractor shall also guarantee such equipment and shall be held for a period of one (1) year from final acceptance test for necessary adjustments and/or replacements of all defective equipment, and materials and workmanship without expense to the Owner.

B. The Contractor shall furnish maintenance and service for one (1) year from final acceptance of the contract for all portions of the system. Such service for the one year period includes the following:

1. Necessary adjustment and/or replacement of all defective equipment and materials furnished.

C. Service and replacement of light bulbs shall be limited to thirty days after final acceptance of the job.

D. Upon expiration of each of these limits noted herein, the maintenance, including labor and material costs, shall be at the Owner's expense.

1.19 ACCEPTANCE

A. As a precedent to requesting a final inspection and release of retained monies, the Electrical Contractor shall:

1. Complete all work required under the electrical section of the specifications.
2. Submit four (4) certified copies of final test data to the Architect/Engineer.
3. Furnish a complete set of "as built" reproducible tracings of the Contractor's work to the Architect/Engineer.
4. Submit four (4) copies of operating and maintenance books to the Architect/ Engineer.
5. Provide resolution to all issues noted on Engineers' Field Reports and Final Punch lists.
6. Provide all copies of certificates of inspection issued by Authorities Having Jurisdiction.

END OF SECTION

SECTION 16110
RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The General Provisions of the contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. Refer to Supplementary General Conditions.

1.02 DESCRIPTION OF WORK

A. The work included under this Section of these specifications consists of furnishing all materials and equipment and performing all labor and services necessary for the complete installation of the system of conduits for power and lighting service, including all related system and accessories as shown by the drawings and herein after specified.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metallic conduit.

C. ENT: Electrical non-metallic tubing.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquid-tight flexible metal conduit.

G. LFNC: Liquid-tight flexible nonmetallic conduit.

H. RNC: Rigid non-metallic conduit.

PART 2 - PRODUCTS

2.01 BUSHINGS, LOCKNUTS AND CONNECTORS

A. Where rigid conduit enters a box of any description, the conduit shall be secured to the box with a locknut on the outside and a similar nut and bushings on the inside.

B. Where electric metallic tubing enters such boxes, the connection between the connector and the box shall be made tight by an approved manner both on the inside and the outside of the box.

C. Conduit terminations at the boxes shall be provided with bushings. Bushings for conductors through #8 AWG shall be galvanized, non-insulating type; for #6 AWG and larger conductors, bushings shall be insulated and selected for the size conduit involved.

2.02 CONDUIT

A. Manufacturers:

1. Allied Tube & Conduit
2. AFC Cable Systems, Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney, Unit of General Signal
9. Wheatland Tube Co.

B. All conduit installed in concrete floor slabs shall be Underwriter's approved hot-dipped rigid galvanized steel conduit or Schedule 40 PVC conduit.

C. All conduit installed underground shall be Schedule 40 rigid polyvinyl chloride (PVC) or hot-dipped rigid galvanized steel conduit coated with an asphaltum paint approved by the Architect.

D. All conduit installed exposed in exterior areas above finished grade shall be Underwriter's approved rigid hot-dipped galvanized steel. Conduit installed exposed in interior areas above finished floor shall be Underwriter's approved hot-dipped rigid galvanized steel or electrical metallic tubing, unless otherwise noted on the drawings.

E. All conduit installed in or above ceilings or stud partitions shall be electrical metallic tubing.

F. PVC Schedule 40 conduit shall not be used above grade or within the bulding anywhere on the project.

G. Electrical Metallic Tubing: All electrical metallic tubing shall be galvanized and conform to all pertinent requirements of the National Electrical Code.

H. All flexible metallic conduit installed in wet or damp locations shall be liquid-tight (PVC extruded cover) and all installations in dry locations shall be flexible steel conduit (no cover), unless specifically noted otherwise.

I. PVC Conduit: All polyvinyl chloride conduit shall be heavy-wall Schedule 40, with factory made bends, couplings and fittings.

J. Connectors and Couplings: For electrical metallic tubing, compression, galvanized steel, or set screw type fittings shall be used. For rigid steel conduit, threaded couplings and locknuts and bushings shall be used. For PVC, PVC couplings and fittings shall be used. Where PVC underground conduit connects to steel conduit, suitable threaded conduit adapter fittings shall be used. For flexible conduit, liquid-tight fittings shall be used with liquid-tight flexible conduit and compression fittings shall be used with flexible steel conduit

K. Conduit serving patient care/occupied areas shall be rigid galvanized steel or electrical metallic tubing. Patient care/occupied areas shall include, but not be limited to, the following: physical therapy rooms, patient rooms, patient toilet rooms, dining areas and similar areas that may be used as an area of refuge.

PART 3 - EXECUTION

3.01 INSPECTION

A. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Verify the electrical installation may be made in complete accordance with all pertinent codes and regulations and the original design.

3.02 DISCREPANCIES

A. In the event of discrepancy, immediately notify the Architect/Engineer.

B. Do not proceed with the installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.03 PREPARATION

A. Coordinate the installation of electrical items with the work schedules of other trades to prevent unnecessary delays in the total work.

B. Do not proceed with the installation in areas where there is any discrepancy until all such discrepancies have been fully resolved.

3.04 INSTALLATION OF RACEWAYS AND FITTINGS

A. All conduit penetrating a fire or smoke wall shall be sealed with an approved firestop material to preserve the rating of the firewall.

B. All conduit shall be concealed unless otherwise shown on the drawings. Concealed conduit run above the ceiling shall be supported from the roof structure, i.e., roof trusses, bar joints and shall be totally independent from ceiling and/or rated membrane construction. Where a ceiling of the lay-in type is used, the conduit must be installed high enough to permit removal of ceiling panels.

C. Exposed conduit shall be run parallel with or at right angles to the building walls and supported from the walls or ceilings with straps or clamps secured with wood screws for wood construction, machine screws for metal construction, and expansion anchors with bolts for masonry or concrete slab construction, All exposed conduit runs shall be subject to approval.

D. Conduit shall be continuous from outlet to outlet and from outlet to cabinet, junction or pull box. Conduits shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets.

E. Approved Appleton, Crouse-Hinds, or O.Z. Manufacturing Company expansion fittings shall be installed in all rigid conduit and EMT runs, where such conduit runs extend across expansion joints in the building.

F. No conduit shall be trapped except where shown on the drawings.

G. At rigid steel couplings, conduits shall be threaded so that they meet in the coupling. Right and left couplings shall not be used. Conduit couplings of the Erickson type shall be used at locations requiring such joints.

H. Conduit shall be secured in place and protected to prevent damage to work during construction. The ends of all conduit runs shall be plugged to avoid filling with plaster, etc. All conduit shall be blown out and/or swabbed clear of water and trash prior to pulling wire.

I. Flexible conduit shall be used only where indicated on the drawings, or where specified otherwise.

J. Conduit connections from outlet boxes, junction boxes, conduit, switch boxes, or motor controller to rotating or vibrating machinery or equipment shall be made with flexible conduit which shall be as short as possible with a maximum length of 36 inches.

K. Conduit connections from outlet boxes to recessed lighting fixtures shall be made with 3/8" flexible conduit which shall have a maximum length of 72 inches, unless otherwise noted.

L. Where underground PVC conduit turns up to run above grade, the elbow and all conduit from the elbow up shall be rigid galvanized steel. Where the PVC conduit is encased in concrete, the transition to steel conduit shall be made within the concrete casing.

M. All telephone conduit routed to the telephone terminal wood backboard shall be terminated with an end bushing within six (6) inches of the edge of the backboard.

N. All conduit penetrating a fire or smoke wall shall be sealed with an approved firestop material to preserve the rating of the firewall.

S. All boxes and enclosures including conduits for emergency circuits shall be spot painted so that they will be readily identified as a component of an emergency circuit. Colors to be as follows:

Yellow	-	Life Safety Branch
Orange	-	Critical Branch
Green	-	Equipment Branch
Red	-	Fire Alarm System
Purple	-	Other Emergency System wiring not covered above (generator feeders, transfer switches, etc.)

T. All metal feeder raceways associated with essential system shall have terminations equipped with grounding bushings in accordance with NEC 517-19.

END OF SECTION

SECTION 16120
CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

B. Refer to Supplementary General Conditions.

C. Refer to Raceways.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction, current edition, including all revisions; National Electrical Contractors Association.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 83 - Thermoplastic-Insulated Wires and Cables, current edition, including all revisions.

D. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

E. UL 486C - Splicing Wire Connectors, current edition, including all revisions; Underwriters Laboratories.

F. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables, current edition, including all revisions; Underwriters Laboratories.

G. UL 1569 - Metal-Clad Cables, current edition, including all revisions; Underwriters Laboratories.

H. ASTM B 3 - Standard Specification for Soft or Annealed Copper Wire, latest edition; American Society for Testing and Materials.

I. ASTM B 8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, latest edition; American Society for Testing and Materials.

J. ASTM B 787/B 787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation, latest edition; American Society for Testing and Materials.

1.03 DESCRIPTION OF WORK

A. The work included under this Section of these specifications consists of furnishing all materials and equipment and performing all labor and service necessary for the complete installation of the system of conductors for power and lighting service, including all related raceways, devices, systems and accessories as shown by the drawings and herein after specified.

B. Commencement of work signifies this Installer's acceptance of existing conditions. In the acceptance or rejection of the finished installation, no allowance shall be made for lack of workmen skill.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Cerro Wire LLC: www.cerrowire.com.

B. Industrial Wire & Cable, Inc: www.iewc.com.

C. Southwire Company: www.southwire.com.

D. Alcan Aluminum Corporation; Alcan Cable Div.: www.alcan.com.

E. American Insulated Wire Corp.; a Leviton Company: www.aiwc.com.

F. General Cable Corporation: www.generalcable.com.

2.02 MATERIALS

A. Provide products that comply with requirements of NFPA 70 and that are listed and classified by Underwriters Laboratories (UL) as suitable for the purpose indicated.

B. All conductors #2 AWG and smaller shall be soft-drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B 3, ASTM B 8, or ASTM B 787/B 787M, with 600 volt insulation.

1. Conductors #1 AWG and larger shall be permitted to be electrical grade compacted aluminum with 600 volt insulation, unless noted otherwise.
2. Terminate aluminum conductors with tin-plated aluminum-bodied compression connectors. Fill connector body with anti- oxidant compound before installing conductor.

C. Conductors and conduit sizes specified are based on copper AWG up to 4/0 and circular mils above 4/0.

1. Conductor sizes 10 AWG and smaller shall be solid; Conductors #8 AWG and larger shall be stranded.
2. Stranded conductors may only be terminated with UL or ETL Listed type terminations or methods. Stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.
3. Conductors #6 and smaller shall be NEC standard dual rated Type THWN or THW thermoplastic, approved for operation at 75 degrees Celsius in dry and wet locations and 90 degrees Celsius within electric discharge lighting equipment as permitted in NEC 410.
4. Use only building wire with Type THWN insulation in raceway or service-entrance cable.
5. Conductors #4 and larger shall be NEC Standard rated Type THWN approved for operation at 75 degrees Celsius in dry and wet locations.

2.03 ALUMINUM CONDUCTORS

A. The following requirements shall be met when Aluminum conductors are utilized:

1. Aluminum alloy conductors shall be compact stranded conductors of a recognized Aluminum Association 8000 Series aluminum alloy conductor material (AA-8000 series alloy).
2. It is the responsibility of the contractor to increase the size of the conduit, wire gutter, or enclosure, if necessary, to accommodate the aluminum conductors and meet allowable code requirements.
3. It is the responsibility of the contractor to increase the size of the aluminum conductor to match the ampacity of the copper conductor circuit shown on the Drawings.
4. The contractor shall submit a feeder schedule to the Engineer for all conductor substitutions indicating the aluminum conductor wire size and the conduit size. The contractor shall not begin the installation until written approval is granted by the Engineer.
5. All aluminum conductors shall terminate on a mechanical screw-type connector or mechanical compression-type connector. Connector shall be dual rated (AL7CU or AL9CU) and Listed by UL for use with aluminum and copper conductors, and sized to accept aluminum conductors of the required ampacity. When using compression-type connectors, the lugs shall be marked with wire size, die index, number and location of crimps and shall be suitably color-coded. Using a suitable stripping tool, remove insulation from the required length of the conductor. Wire brush the conductor and apply a listed joint compound. Tighten or crimp the connection per the connector manufacturer's recommendation. Wipe off any excess joint compound.
6. When terminating aluminum conductors to aluminum bus, prepare a mechanical screw-type or compression-type connection. Bolts shall be anodized alloy and conform to current ANSI and ASTM chemical and mechanical property limits. Nuts shall be aluminum alloy and conform to current ANSI standards. Washers shall be flat aluminum alloy, Type A plain, standard wide series conforming to current ANSI standards. Lubricate and tighten the hardware per manufacturer's recommendations.
7. When terminating aluminum conductors to copper bus, prepare a mechanical screw-type or compression-type connection. Bolts shall be plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to current ASTM standard or SAE grade 5. Nuts shall conform to current ANSI standards. Washers shall be steel, Type A plain, standard wide series conforming to current ANSI standards. Belleville conical spring washers shall be of hardened steel, cadmium plated or silicone bronze. Lubricate and tighten the hardware per manufacturer's recommendations.
8. The final tightening torque shall be recorded for all aluminum conductor mechanical screw-type connections and provided in report form, in the completed O&M manuals.
9. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
10. The contractor shall perform an infrared survey of all aluminum conductor connections after the installation is complete and in normal service. Infrared surveys shall be performed during periods of maximum possible loading with at least 30% of rated load of the equipment being inspected. All connections with elevated temperatures shall be corrected by the contractor. The infrared survey results shall be provided in report form, in the completed O&M manuals.

B. No copper-to-aluminum transitions permitted when splicing onto existing copper feeders.

C. Insulation shall have a 600 volt rating.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Minimum size conductor installed shall be #12 AWG for all applications, except for special system circuits and where specifically noted otherwise.

B. All lighting and receptacle branch circuit conductors shall be color coded. Feeder cables and service entrance conductors shall be color coded by use of colored plastic tape applied within six (6) inches of each conductor end. All color coding shall be with the same color being used with its respective phase or bus through the entire job as follows:

208/120 Volts			**480/277 Volts**	
Phase A	Black		Phase A	Brown
Phase B	Red		Phase B	Orange
Phase C	Blue		Phase C	Yellow
Neutral	White		Neutral	Grey
Ground	Green		Ground	Green

C. No wires or cables shall be pulled into the conduit until the conduit system is complete and plastering is applied and dried. This does not refer to a white finish coat of plaster, which may be applied after the wires are pulled.

D. All wiring for lighting and receptacles branch circuits shall be run as single-phase, two-wire circuits with equipment grounding conductor. A common neutral shall be permitted for multi-wire circuits where the available electrical service is three-phase, provided the circuits are supplied from different phases. If it is necessary that more circuits be placed in any run, a separate neutral must be provided for additional two-wire, three-wire or four-wire branch circuits.

1. No more than 6 current carrying conductors of multi-outlet circuits shall be permitted to be installed in a single raceway, regardless of size of conductors or raceway.
2. Install conductors at each outlet, with at least 6 inches (150 mm) of slack conductor length.

E. Conductors shall be continuous from outlet to outlet and from outlet to junction box or pull box. All splices and joints shall be carefully and securely made to be mechanically and electrically solid with solderless pressure connectors and insulated with vinyl electrical tape and friction tape, if insulation is not provided in pressure type connector used.

1. All conductors shall be properly terminated in accordance with torque requirements specified in manufacturer's instructions.
2. Aluminum terminations shall be treated with an oxide inhibiting compound prior to torqueing.
3. Where connection is made to any terminals of more than 30 amperes capacity and where conductors larger than #10 are connected to any terminal, CU/AL terminal lugs shall be bolted to the conductors.

4. Where multiple connections are made to the same terminal, individual lugs for each conductor shall be used.
5. Install 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.
6. Install 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

F. All wire and cables for power, lighting, control and signal shall be continuous from origin to destination with proper splices as specified. At the end of these wires and cables, only sufficient slack shall be left as may be required for making proper connections. There shall be no unnecessary slack, but not less than 6 inches of slack at any junction box, outlet, device or terminal.

G. Where conductors are to be connected directly to the devices without the use of lugs, such as occurs at side connections of lighting switches and plug receptacles, the conductors shall be formed into suitable loops to fit around the terminal screws.

H. Where wires and cables are connected to metallic surfaces, the coated surfaces of the metal shall be polished before installing the mechanical connectors. The lacquer coating of conduits shall be removed where ground clamps are to be installed.

I. The conductors terminating at each wired outlet shall be left not less than six (6) inches long at their outlet fitting to facilitate the installation of devices or fixture. Where more than one pair of conductors enters an outlet, the several pairs of conductors shall be neatly spliced and made mechanically and electrically secure. The conductors shall be not less than six (6) inches long at any junction box, outlet, device or terminal.

J. Branch circuit wiring which supplies more than one fluorescent fixture through the wireway of other fixtures shall be approved for use at 90 degrees Celsius. Such fixture wireways shall be U.L. listed for through wiring.

K. Wall switch outlets shall be wired to provide control of outlets indicated. All connections to single pole switches shall be made so that the “OFF” operation of the switch opens the ungrounded leg.

L. Each wire in a pull box, junction box or equipment wire chamber shall be labeled with the proper panel letter and circuit number identification, and where two or more wires are spliced, each shall be labeled. Labels shall be printed numbers and letters on suitable plastic tape. Wires and cables shall be identified by suitable Brady or approved equal adhesive label tapes.

M. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION

SECTION 16131
JUNCTION AND PULL BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

B. Refer to Supplementary Conditions.

1.02 DESCRIPTION OF WORK

A. The work included under this Section of these specifications consists of furnishing all material and equipment and performing all labor and services necessary for the installation of junction and pull boxes, including all related systems and accessories as shown by the drawings and hereinafter specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Junction and pull boxes 100 cubic inches in volume or smaller shall be standard outlet boxes. Those 150 cubic inches or larger shall be constructed as specified for cabinet construction and shall be furnished with covers. Boxes shall be coated inside and out to prevent corrosion.

B. Boxes shall be sized in accordance with the requirements of the National Electrical Code, and junction boxes not used for service entrance duty shall not be smaller than four (4) inches square and 1-1/2 inches in depth with covers accessible at all times. Boxes on concealed conduit shall be set with covers flush with the finished plaster line, unless otherwise shown.

2.02 MANUFACTURERS

A. Hubbell – RACO.

B. Thomas & Betts – Steel City.

C. Appleton Electric.

D. Arcade Metal Stamping.

E. Unity Manufacturing.

F. Communications Integrators, Inc.

G. Hubbell Wiring Devices-Kellems.

H. Legrand – Walker.

I. Hubbell – Killark.

J. Eaton – Cooper Industries – Crouse Hinds.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Junction boxes and pull boxes made of code gauge steel shall be furnished and installed where such boxes may be necessary to facilitate the pulling or splicing of cables. Boxes must be made accessible. Conduits shall enter these boxes through tight fitting clearance holes. Where required, suitable supports shall be provided in all pull boxes to support feeders passing through the boxes so that feeder conductors will not remain unsupported for a distance greater than three (3) feet.

B. Junction boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have suitable provisions to secure covers.

C. Junction boxes shall be securely attached to the building construction, using wood screws for wood construction, bolts for metal construction, and expansion anchors with bolts for masonry or concrete construction. Boxes flush mounted in tile or masonry construction shall be secured in place with cement mortar. Boxes flush mounted in ceiling shall be supported from building structure independent of the ceiling construction.

END OF SECTION

SECTION 16134
BOXES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling outlet boxes.

B. Floor boxes.

C. Junction and pull boxes.

1.02 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

B. Refer to Section 16010 for Supplementary Conditions.

1.03 REFERENCE STANDARDS

A. NECA 1 – Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association, latest edition.

B. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association, latest edition.

C. NEMA OS 1 – Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association, latest edition.

D. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association, latest edition.

E. NFPA 70 – National Fire Protection Association – National Electrical Code; most recent edition adopted by authority having jurisdiction (AHJ), including all applicable amendments and supplements.

1.04 DESCRIPTION OF WORK

A. The work included under this Section consists of furnishing all material and equipment and performing all labor and services necessary for the installation of outlet boxes, including all related systems and accessories as shown by the drawings and herein specified.

B. Boxes shall be sized in accordance with the requirements of the National Electrical Code (NEC), and junction boxes not used for service entrance duty shall not be smaller than four (4) inches square and 1-1/2 inches in depth with covers accessible at all times. Boxes on concealed conduit shall be set with covers flush with the finished plaster line, unless otherwise shown.

C. Junction and pull boxes 100 cubic inches in volume or smaller shall be standard outlet boxes and this specification. Those 150 cubic inches or larger shall be constructed as specified for cabinet construction and shall be furnished with covers. Boxes shall be coated inside and out to prevent corrosion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Hubbell – RACO

B. Thomas & Betts – Steel City

C. Appleton Electric

D. Legrand – Walker

E. Hubbell – Killark

F. Eaton – Cooper Industries – Crouse Hinds

2.02 MATERIALS

A. At each outlet shown, furnish and install a box of suitable size and construction to serve the purpose properly. Furnish and install plaster rings where required in connection with adjacent plaster finish where these occur. In unfinished masonry walls, furnish and install handy boxes of such size as to permit them from being completely covered by the device plate. Boxes throughout shall be galvanized steel. All unused knockouts in boxes shall be filled or capped before plates or devices are installed.

B. Ceiling outlets shall be four (4) inch octagonal boxes of the appropriate depth and furnished with 3/8" fixture studs fastened through from back of boxes. For plaster surfaces, furnish and install plaster rings and ears.

C. At each switch or receptacle outlet shown, provide outlet box of (4) inches square and 1 ½ "in depth with extension ring as necessary for devices contained.

D. Outlet boxes for all exposed work shall be of the cast type and manufactured by an approved vendor selected from the above list.

E. Stamped steel outlet boxes shall be manufactured by an approved vendor selected from the above list.

F. Cast metal outlet boxes shall be manufactured by an approved vendor selected from the above list.

G. Service fittings shall be as manufactured by those listed above.

2.03 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.

C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

D. Wall Plates for Finished Areas: As specified in Wiring Devices.

2.04 FLOOR BOXES

A. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches (38 mm) deep.

B. Material: Formed steel.

C. Service Fittings: As specified in Wiring Devices.

D. Coordinate the installation of electrical items with the schedules for work of other trades to prevent unnecessary delays in the total work.

E. Provide all trenching and backfilling required in connection with the work of this Section.

2.05 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Hinged Enclosures: As specified in Cabinets and Enclosures.

C. Surface Mounted Cast Aluminum Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

D. In-Ground Cast Aluminum Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:

E. Fiberglass Hand-holes: Die molded glass fiber hand holes:

2.06 HINGED-COVER ENCLOSURES

A. NEMA 250, Type 1, with continuous hinge cover and flush latch

B. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2.07 CABINETS

A. NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge.

B. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have suitable provisions to secure covers.

C. Each outlet and device box shall have sufficient depth to permit the equipment being installed within it to be properly mounted and it shall have sufficient clearance to prevent damage to any conductors, devices or other equipment installed within the box.

D. Boxes shall be securely attached to the building construction, using wood, screws for wood construction bolts for metal construction, and expansion anchors with bolts for masonry or concrete construction. Boxes flush mounted in tile or masonry construction

shall be secured in place with cement mortar. Boxes flush mounted in ceiling shall be supported from building structures independent of the ceiling construction.

E. All outlet boxes shall be flush mounted within the wall regardless of wall construction, unless they are specifically shown as being used with exposed conduit.

F. The edge of all outlet box extension rings shall be flush with the surface in which they are recessed. The Contractor shall be attentive to boxes set in masonry walls. The devices that fit into the outlet boxes shall be screwed tight before the cover plates are installed. The cover plates shall not be used as a means of tightening the devices in place.

G. Flush mounted outlet boxes in all exposed masonry walls shall be masonry boxes or shall be 4 inch square boxes with square cornered tile covers. The boxes or box covers shall have square edges and shall have the device holes inside the box.

H. Extra deep type concrete boxes shall be used in concrete walls and slabs to permit entering and leaving of conduits and to avoid steel reinforcing rods.

I. Wall switch outlets shown at door locations shall be installed on the lock side of the door, 4 inches from the jamb, unless otherwise indicated on the drawings. Door swings shall be verified from architectural drawings.

J. Outlet boxes designated for information management shall be 4 inches square and shall have raised covers with rectangular opening in center.

K. Outlets shall be located approximately as shown on the plans. Exact mounting heights for all outlets shall be determined at the building site and shall be verified by the Contractor from architectural drawings which indicate casework and other architectural conditions. Outlets shall be located so as not to split the top of wainscot, backsplashes, or to be obstructed by equipment of any type indicated or specified. Where outlets are shown on the drawings as being adjacent and different mounting heights are specified for each, they shall be mounted one directly over the other, on the centerline of the group or on the centerline of the room.

L. Outlet boxes and conduit work which is exposed to the weather, and for vapor-tight lighting fixtures and devices shall be cast corrosion resistant type with threaded conduit hubs to accommodate the conduit size entering.

M. Outlets for the attachment of lighting fixtures shall be provided with fixture studs securely anchored to the boxes. Where outlet boxes are used to support lighting fixtures, the outlet boxes shall be firmly anchored to the structural members of the building.

N. Outlets installed in a common wall and are intended to serve each side of the wall shall not be installed back to back but shall be staggered in the wall. Openings in wall common to both sides of walls shall not be acceptable.

O. Outlet boxes which serve separate patient rooms but require installation in common walls as in a typical headwall of a patient room, shall be “staggered” with a wall stud separating each. Back to back box installation will not be permitted.

P. Outlet boxes installed in rated walls shall not exceed 16 square inches unless enclosed by a fire putty pad or fire rated “5-sided box”.

Q. The aggregate area of all boxes in a rated wall and not enclosed by a "5-sided box" shall not exceed 100 square inches in 100 square feet of wall as measured from floor to structural deck or rated membrane.

R. Outlet boxes with openings on opposite faces of rated walls shall have a horizontal separation of 24" minimum unless enclosed by a "5-sided box" or a box with 4 sides and a back.

S. In the event of any discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

T. Junction boxes and pull boxes made of code gauge steel shall be furnished and installed where such boxes may be necessary to facilitate pulling or splicing cables and conductors. Boxes shall be accessible. Conduits shall enter these boxes through tight fitting clearance holes. Where required, suitable supports shall be provided for all pull boxes to support feeders passing through the boxes so that feeder conductors will not remain unsupported for a distance greater than three (3) feet.

END OF SECTION

SECTION 16136
WIREWAY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wireway

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. National Electrical Contractors Association (NECA) Standard of Installation.

C. NEMA WD 6 - Wiring Device Configurations.

D. Underwriters Laboratories (UL) Standard of Safety 870 - Wireways, Auxiliary Gutters and Associated Fittings.

E. National Electrical Code (NEC) 362 - Wireways, 374 - Auxiliary Gutters.

1.03 SUBMITTALS

A. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under article 1.03 - References. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five years of [documented] experience.

B. Furnish Products listed and classified by UL, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.01 MANUFACTURERS-WIREWAY

A. Manufacturers:

1. Square D Company LD SQUARE-Duct NEMA 1
2. Square D Company LJ Oiltight Wireway NEMA 12
3. Square D Company LDR Raintight Wireway NEMA 3R
4. Square D Company RD Raintight Trough NEMA 3R
5. Or approved equal from Eaton, Siemens, GE.

2.02 DESCRIPTION

A. Description: General purpose and Raintight type wireway.

B. Knockouts: Manufacturer's standard.

C. Size: As indicated on drawings.

D. Cover: Screw cover.

E. Connector: Flanged.

F. Fittings: Lay-in type with removable side with captive screws with drip shield if indicated.

G. Finish: Electro-coated ANSI-49 Gray Epoxy Paint over Phosphate Primer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Use screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.

C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

D. Wireway Supports: [Per manufacturer's recommendations].

E. Close ends of wireway and unused conduit openings.

END OF SECTION

SECTION 16139
CABLE TRAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cable trays and accessories.

B. Fire stopping within (not around) cable trays.

1.02 RELATED REQUIREMENTS

A. Fire stopping: Fire stopping around cable trays.

B. Grounding and Bonding for Electrical Systems.

C. Hangers and Supports for Electrical Systems.

1.03 REFERENCES

A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2009.

B. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2009a.

C. NEMA FG 1 - Fiberglass Cable Tray Systems; National Electrical Manufacturers Association; 1993 (R98).

D. NEMA VE 1 - Metallic Cable Tray Systems; National Electrical Manufacturers Association; 2009.

E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for fittings and accessories.

C. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products: www.schneider-electric.us.

B. Thomas & Betts Corporation: www.tnb.com.

C. Wiremold Company: www.wiremold.com.

D. B-Line Systems, Inc: www.b-line.com.

E. Chalfant Cable Trays: www.chalfantcabletray.com.

F. Cablofil, Legrand Group: www.cablofil.com.

G. GS Metals Corp.: www.gsmetals.com.

H. Mono-Systems, Inc.: www.monosystems.com.

I. MPHusky, Inc.: www.mphusky.com.

J. P-W Industries, Inc.: www.pwindustries.com.

2.02 BASKET-TYPE CABLE TRAY

A. Description: NEMA VE 1-2002/CSA C22.2 No. 126.1-02 - Metal Cable Tray Systems

B. Material: Continuous, rigid, welded steel, hot-dip galvanized after fabrication in accordance with ASTM A 123/A 653, wire mesh cable management system.

C. Minimum Inside Width: 12 inches (305 mm).

D. Minimum Inside Depth: 3 inches (76.2 mm).

E. Inside Radius of Fittings: 12 inches (305 mm).

F. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install metallic cable tray in accordance with NEMA VE 1.

B. Support trays in accordance with Vibration and Seismic Controls for Electrical Systems. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 Ft (2438 mm) maximum.
   1. Cable trays shall be supported using a trapeze with hanging supports on each side of the cable tray.
   2. Center-hung support systems shall not be used.

C. Use expansion connectors where required.

D. Remove all burrs and sharp edges from cable trays.

E. Provide fire stopping to sustain ratings when passing cable tray through fire-rated elements.

F. Ground and bond cable tray under provisions of Grounding and Bonding.
   1. Provide continuity between tray components by bonding each cable tray section.
   2. Provide 2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each component.
   3. Connections to tray may be made using mechanical or exothermic connectors.

G. Install warning signs at 50 feet (1500 mm) centers along cable tray, located to be visible.

H. Install cable tray level and plumb according to manufacturer's written instructions, shop drawings, original design, and referenced standards.

I. Make cable tray connections and changes in direction and elevation using standard fittings. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independently of fittings. Do not carry weight of cable tray on equipment enclosure.

J. Seal penetrations through all fire and smoke barriers according to Division 7 Section "Firestopping." Use removable, modular pillows or bricks for fire stopping.

K. Workspace: Install cable trays with a minimum 6" working space to permit access for installing cables.

L. Install barriers to separate cables of different insulation levels, or of different systems, such as power, communications.

M. Where mechanical, electrical, piping, architectural or other obstructions do not permit cable tray installation, J-hooks may be substituted for cable tray provided the installation conforms to the following requirements:
   1. J-hooks shall be spaced at a maximum of 4' between centers;
   2. J-hooks shall have minimum 4" depth for cable trays with widths less than 20" wide and a minimum of 6" depth for cable trays greater than 20" wide;
   3. J-hooks shall be provided in a stacked configuration with one (1) hook being provided for each 4" of cable tray width for cable trays less than 20" wide and one (1) hook being provided for each 6" of cable tray width for cable trays greater than 20" wide.

N. In existing healthcare facilities where it is not feasible to provide cable trays for imaging suites as shown on plans or as specified above:
   1. Install point-to-point raceway or conduit systems for the imaging equipment.
   2. Run the raceways for all cables in the shortest practicable manner as approved by the equipment manufacturer and the engineer.
   3. Align holes in the floors, walls and ceilings for conduit penetrations with equivalent thickness of shielding sleeves curved or offset, caulked and flanged for adequate shielding so that magnetic or radiation emissions will not penetrate the floors, walls and ceilings.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Receptacles with integral USB charger.
3. Receptacles with integral Arc Fault Circuit Interrupter, AFCI.
4. Plugload Control Receptacles.
5. Twist-locking receptacles.
6. Receptacles with integral surge-suppression units.
7. Isolated-ground receptacles.
8. Tamper-resistant receptacles.
9. Weather-resistant receptacles.
10. Snap switches and wall-box dimmers.
11. Solid-state fan speed controls.
12. Wall-switch and exterior occupancy sensors.
13. Communications outlets.
14. Pendant cord-connector devices.
15. Cord and plug sets.
16. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies.

1.03 DEFINITIONS

A. AFCI: Arc fault circuit interrupter.

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

E. Plugload Control Receptacle: Automatically occupancy switched receptacle.

F. RFI: Radio-frequency interference.

G. UTP: Unshielded twisted pair.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Incorporated; Wiring Device-Kellems; Wiring Device-Kellems (Hubbell) or a comparable product by one of the following:

1. Leviton Manufacturing Co., Inc.
2. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, Heavy Duty 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

B. USB Charging Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596. Compatible with USB 1.1/2.0/3/0 devices, including Apple products.

C. Arc Fault Convenience Receptacles, 125 V, 15A and 20A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

D. Plugload Controlled Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

E. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, Tamper-Resistant Convenience Receptacles, 125 V, 20 A. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

F. Weather Resistant and Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, Tamper-Resistant Convenience Receptacles, 125 V, 20 A. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

2.04 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

2.05 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.06 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.07 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:
   1. Single Pole:
   2. Double Pole:
   3. Three Way:
   4. Four Way:

C. Pilot-Light Switches, 20 A:
   1. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.08 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

B. Tamper-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
   1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

C. Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5 20R, and UL 498.
   1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

D. GFCI, Non-Feed Through Type, Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.

E. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
   1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

F. Toggle Switches, Square Face, 120/277 V, 20 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.

G. Lighted Toggle Switches, Square Face, 120 V, 20 A: Comply with NEMA WD 1 and UL 20.

1. Description: With neon-lighted handle, illuminated when switch is “off.”

2.09 RESIDENTIAL DEVICES

A. Residential-Grade, Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

B. Weather-Resistant and Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R and UL 498.

1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

C. Fan Speed Controls:

1. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters.
2. Comply with UL 1917.
3. Continuously adjustable [**slider**] [**toggle switch**] [**rotary knob**], [**5 A**] [**1.5 A**].
4. Three-speed adjustable [**slider**] [**rotary knob**], 1.5 A.

D. Telephone Outlet:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Wiring Device Kellems: NSJ5E Jack, NS614 Frame with NP 26 Wall Plate, or comparable product by one of the following:
   a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
   b. Leviton Manufacturing Co., Inc.
2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with **Category 5e.** Comply with UL 1863.

E. Combination TV and Telephone Outlet:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Wiring Device Kellems; NSJ5E Jack, SFGRF Connector, NS614 Frame with NP 26 Wall Plate or comparable product by one of the following:
   a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
   b. Leviton Manufacturing Co., Inc.
2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with **Category 5e**. Comply with UL 1863.

2.10 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable **slider**]; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

2.11 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch thick, satin-finished, or Type 302 stainless steel 0.04-inch thick.
3. Material for Unfinished Spaces: Galvanized steel.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with lockable cover and per detail.

2.12 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Incorporated; Wiring Device-Kellems; [Plug Trak HBL20, HBL24 series steel] [HBLALU20, HBLALU24 Alumium] [Plug Trak PT 20 series PVC] or a comparable product by one of the following:

1. Wiremold / Legrand.

B. Description:

1. Two-piece surface painted steel, brushed aluminum or PVC raceway, with factory-wired multioutlet harness.
2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Painted Metal.

D. Multioutlet Harness:

1. Receptacles: 20 A, 125-V, NEMA WD 6 Configuration 5-20R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: 6 inches.
3. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

2.13 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Color shown on the construction documents unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red
3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed on the construction documents.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
5. Cut back and pigtail, or replace all damaged conductors.
    a. Straighten conductors that remain and remove corrosion and foreign matter.
    b. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles up and on horizontally mounted receptacles to the right.
   2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Verify that dimmers used for fan speed control are listed for that application.
   3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Section "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
   2. Test Instruments: Use instruments that comply with UL 1436.
   3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 16142
ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section. Section 16010, Supplementary Electrical Conditions, shall apply to the work of this section.

B. This section is a Division-16 Basic Electrical Materials and Methods section, and is part of each Division-15 and –16 section making reference to electrical connections for equipment specified herein.

1.02 DESCRIPTION OF WORK

A. The Division 16 Contractor shall provide for final electrical connections to all electrically powered equipment furnished by others, shown on drawings as part of the work. Final electrical connections are hereby defined to include raceways, conductors, and termination materials required for providing electrical power and equipment ground to equipment furnished under this and other divisions.

B. Refer to Division 15 sections for mechanical equipment and control system wiring and all circuiting less than 120 volt alternating current.

C. Refer to Specification Section 11400 incorporated by reference only. Where electrical connections to these systems and/or equipment are shown on the construction documents, such work shall be included in the scope of work and coordinated with installation manual. Electrical contractor shall not be responsible for installing any owner furnished equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND COMPONENTS

A. Raceways

1. Products shall comply with Division-16 basic electrical materials and methods Section 16110. Provide metal raceways and fittings of types grades, sizes and weights indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC and manufacturer's requirements for raceways.

B. Conductors

1. Provide conductors and connectors complying with Division-16 basic electrical materials and methods Section 16120.

C. Connectors and Terminals

1. Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications. Where receptacles or

connectors are required, coordinate to mate with device provided or equipment supplied.

D. Electrical Connection Accessories

1. Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

E. Disconnecting means:

1. All electrical equipment shall contain a disconnecting means. All disconnecting means not furnished integral with equipment shall be provided and installed by the electrical contractor regardless if they are indicated on the drawings. Comply with Section 16170 requirements.

F. Motor controllers.

1. All motors shall contain a controller. Where disconnecting means cannot serve as the controller such controllers shall be provided and installed by others. Make all electrical connections to/from the controller.

PART 3 - EXECUTION

3.01 COORDINATION

A. Review shop drawings and submittal data with regards to area and conditions under which electrical connections for equipment are to be provided. Manufacturer's installation recommendations are to be reviewed prior to rough-in installation. Where clearances provided do not meet code or installation requirements, written notification shall be provided to the Architect.

B. The electrical contractor shall be responsible for obtaining the booklet for all Owner furnished equipment. Ignorance on the part of the contractor shall in no way relieve the contractor from responsibility to meet requirements of equipment manufacturer’s.

3.02 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Provide electrical connections as indicated; in accordance with equipment manufacturer's written instructions, with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting though tapes which will remain on conductors. Ringing of copper conductors or cutting of strands is not acceptable.

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torqueing tools.

D. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

E. Provide identification for each disconnect for each piece of equipment served which indicates its voltage, source, and identification in accordance with Specification Section 16170 whether or not disconnect is provided by Owner.

3.03 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirements.

B. Electrical contractor shall be required to identify equipment controllers or disconnects regardless if provided by electrical contractor or others.

END OF SECTION

SECTION 16160
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.03 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with NFPA 70E.

D. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

E. Comply with ANSI Z535.4 for safety signs and labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at more than 600 V:

1. Black letters on a yellow field.

2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high letters.

C. Colors for Raceways Carrying Circuits at 277 V up to 600V: and conduits larger than two inches:
1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

D. Colors for Raceways Carrying Circuits at 120 V up to 240V: and conduits larger than two inches:
1. Black letters on a white field.
2. Legend: Indicate voltage and system or service type.

E. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

F. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less and conduits larger than two inches: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tapes not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

D. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.04 FLOOR MARKING TAPE

A. 2-inch wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.05 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils, consisting of a printed pigmented polyolefin film, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
4. Overall Thickness: 5 mils.
5. Foil Core Thickness: 0.35 mils.
6. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
7. 3-Inch Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.06 WARNING LABELS AND SIGNS

A. Comply with NFPA 70, 70E, and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

C. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES."
3. Arc Flash Protection Field Marking: All panelboards, switchgear, switchboards, panelboards motor control centers, motor control panels and electrical control panels shall be provided with a black on yellow warning sign per ANSI Z535.4 and ISO 3864. The sign shall read: “WARNING! ARC FLASH and SHOCK HAZARD. APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT REQUIRED.” The sign shall be prominently mounted on the front of the equipment, readily visible and indicate all relevant class information. If the equipment has multiple removable front covers, a

sign shall be mounted on each cover. For flush mounted panelboards in finished spaces, the sign shall be mounted on the inside of the door or inside cover. Manufacturers' standard labels are not acceptable.

2.07 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.08 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Engraved, Laminated Acrylic or Melamine Nameplate: Minimum letter height shall be ½ inch. Refer to Drawings for Nameplate Detail.

B. Fasteners for nameplates: stainless steel screws that do not change the NEMA or NRTL rating of the enclosure, adhesive labels shall not be used.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways Larger than Two Inches: Each color-coding band shall completely encircle conduit. Locate bands at changes in direction, at penetrations of walls and floors, at 30-foot maximum intervals in straight runs, in electrical rooms and vaults color shall be solid, see "Raceways" Section.

F. System Identification Labels for Raceways carrying circuits above 600V: Locate labels at changes in direction, at penetrations of walls and floors, at 30-foot maximum intervals in straight runs, at 10-foot maximum intervals in electrical rooms and vaults, and within six inches of pull or junction boxes.

G. System Identification Labels for Raceways carrying circuits 600V and less: Locate labels at changes in direction, at penetrations of walls and floors, at 30-foot maximum intervals in straight runs.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 18 inches overall.

I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend, system voltage, and panel/circuit number. System legends shall comply with Section 16110.

1. Normal power.
2. Emergency power.
3. UPS.

B. Power-Circuit Conductor Identification, 600 V or Less: .For conductors in electric rooms or vaults pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
   a. Color shall be factory applied.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White.
      5) Ground: Green.
   c. Colors for 480/277-V Circuits:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral: Gray.
      5) Ground: Green with Yellow Stripe.
   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
   e. Switch loops shall retain correct color code with a white tracer.
   f. For new work in existing buildings, the existing identification method shall be used for new conductors provided it meets all requirements of this Section and the NEC.

C. Install instructional sign including the color code for grounded and ungrounded conductors

using adhesive-film-type labels.

D. Emergency Sources: A sign shall be placed at the service entrance equipment indicating the type and location of on-site emergency power sources per NEC Art. 700.

E. Elevator Disconnects: Provide "Fed From" signs indicating the location of the supply side OCPD for each elevator power source.

F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Arc Flash warning labels shall be provided on all new electrical equipment and existing equipment that has been modified a part of a project and conform to Arc Flash report.

K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs or Metal-backed, butyrate warning signs.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.
   c. Other equipment as indicated on the Drawings.

L. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

M. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer and load shedding.

N. Provide permanent nameplates for all pull and junction boxes identifying circuits, voltage, and source.

O. Wiring device identification: comply with Section 16140 – 2.01.

P. Equipment Identification Nameplates: On each unit of equipment, install unique designation nameplate that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply nameplates to Switchgears, Switchboards, Distribution Panels, Panelboards, Transformers, Individual Starters, Contactors, Disconnect Switches, Transfer Switches, Control Panels and Similar Equipment. Systems include power, lighting, and control systems unless equipment is provided with its own identification.

1. Colors for equipment nameplates:
   a. NORMAL power system:
      1) 120V – 240V: black letters on white background.
      2) 277V – 600V: black letters on orange background.
      3) 600V and up: black letters on yellow background.
   b. Emergency (EM) & Essential (ES) 480/277V loads as defined by NEC Art. 700 – Red letters w/black outline on Orange background.
   c. LIFE SAFETY loads as defined by NEC Art. 700: white letters on red background.
   d. Emergency (EM) & Essential (ES) 208/120V as defined by NEC Art. 700 – Red letters on white background.
   e. LEGALLY REQUIRED loads as defined by NEC Art. 701(elevators, smoke control, HVAC, etc.):
   f. OPTIONAL STANDBY loads as defined by NEC Art. 702 (Labs, HVAC, etc.): Red letters on white background.
2. Labeling Instructions:
   a. Identify the piece of equipment, the source, voltage characteristics, and the load served
   b. Indoor Equipment: Engraved, laminated acrylic or melamine nameplate. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
   c. Outdoor Equipment: Engraved, laminated acrylic or melamine nameplate. Unless otherwise indicated, provide a single line of text with one-inch high letters on 3-inch high label; where two lines of text are required, use labels 4 inches high.
   d. Elevated Components: Increase sizes of nameplates and letters to those appropriate for viewing from the floor.
   e. Fasten nameplates with appropriate stainless steel screws that do not change the NEMA or NRTL rating of the enclosure. Stick-on or adhesives are not acceptable unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART I – GENERAL

1.02 SUMMARY

A. This Section includes restraints and other restraint measures for electrical components.

B. Related Sections:
   1. Cast-In-Place Concrete
   2. Unit Masonry
   3. Structural Steel
   4. Rough Carpentry
   5. Common Work Results for Electrical

C. Intent: The intent of this specification is that all electrical building system components remain in place during an event, and all such systems shall be installed in accordance with applicable codes, component manufacturer's and building construction standards. Whenever a conflict occurs between any of these standards, the most stringent requirements shall apply.

1.03 DEFINITIONS

A. IBC: International Building Code

B. Restraint: A fixed devise or method such as a structural support element, a restraint brace, an anchor bolt or stud, a fastening device or assembly, a metal framing member, a cable or any assembly of these items used to transmit forces from an item of equipment or system to the building structure to limit or restrain movement of that item and used to prevent vertical or horizontal movement, or both.

C. EMT: Electrical metallic tubing.

D. IMC: Intermediate metal conduit.

E. NBC: National Building Code.

F. OSHPD: Office of Statewide Health Planning and Development (applicable only in California).

G. RMC: Rigid metal conduit.

H. SBC: Standard Building Code.

I. UBC: Uniform Building Code.

J. IBC: International Building Code.

K. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements.

1.04 SUBMITTALS

A. Submit the following supporting data:

1. Product Data:
   a. Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of restraint component used.
   b. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by an agency approved by the authority having jurisdiction (AHJ).
2. Shop Drawings: Anchorage and bracing for equipment not defined by details and charts on Drawings. Indicate materials, and show designs.
   a. Design Analysis: To support selection and arrangement of restraints. Include calculations of tensile and shear loads, if used.
   b. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths.
3. Coordination Drawings: Plans and sections drawn to scale and coordinating restraint bracing for electrical components with other systems and equipment.
4. Product Certificates: Mmanufacturers of restraint products furnished comply with requirements.

1.05 QUALITY ASSURANCE

A. Comply with restraint requirements in International Building Code (IBC), unless requirements in this Section are more stringent.

B. Testing Agency Qualifications: If required, an independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

1.06 COORDINATION

A. Coordinate layout and installation of restraint bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features.

B. Coordinate concrete bases with building structural system.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. B-Line Systems, Inc.
2. Thomas & Betts Corp.
3. Unistrut Corporation.
4. Hubbell Power Systems.
5. Cooper Industries.

2.02 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.

2.03 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Strength in tension and shear of components used shall be at least two times the maximum forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed rigid equipment mountings, and matched to the type and size of attachment devices used.

2.04 RESTRAINT BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches O.C. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A570, GR33.
2. Materials for Fittings and Accessories: ASTM A575, ASTM A576, or ASTM A36.
3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
2. Wire Rope Cable: Comply with ASTM 603. Use 49- or 133-strand cable with a minimum strength of 2 times the estimated or calculated force to be resisted.

D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install restraints according to applicable codes and regulations and as approved by authorities having jurisdiction.

3.02 STRUCTURAL ATTACHMENTS

A. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.

B. Attachments to Existing Concrete: Use expansion anchors.

C. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.

D. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.

E. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.

F. Attachments to Wood Structural Members: Install bolts through members.

G. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.03 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, unit substations, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:

1. Size concrete bases so that expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.04 RESTRAINT BRACING INSTALLATION

A. Where restraint bracing is required, install bracing according to spacings and strengths indicated by approved analysis.

B. Expansion and Contraction: Install to allow for thermal movement of braced components.

C. Cable Braces: Where cable bracing is required, install with maximum cable slack recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

END OF SECTION

SECTION 16289
SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes transient voltage surge suppressors for low-voltage (600Volts and below) power equipment

B. Related Sections include the following:

1. Division 16 Section "Wiring Devices" transient voltage surge suppressors.
2. Division 16 Section "Panelboards"
3. Division 16 Section "Switchboards"
4. Division 16 Section "Lightning Protection"

1.3 SUBMITTALS

A. Must have ten day prior approval to submit on project.

B. Request for submittals must be in writing and attached with independent documentation of the following items.

C. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection notes, wire size and wiring diagram.

D. Equipment Manual: The manufacturer shall furnish an installation manual with installation notes, start-up and operating instructions for the specified system. Installation instructions shall clearly state whether the system requires an external overcurrent device to maintain the system's UL 1449 listing. SPD requiring external overcurrent devices are not acceptable.

E. Verification that all SPD are UL 1449 4th Edition (VZCA) listed and rated with a 20kA (In) nominal discharge rating for compliance to UL96A Lightning Protection Master Label and NFPA 780. Also provide UL 1449 4th Edition VPR showing the following maximum VPR (clamping voltage) as follows:

1. 120Vsystem 800V (L-N) on Distribution/Branch Panels and 800V (L-N) at Service Entrance

2. 277Vsystem 1200V (L-N)

F. SPD manufacturer shall provide UL 4th Edition documentation as part of submittal.

G. Manufacturer's Warranty Statement, showing a 10-year replacement warranty for modules or units which are damaged by transient voltages

1.4 STANDARDS

A. Underwriters Laboratories 1449 - (UL 1449 4th edition safety standard for surge protection devices)

B. NEC article 285. National Electrical Code 2008 SPD shall be labeled with a minimum 200kAIC rating.

C. NFPA 780 Standard for the installation of lightning protection systems

D. UL96A - Lightning Protection System Master Label

E. IEEE (Institute of Electrical and Electronic Engineering Inc.) C62.41.1 and C62.41.2 – 2002, IEEE C62.45 – 2002, IEEE C62.33 & C62.35

F. All manufacturers must comply with above listed standards and any additions current revisions of industry standards. All products that do not comply with current industry standards will not be accepted.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain suppression devices and accessories from a single manufacturer.

1.6 PROJECT CONDITIONS

A. Placing into Service: Do not energize or connect service entrance equipment, panel boards, control terminals, or data terminals to their sources until the surge protective devices are installed and connected.

B. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:
   1. Maximum Continuous Operating Voltage (MCOV): Not less than 115 percent
   2. Operating Temperature: : -40 to 176 deg F
   3. Humidity: 0 to 85 percent, non-condensing.
   4. Altitude: Less than 20,000 feet (6000 m) above sea level.

1.7 COORDINATION

A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

B. Coordinate surge protective devices with Division 26 Section "Electrical Power Monitoring and Control."

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer shall provide a product warranty for a period of not less than ten (10) years from date of supply. Warranty shall cover unlimited replacement of TVSS modules during the warranty period, firms responding to these specifications shall provide the necessary warranty document showing they comply with the unlimited warranty replacement.

C. Manufacturers responding to this specification shall provide proof that they have been regularly engaged in the design, manufacturing and testing of TVSS for not less than five (5) years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. PQ Protection

B. Current Technologies

C. ASCO

2.2 SERVICE ENTRANCE SUPPRESSORS

Panel Amperage	**≥3,000Amps**	**2500-1600Amps**	**1200-400Amps**
Service Entrance	400kA/Modular	300kA/modular	200kA/modular

A. Provide service entrance rated, UL Type 1 SPD/PML as shown and indicated on contract drawings.

B. Minimum surge current ratings per phase shown above, three phase, wye systems per phase rating shall equal L-N and L-G modes added together. No other methods are acceptable for per phase surge current rating calculations.

C. SPD's shall be a multi-stage parallel connected device.

D. SPD's UL 1449 4th Edition VPR (clamping voltage) shall be a maximum rating of:

1. 120V system 800V (L-N)
2. 277V system 1200V (L-N)

E. SPD's shall mount external to the panel; internally mounted SPD's are not acceptable.

F. SPD voltages shall be verified by location on drawings, one-line diagrams and equipment schedules.

G. SPD shall be modular design with field replaceable individual modules redundant per phase and redundant per mode. A "brick" module design is not acceptable.

H. SPD shall have redundant status indicators on the front of the enclosure and shall monitor and indicate whether suppression capabilities have been compromised.

I. SPD shall also indicate that voltage is present at the SPD.

J. SPD shall contain protective components that utilize multiple thermally protected metal oxide varistors (MOV) per mode.

K. SPD's relying upon external and/or supplementary installed safety overcurrent protection do not meet the intent of this specification.

L. SPD's that are limited to being connected to breaker whether or not an integral disconnect switch is supplied do not meet the intent of this specification.

M. SPD's shall have an UL "In" rating (nominal discharge) of 20kA.

N. SPD shall have dry contacts for remote monitoring capabilities.

O. Service Entrance SPD's shall have audible alarm and surge counter.

P. SPD's shall have a metal, NEMA 4 rated enclosure.

Q. SPD shall be designed and equipped with integral disconnecting means.

R. Protection modes: The SPD shall provide Line to Neutral (L-N) (Wye), Line to Ground (LG) (Wye or Delta), Line to Line (L-L) (Delta) and Neutral to Ground (N-G) (Wye) protection.

S. Provide Top Switchboard Mounting Kit by manufacturer of SPD if SPD is shown indicating this option.

2.3 DISTRIBUTION, BRANCH PANEL AND/OR AUXILLARY PANELS

Panel Amperage	**1200-800A**	**600A**	**400-100A**
Distribution	200kA	200kA	200kA
Branch Panels		100kA	100kA

A. Provide UL Type 2 SPD's as shown and indicated on contract drawings.

B. SPD's minimum surge current ratings per phase shown above, three phase, wye systems per phase rating shall equal L-N and L-G modes added together. No other methods are acceptable for per phase surge current rating calculations.

C. SPD's shall be a multi-stage parallel connected device.

D. SPD's shall mount external to the panel; internally mounted SPD's are not acceptable.

E. SPD voltages shall be verified by location on drawings, one-line diagrams and equipment schedules.

F. SPD shall be a compact, non-modular design

G. SPD shall have per phase status indicators on the front of the enclosure and shall monitor and indicate whether suppression capabilities have been compromised.

H. SPD shall contain protective components that utilize multiple thermally protected metal oxide varistors (MOV) per mode.

I. SPD's relying upon external and/or supplementary installed safety overcurrent protection do not meet the intent of this specification.

J. SPD's shall have an UL "In" rating (nominal discharge) of 20kA.

K. SPD shall have dry contacts for remote monitoring capabilities.

L. SPD's shall have a metal, NEMA 4 rated enclosure

M. Protection modes: The SPD shall provide Line to Neutral (L-N) (Wye), Line to Ground (L-G) (Wye or Delta), Line to Line (L-L) (Delta) and Neutral to Ground (N-G) (Wye) protection.

N. Provide Optional Side Mount Brackets for panels with SPD mounted on the side.

2.4 EXTERIOR CIRCUITS (only applicable if shown on drawings and/or on AHCA Projects)

A. Provide a UL 1449 4th Edition listed SPD that incorporates one or more load circuit SPD's in a NEMA rated indoor/outdoor enclosure. The SPD shall have an overall UL listing including enclosure and components as one device.

B. SPD shall be UL 1449-Type 2 rated, 20kA In rated, and modular for ease of in-field serviceability. SPD shall be connected via breaker conductors feeding the load. SPD shall have a 65kAIC rating

C. SPD shall have visible failure indication per circuit and dry contacts for remote monitoring capabilities.

D. SPD shall have L-N & N-G protection modes (L-G & L-L in delta applications) and have a 50kA repetitive surge current rating.

E. SPD shall incorporate a grounding terminal for every three circuits as a minimum and all terminations shall accommodate a #8-#12 AWG conductor.

F. Exterior circuit SPD's shall have a five year replacement warranty.

G. Exterior circuit SPD's shall come fully assembled.

H. Install as indicated on drawings or as required by FBC/AHCA.

I. Basis of design is PQ Protection by PowerLogics, Model PQD Series (where #6 AWG or greater is required install the PQ Protection PQLA at the load disconnect).

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A Review all installation information in manufacturer's installation manual prior to installing SPD's.

B Verify all voltages before connecting to avoid injury and damage to equipment.

C The SPD's shall be installed external to switchboard, distribution and panelboard.

D Internally mounted SPD's will not be accepted.

E The service entrance/switchboard/switchgear SPD's shall be installed with the shortest lead length possible and shall avoid any unnecessary or sharp bends. Where the SPD's are connected to breakers utilize a 30-amp, 3 pole breaker for connection means. If no circuit breaker is available, utilize SPD's integral disconnecting means as described under 2.2.Q.

F The distribution, panelboard and auxiliary SPD's shall be installed with the shortest lead length possible from the panel it is protecting and shall avoid any

unnecessary or sharp bends. Utilize a 30-amp, 3 pole breaker for connection means. If no circuit breaker is available, utilize SPD as described under 2.2.Q with integral disconnect means.

G Ground resistance shall be 25 Ohms or less per NEC Article 250.56

H Refer to manufacturer's installation manual for further installation details.

3.2 FIELD QUALITY CONTROL

A INSTALLATION

1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with manufacturers' installation instruction requirements and recommendations.

B MANUFACTURERS FIELD SERVICE

1. Engage a factory authorized service representative to inspect equipment installation. Report results in writing to Owner.

2. Verify that electrical wiring installation complies with manufacturer's installation requirements.

END OF SECTION

SECTION 16414
DISCONNECT SWITCHES - GENERAL DUTY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Switches shall be furnished and installed at locations as shown on the drawings. Switches shall be of the type approved, indicated and specified herein.

1.02 REFERENCES

A. Switches shall be manufactured in accordance with the following standards:

1. UL 98 - Enclosed and Dead Front Switches
2. NEMA KS 1 - Enclosed Switches
3. NEMA 250 - Enclosures for Electrical Equipment

1.03 SERVICE ENTRANCE

A. Switches identified for use as service equipment are to be labeled for this application.

1.04 DRAWINGS

A. Provide outline drawings with dimensions, and equipment ratings for voltage, amperage, horsepower and short circuit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Switches shall be manufactured by Square D Company or approved equal.

2.02 SWITCH INTERIOR

A. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.

B. Lugs shall be UL Listed for 75° C conductors, aluminum or copper.

C. All current carrying parts shall be plated to resist corrosion.

2.03 SWITCH MECHANISM

A. The switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.

B. The operating handle shall be an integral part of the box, not the cover.

C. Provisions shall be provided for padlocking the switch in the OFF position.

2.04 SWITCH ENCLOSURES

A. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1) or gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galv-annealed steel (Type 3R).

B. Tangential knockouts shall be provided to facilitate ease of conduit entry on switches through 200 ampere.

C. Enclosures for Type 3R switches through 200 ampere shall have provisions for interchangeable bolt-on hubs in the top endwall. Hubs shall be Square D B-Type hubs sized as indicated on the plans.

2.05 SWITCH RATINGS

A. Switches shall be horsepower rated for 240Vac as indicated on the plans.

B. The UL Listed short circuit rating shall be 10,000 rms symmetrical amperes when used with or protected by class H or K fuses (30-600 amperes) or 100,000 rms symmetrical amperes when used with or protected by Class R fuses (30-600 ampere switches employing appropriate fuse rejection scheme).

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16441
LOAD CENTERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

B. Refer to Supplementary Conditions.

1.02 DESCRIPTION OF WORK

A. Load centers to be furnished and installed at locations as shown on the drawings. Load centers shall be of the type approved, indicated, and specified herein.

1.03 SUBMITTALS

A. Suppliers shall provide data on arrangement of circuit breakers in each load center. Circuit breakers to be utilized, bus ratings and materials, dimensional drawings of enclosures with circuit breaker mounting provisions.

1.04 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

B. NEMA PB 1 - Panelboards

C. NEMA PB 1.1 - General Instruction for Safe Installation, Operation and Maintenance Of Panelboards Rated 600 Volts Or Less

D. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.

E. Federal Specifications W-C-375B - Molded Case Circuit Breakers

F. Federal Specifications W-P115C - Type 1 Class 2 Load Center.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Siemens.

B. Schneider Electric; Square D Products.

2.02 ENCLOSURES

A. NEMA PB1: Type 1 as shown on the drawings.

B. Enclosure shall be fabricated of cold rolled steel for NEMA 1 and galvanized and annealed steel or equivalent rust-resistant steel for location of installation.

C. Indoor Type l enclosures shall have a flush front, with finish of gray baked enamel.

D. A laminated directory label shall be provided with circuits identified via typeset as indicated on the schedule.

E. Mounting shall be as indicated on the drawings.

2.03 INTERIORS

A. NEMA PB1: Type 1 as shown on the drawings.

B. Bus bar connections to the branch circuit breakers shall be the distributed phase type and shall accept plug-on circuit breakers.

C. Short Circuit Current Ratings: 65,000 ampere series ratings shall be provided per the schedule. This rating shall be established by manufacturer testing of a representative load center with main and branch circuit breakers installed.

D. Provide with equipment ground bar with lugs bonded to enclosure.

2.04 SHORT CIRCUIT CURRENT RATINGS

A. NEMA AB 1 Federal Specification W-C-375

B. Circuit breakers shall be Square D type QO plug-on thermal magnetic trip, with an integral crossbar to ensure simultaneous opening of all poles in multi-pole circuit breakers.

C. Circuit breakers shall have an over-center, trip free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication.

D. Handles shall have ON, OFF, and "Tripped" positions. In addition, trip indication shall include a VISI-TRIP indicator appearing in the window of the circuit breaker case (through 125 amperes).

E. Circuit breakers shall be UL Listed in accordance with UL standard 489 with current ratings as noted on the plans. Interrupting ratings shall be selected to provide the required load center short circuit current rating.

F. Circuit breakers intended for use with air conditioning, heating, and refrigeration equipment having motor group combinations and marked as such shall have the HACR marking.

G. The following special application circuit breakers or circuit breaker accessories shall be provided where shown on the drawings:

1. Circuit breakers with ARC fault interrupting capabilities.
2. Circuit breakers with GFIC interrupting capabilities.
3. Circuit breakers with ARC & GFIC interrupting capabilities.
4. Circuit breakers with lockable capabilities.

PART 3 - EXECUTION

3.01 CIRCUIT BREAKERS

A. Circuit breakers shall be rated for the available fault current at the line lugs or main circuit breaker.

B. Circuit breakers shall not be “twin” or “piggyback” mounted in space provisions.

C. All circuit breakers shall be UL labeled and shall be thermal magnetic or electronic solid state, molded case type, quick-make and quick-break both on manual and on automatic operation and shall be of the plug-on type.

D. All multi-pole breakers shall be internal common trip. The breakers furnished shall be determined by the specifications, the ampacity and poles, as scheduled or as indicated, and by the minimum UL labeled RMS symmetrical amperes interrupting capacity at circuit voltage, as indicated by the schedules.

E. Breakers shall not be rated for less than 10,000 RMS symmetrical amperes. NEMA ratings shall not be acceptable in lieu of UL ratings.

F. Breakers shall be labeled as required by the NEC. All circuit breakers shall be rated for available symmetrical fault at its line side terminals. Series rates circuit breakers shall/shall not be acceptable.

END OF SECTION

SECTION 16450
GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

B. Refer to Supplementary Conditions.

1.02 DESCRIPTION OF WORK

A. The work included under this Section of these specifications consists of furnishing all material and equipment and performing all labor and services necessary to insure that the electrical service and electrical systems conform with the requirements of Article 250 of the NEC and as specified hereinafter.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The products specified in Section 16120 apply to the work specified in this Section.

B. Ground rods shall be a minimum of 5/8″ x 10′-0″ Copper-clad ground rods.

C. Ground clamps shall be UL approved for the application.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The following systems and/or equipment shall be grounded in accordance with the rules of the National Electrical Code, the local code and as hereinafter specified.

1. Building Power System
2. Raceway and Conduit Systems
3. Lighting Fixtures
4. Non-current Carrying Metal Parts of all Motors, Panels and Other Electrically Operated Equipment.
5. Telephone System
6. Fire Alarm System
7. Each above Ground Gas Piping System Upstream from the Equipment Shutoff Valve.

B. The service equipment shall be bonded ahead of the main water service meter and grounded to installed ground rods using bare copper wire in steel conduit bonded at both ends. The wire shall be sized in accordance with Article 250-94 of the NEC. Copper-clad ground rods shall be driven to a depth sufficient to provide a grounding

electrode of 25 ohms maximum resistance to ground. If the resistance is greater than 25 ohms, additional ground rods shall be installed and bonded to the first electrode.

C. Made electrodes shall consist of (3) copper ground rods. The rods shall be installed such that at least 10'-0" of length is in contact with the soil. The upper end of the electrode shall be flush with or below ground level unless the above ground end and the grounding wire attachment are protected against physical damage.

D. All metallic conduits entering the building service panel shall be bonded together and to the system service ground. Metallic conduit systems shall be electrically continuous throughout.

E. The system neutral conductor shall be identified throughout and shall be grounded at the building service only.

F. An equipment grounding wire sized as per NEC shall be installed inside all conduit, and shall have green insulation.

G. All grounding electrode connections shall be accessible for periodic inspection and testing.

H. Isolated ground systems shall have a separate ground wire installed in the conduit which is run to the building service ground with no other interconnections between normal ground and isolated ground. Isolated ground wires shall be sized in accordance with the equipment served and shall be identified by a colored stripe on the green insulation.

1. Isolated ground systems shall have a separate ground wire installed in the conduit which is run to the building service ground with no other interconnections between normal ground and isolated ground. Isolated ground wires shall be sized in accordance with the equipment served and shall be identified by a colored stripe on the green insulation.

I. Grounding of all system equipment including, fire alarm, telephone and cable T.V. shall include bonding of the required system grounding electrode with the building service main grounding electrode at the service entrance. Minimum size bonding conductor shall be #6 AWG copper. Bonding together of all separate electrodes shall be permitted.

J. Equipotential Grounding

1. Equipotential grounding shall be conducted in all patient care areas. This test shall include metal conductive surfaces likely to become energized when contacted by patient or attendant touching the patient within the patient vicinity, example: beds, headwall, a/c units, sink trim, etc.

2. Test Method

a. Both voltage and impedance measurements must be made.

b. A reference point in or near the area being tested must be made before measurements are taken. A suitable reference point shall be one of the following:

1) Ground bar in a panel serving the area.

2) Established ground bus.

3) An all-metal cold water pipe.

4) Grounding contact or a receptacle that is powered from a different circuit from the receptacle under test.

c. Voltage measurements shall be made between the reference point and appropriate conductive surfaces including receptacle ground contacts.

d. Impedance measurements are to be made only between reference point and receptacle ground contacts.

3. Testing instrument utilized shall have a calibration date which is less than 1 year old, as of date of testing.

The following is an example of the ground test report format that shall be completed and presented to AHCA at the final inspection.

FACILITY NAME _____ PROJECT NAME _____ AHCA LOG NO. _____

DATE _____ TESTED BY:

Maximum Test Intervals:
General Care – 12 mos.
Critical Care – 6 mos.
Wet Locations – 12 mos.

Name: _____

Company: _____

GROUND TEST REPORT

Type meter used and external network if used: _____

_____

_____

Note: Maximum readings permitted – 20 mv New Construction
40 mv Critical Existing Construction
500 mv General Care Existing Construction
0.1 ohm New Construction
0.2 ohm Quiet Grounds and Existing

ROOM NO.	DESCRIPTION (c) = CRITICAL (g) = GENERAL	VOLTAGE MEASUREMENT			IMPEDANCE MEASUREMENT		REMARKS IF VOLTAGE READINGS MORE THAN 20MV IN EXISTING CONST. NOTE TESTS & INVESTIGATION REQ'D
		NO. OF RECEPTS	NO. OF OTHER	MAX READING IN MILIVOLTS	NO. OF RECEPTS	MAX READING IN OHMS	

END OF SECTION

SECTION 16510
INTERIOR LIGHTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. LED Luminaires

D. Exit signs.

E. Fluorescent emergency power supply units.

F. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Electrical Boxes.

B. Electrical Raceways.

1.03 REFERENCE STANDARDS

A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns.

B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast.

C. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type).

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.

E. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association.

F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association.

G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association.

I. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

J. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.04 DEFINITIONS

A. BF: Ballast factor is the ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.

B. CRI: Color rendering index is a measure of the ability of a light source to reproduce the colors of various objects being lit by the source. It is measured by comparing the color rendering of the test source to that of a black body radiator source, such as an incandescent lamp. CRI measurements range from 0 to 100, where 100 is the best color rendition. For example, an incandescent lamp will have a CRI of 100 and some tri-phosphor fluorescent lamps may have a CRI of 80 to 90.

C. Color Temperature and Correlated Color Temperature: Related to CRI is the color temperature of the lamp, expressed in degrees Kelvin (K). The color temperature of a light source is determined by comparing its chromaticity with a theoretical, heated black-body radiator. The temperature at which the heated black-body radiator matches the color of the light source is the color temperature of that source. Many light sources, such as fluorescent lamps, do not emit light because of the temperature of the source and the emitted radiation does not follow the form of a black-body spectrum and is assigned a correlated color temperature (CCT). For example, a fluorescent lamp may be specified with a correlated color temperature of 3000 K.

D. CU: Coefficient of utilization is a measure of the efficiency of a luminaire (lighting luminaire) in transferring luminous energy to the working plane in a particular area. It is the ratio of lumens from a luminaire incident upon a work plane relative to the lumens emitted by the lamps within the luminaire and measures the light actually reaching the desired plane as a percentage of the total light produced by the luminaire.

E. LER: Luminaire efficiency rating calculated according to NEMA LE-5 or estimated from photometric data using the following formula: LER is equal to the product of rated lamp lumens times BF times luminaire efficiency, divided by input watts.

F. RCR: Room cavity ratio is calculated as 2.5 times the room cavity depth (RCD) times the perimeter of the room divided by the area of the room. The room cavity depth is the depth, in feet, from the luminaire (lighting luminaire) to the work-plane.

1.05 SUBMITTALS

A. See Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: For each type of luminaire scheduled, arranged in order of luminaire designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including dimensions and verification of indicated parameters.
2. Battery and charger for emergency lighting units.
3. Ballasts for fluorescent and high-intensity-discharge (HID) luminaires.
4. Lamps to be used in each luminaire type.
5. Photometric data based on laboratory tests of each lighting luminaire type with lamps, ballasts and accessories identical to those indicated for the lighting luminaire for this Project.

6. Energy efficiency data.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Conform to requirements of NFPA 101.

1.07 EXTRA MATERIALS

A. See Product Requirements, for additional provisions.

B. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Metalux /Cooper

B. Columbia

C. Lithonia

D. Hubbell

E. Approved Equal

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598.

C. Provide products that comply with requirements of NFPA 101.

D. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

2.03 LIGHT EMITTING DIODE (LED) LUMINAIRES

A. Light loss and physical failure shall comply with L70 for an expected lifetime of 50,000 hours, or better.

B. Light loss and color rendering index (CRI) rating shall comply with Code 8, or 80% as a minimum.

C. Power factor shall be 85%, or better.

D. LED modules and LED luminaires shall comply with the performance requirements of the latest versions of the International Electro-technical Commission (IEC) publically available specification (PAS) numbers 62717 and 62722.

E. LED modules and LED luminaires shall have a ten (10)-year operational life while operating with a case temperature range of 32 degrees F to 167 degrees F and 90 percent non-condensing relative humidity.

F. Maximum inrush current for LED module shall not exceed 2 amperes for 120V and 277 V drivers and shall have no visible change in light output with a variation of +/- 10 percent line voltage input.

G. Compatibility of driver and LED light engine must be tested and ensured by driver manufacturer. Drivers shall track evenly across multiple fixtures and at all light levels.

2.04 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery: Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Provide accessories and fittings as recommended by manufacturer to properly and completely install and wire Luminaires.

G. Electrical Characteristics: 120 volts, 60 Hz, unless otherwise indicated.

H. Furnish products as indicated in the Luminaire Schedule included on the Drawings.

2.05 LUMINAIRE TYPES

A. Furnish products as indicated in Schedule included on the Drawings.

B. Luminaire: Furnish products as indicated in the Luminaire Schedule included on the Drawings:

C. Emergency Lighting Units: Self-contained fluorescent emergency lighting unit.

1. Self-contained emergency lighting units shall comply with UL 924.
2. Self-contained emergency lighting units shall have a sealed, maintenance-free, lead-acid type battery with a minimum 10 year nominal life and special warranty.
3. Self-contained emergency lighting units shall have a fully automatic, solid-state type charger with a sealed transfer relay.
4. Self-contained emergency lighting units shall be relay operated to automatically turn lamps on when power supply circuit voltage drops below 80 percent of nominal voltage, and automatically disconnects lamps from battery when normal voltage is restored. Relay shall also disconnect lamps from the battery when voltage approaches deep-discharge level. Battery shall be automatically recharged and floated on charger.
5. Unit shall connect un-switched circuit to battery-inverter unit and switched circuit to luminaire ballast.
6. Where a wire guard is specified for a self-contained emergency lighting unit, wire guard shall be heavy chrome-plated wire that protects the lamp or Luminaire head.
7. Battery: 6 or 12 volt (see Luminaire Schedule), nickel-cadmium type, with 1.5 hour capacity.
8. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
9. Indicators: Lamps to indicate AC ON and RECHARGING. Voltmeter to indicate battery voltage.
10. TEST switch: Transfers unit from external power supply to integral battery supply.
11. Electrical Connection: Conduit connection.
12. Input Voltage: 120 or 277 volts, unless otherwise shown or noted on the Drawings.
13. Product: Furnish products as indicated in the Luminaire Schedule included on the Drawings

2.06 EXIT SIGNS

A. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single or double as indicated or as required for the installed location.
2. Directional Arrows: As indicated or as required for the installed location.

B. General Requirements: Comply with UL 924, and for sign colors and lettering size, comply with requirements of authority having jurisdiction (AHJ).

C. Internally Lighted Exit Signs:

1. Lamps for AC operation shall have light-emitting diodes rated at 70,000 hours, minimum lamp life.

D. Manufacturers:

1. Shall be as shown in the Luminaire Schedule on Drawings.

E. Exit signs shall be suitable for use as emergency lighting unit and comply with the following requirements:

1. Provide luminaires complying with NFPA 101.
2. Manufacturers shall be as shown in the Luminaire Schedule on Drawings.
3. Directional Arrows: Universal type for field adjustment.
4. Mounting: Universal, for field selection.
5. Lamps: Provide manufacturer's standard lamps, as shown in the Luminaire Schedule on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate locations of outlet boxes as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workman-like manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Surface Mounted Luminaires: Install plumb and square and aligned with building lines and with each other; secure to prevent movement.

F. Suspended Ceiling Mounted Luminaires:

1. Install at locations indicated on reflected ceiling plan.
2. Support luminaires of all sizes independently of the ceiling grid and anchored directly to building structure. Refer to suspension details shown on drawings.
3. Install clips to secure luminaires in place.
4. Luminaires Recessed in Ceilings: Install to permit removal from below.
5. Suspended Luminaires: Install using pendants supported from swivel hangers, with pendant length as required for indicated height.

H. Wall Mounted Luminaires: Install at height as indicated on the drawings.

I. Recessed Luminaires: Comply with NEMA LE-4 for ceiling compatibility of recessed luminaires. Provide flexible conduit whip in maximum length of six (6) feet for recessed luminaires for connection to external J-boxes, unless junction boxes are integral in pre-wired systems.

J. Luminaire supports shall comply with the following requirements applicable to the support and luminaire type specified and provided.

1. Single Stem Hangers: One 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish shall be same as luminaire.
2. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single luminaire. Finish shall be same as luminaire.
3. Wires: Comply with ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12

gauge (2.68 mm).

4. Wires In Humid Spaces: Comply with ASTM A 580/A 580M, stainless steel composition type 302 or 304, 12 gage (2.68 mm).
5. Rod Hangers: 3/16 inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
6. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.
7. Aircraft Cable Support: Use cable, anchorages and intermediate supports recommended by luminaire manufacturer.

K. Install accessories furnished with each luminaire.

L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire; use flexible conduit.

M. Connect luminaires and exit signs to branch circuit outlets using flexible conduit.

N. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

O. Bond products and metal accessories to branch circuit equipment grounding conductor.

P. Install specified lamps in each luminaire, emergency lighting unit and exit sign.

3.02 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by the Engineer. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by the Engineer or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by the Engineer or authority having jurisdiction.

D. Aim and adjust luminaires as indicated.

E. Position exit sign directional arrows as indicated.

3.03 CLEANING

A. Remove all plastic covers and protective coatings.

B. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

C. Clean electrical parts to remove conductive and deleterious materials.

D. Remove dirt and debris from enclosures.

E. Clean finishes and touch up damaged surfaces.

END OF SECTION

SECTION 16520
EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires with lamps and ballasts and accessories.

B. LED Drivers.

C. Ballasts.

D. Lamps.

1.02 UNIT PRICES

A. See Unit Prices, for additional unit price requirements.

1.03 REFERENCE STANDARDS

A. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type.

B. ANSI O5.1 - American National Standard for Wood Poles -- Specifications and Dimensions.

C. IESNA RP-8 - American National Standard Practice for Roadway Lighting; Illuminating Engineering Society of North America; 2000(R2005) (ANSI/IES RP8).

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.

E. NECA/IESNA 501 - Recommended Practice for Installing Exterior Lighting Systems.

F. NECA 505 – Standard for Installing and Maintaining High Mast, Roadway and Area Lighting

G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: For each luminaire, arranged in the order of lighting unit designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of fixture, including dimensions and verification of indicated parameters.
   2. Luminaire dimensions and details, effective projection area, accessories,

installation, luminaire attachment and other construction details.
3. Luminaire materials.
4. Photoelectric relays.
5. Fluorescent and high-intensity-discharge ballasts.
6. Fluorescent and high-intensity-discharge lamps.
7. Electrical and energy-efficiency data for ballast

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 COORDINATION

A. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

B. Provide pole bases as directed by the manufacturer to support and provide lateral support for poles and luminaires.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers shall be as shown in the Luminaire Schedule on Drawings.

2.02 LUMINAIRE TYPES

A. Furnish products as indicated in Luminaire Schedule included on the Drawings.

2.03 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.
B. Provide products suitable for wet locations that are listed and labeled as defined in NFPA 70 (NEC), Article 100 and that comply with UL 1572 or 1598, where applicable,.

C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, drivers, ballasts, reflectors, lenses, housings and other components required to

position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, grounding equipment, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

2.04 LED DRIVERS

A. Light loss and physical failure shall comply with L70 for an expected lifetime of 50,000 hours, or better.

B. Light loss and color rendering index (CRI) rating shall comply with Code 8, or 80% as a minimum.

C. Power factor shall be 85%, or better, when operated at 120 VAC.

D. LED modules and LED luminaires shall comply with the performance requirements of the latest versions of the International Electro-technical Commission (IEC) publically available specification (PAS) numbers 62717 and 62722.

E. LED modules and LED luminaires shall have a ten (10)-year operational life while operating with a case temperature range of 0 degrees C (32 degrees F) to 62 degrees C (167 degrees F) and 90 percent non-condensing relative humidity.

F. Maximum inrush current for LED module shall not exceed 2 amperes for 120V and 277V drivers and shall have no visible change in light output with a variation of +/- 10 percent line voltage input.

G. Compatibility of driver and LED light engine must be tested and ensured by driver manufacturer. Drivers shall track evenly across multiple fixtures and at all light levels.

H. Drivers intended for outdoor applications and suitable for wet locations and rated for NEMA 4 or IP 64.

I. Operating temperatures: -20 degrees F to 150 degrees F.

J. Calculated mean time between failures (MTBF) shall be greater than 100,000 hours, when operating at full load and 77 degrees F ambient temperature.

K. Electrical filtering for electromagnetic compatibility (EMC), electromagnetic interference (EMI) or radio frequency interference (RFI) shall comply with federal standards established by 47 CFR Parts 2 and 15.

L. Drivers shall be UL 48/1310 Class 2 certified.

M. Maximum power requirements shall be less than 100 watts, unless noted otherwise.

N. Driver shall have integral protection for over-current, over-voltage and short circuits.

2.05 BALLASTS

A. All Ballasts:

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).

2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Fluorescent Ballasts: Comply with ANSI C82.1 and be suitable for lamps specified. Ballasts shall be suitable for low-temperature environments.

1. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
2. Temperatures 0 Degrees F and Higher: Electronic or electromagnetic type rated for 0 deg F starting temperature.
3. Retain subparagraph above or below depending upon design temperatures.
4. Temperatures Minus 20 Degrees F and Higher: Electromagnetic type designed for use with high-output lamps.

C. High Intensity Discharge (HID) Ballasts: ANSI C82.4 and UL 1029, metal halide lamp ballast, suitable for lamp specified. HID ballasts shall include the following features, unless indicated otherwise:

1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 degrees F for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 degrees F. Open-circuit operation will not reduce average life.
4. Voltage: Multi-tap voltage ballast

2.06 LAMPS

A. Manufacturers:

1. GE Lighting: www.gelighting.com.
2. Philips Lighting Co of NA: www.lighting.philips.com.
3. OSRAM Sylvania: www.sylvania.com.

B. All Lamps:

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined to be inconsistent in perceived color temperature.

C. Lamp Types: As specified in the Fixture Schedule included on the Drawings for each luminaire.

D. Fluorescent Lamps:

1. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature 3000K and average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

E. High Intensity Discharge (HID) Lamps:

1. Metal-Halide Lamps: Comply with ANSI C78.1372, wattage and burning position as shown in the Fixture Schedule included on the Drawings, CRI 65 (minimum) and color temperature 4000K.

2.07 FINISHES

A. Factory Finish: Manufacturer's standard paint applied to factory-assembled and factory-tested luminaire before shipping. Where indicated, match color of pole or support accessories and materials specified. Comply with National Association of Architectural Metal Manufacturers (NAAMM) recommendations for "Metal Finishes Manual for Architectural and Metal Products" for applying and designating finishes.

B. Field Painting Finish: Provide manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Install accessories furnished with each luminaire.

F. Bond products and metal accessories to branch circuit equipment grounding conductor.

G. Install lamps in each luminaire.

H. Bond luminaires, metal accessories, and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.

3.02 FIELD QUALITY CONTROL

A. See Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Perform field inspection, testing, and adjusting in accordance with Section 01400 - Quality Control.

D. Operate each luminaire after installation and connection to verify proper operation.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by the Owner or Engineer.

3.03 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed. Secure locking fittings in place.

B. Aim and adjust luminaires to provide illumination levels and distribution indicated on Drawings.

3.04 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure.

D. Clean finishes and touch up damage.

END OF SECTION

SECTION 16950
OCCUPANCY SENSORS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.

B. Contractor/Supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 16.

C. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.

1.02 EQUIPMENT QUALIFICATION

A. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.

B. All components shall be U.L. listed, offer a five (5) year warranty and meet all state and local applicable code requirements.

C. Products shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

D. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

1.03 SYSTEM DESCRIPTION

A. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.

B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

C. Contractor shall warrant all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with specifications. The supplier’s obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

1.04 SUBMITTALS

A. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.

B. Submit a lighting plan clearly marked by manufacturer showing proper product, location and orientation of each sensor.

C. Submit any interconnection diagrams per major subsystem showing proper wiring.

D. Submit standard catalog literature which includes performance specifications indicating compliance to the specification.

E. Catalog sheets must clearly state any load restrictions when used with electronic ballasts.

1.05 SYSTEM OPERATION

A. It shall be the contractor's responsibility to make all proper adjustments to assure owner's satisfaction with the occupancy system, or;

B. Factory Startup (Optional): It shall be the manufacturer's responsibility to verify all proper adjustments and train owner's personnel to ensure owner's satisfaction with the occupancy system. This service is provided at an additional cost.

PART 2 - SPECIFIC REQUIREMENTS

2.01 ACCEPTABLE MANUFACTURERS

A. Watt Stopper or Pre-approved equal: For pre-approval, provide all the information listed under section 1.04A and 1.04D a minimum of ten (10) working days prior to initial bid date.

B. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for sensors which meet or exceed the specifications included herein.

2.02 PRODUCTS

A. All products shall be Watt Stopper product numbers:

1. Ceiling sensors: WT-605, WT-600, WT-1105, WT-1100, WT-2205, WT-2200, WT-2250, WT-2255, WP-605, WP-1105, WP-2255, WP-2205, W-500A, W-1000A, W-2000A, W-2000H, UT-300, UT-305, UT-355, WPIR, DT-200, DT-205, DT-300, DT-305, DT-355, CX-100, CX-105, CI-200, CI-205, CI-300, CI-305, CI-355, CI-12, CI-24
2. Wall switch sensors: PW-100, PW-100-24, PW-200, WS-200, WD-170, WD-180, WD-270, WD-280, WN-100-120, WN-100-277, UW-100, UW-100-24, UW-200, DW-100, DW-100-24, DW-200.
3. Power and Auxiliary Packs: BZ-50, BZ-100, BZ-150, LC-100, C120E-P, C277E-P, S120/27-P, AT-120, AT-277
4. HID Control: DM-100, DM-105, DM-105-WP

5. Outdoor sensors: EW-100, EW-200, EWF-105, EWF-205, EW-105-24, EW-205-24, EN-100, EN-200
6. Low Temperature: CB-100
7. Digital Time Switches: TS-400, TS-400-24
8. Automatic Control Switch: AS-100

B. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.

C. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180˚ coverage capability.

D. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

E. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.

F. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

G. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.

H. Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.

I. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).

J. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

K. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

L. Dual technology sensors shall be wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.

M. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

N Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

O. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

P. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

Q. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

R. When specified, sensors shall utilize SmartSet™ technology for automatically adjustable time delay and sensitivity settings.

S. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

T. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

U. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

V. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

W. All sensors shall have UL rated, 94V-0 plastic enclosures.

X. Outdoor sensors shall have UL 773A ratings. EWF outdoor sensors shall additionally have UL 1571 ratings.

Y. EW-100 outdoor sensors shall cover up to 35 feet, with a field of view of 180 degrees. EW-200 shall cover up to 52.5 feet, with a field of view of 270 degrees. EN-100 outdoor sensors shall cover up to 35 feet, with a field of view of 90 degrees. EN-200 outdoor sensors shall cover up to 100 feet, with a long range lens view.

Z. EWF outdoor sensors shall include polycarbonate lamp holders that accept PAR 20 or 38 lamps up to 150W per lamp.

AA. Outdoor sensors shall have an operating temperature range of -40°F to +130°F.

BB. To ensure complete protection from weather elements and exposure, outdoor sensors shall be manufactured with precision double-shot tooling and contain internal silicon gaskets.

CC. HID controller shall be compatible with all types of High Intensity Discharge (HID) lamps, including Metal Halide, Metal Halide Pulse Start, and High Pressure Sodium.

DD. HID controller shall operate with HID lamps utilizing Constant Wattage Autotransformer (CWA) type ballasts.

EE. To avoid lamp damage during the HID power up period, the HID controller shall maintain a full light level during lamp warm up for 15 minutes.

FF. To maximize lighting control scenarios, the HID controller shall be compatible with any 24 VDC controlling device, such as occupancy sensors, time switches, control panels, or photocells.

GG. The HID controller shall be capable of linking to other HID control modules to enable effective multizone control. More than 100 individual devices shall be capable of being connected.

2.03 CIRCUIT CONTROL HARDWARE - CU

A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.

B. Relay Contacts shall have ratings of:
13A - 120 VAC Tungsten
20A - 120 VAC Ballast
20A - 277 VAC Ballast

C. Control wiring between sensors and controls units shall be Class II , 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

PART 3 - EXECUTION

3.01 INSTALLATION

A. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

B. It is the contractor’s responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.

C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

3.02 FACTORY COMMISSIONING (OPTIONAL)

A. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments

and sensor placement to ensure a trouble-free occupancy-based lighting control system. This service is provided at an additional cost.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the scheduled commissioning date. Upon completion of the system fine tuning the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors.

END OF SECTION