

## APPENDIX A

### MECHANICAL SPECIFICATIONS

#### SECTION 15010 - BASIC MECHANICAL REQUIREMENTS

##### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Conditions of the Contract (General, Supplementary, and other Conditions), Specifications, and addenda, apply to this section.

##### 1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements of Division 1:

- 1. Submittals.
- 2. Maintenance manuals.
- 3. Mechanical installations.

- B. Related Sections: The following Sections contain requirements that relate to this Section. However, requirements shall not be limited to those sections listed.

- 1. Section I.I.O. "PROJECT CLOSEOUT" for requirements to record documents and maintenance manuals.

- C. Refer to Section I.B. for "Project Intent."

##### 1.3 SCOPE OF WORK

- A. Work in this Section shall include the following:

- 1. Demolish and replace existing pipe and/or pipe insulation as indicated in the contract documents for each project proposal.

##### 1.4 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Specification Sections.

- B. The Contractor may need and submit additional copies as may be required by individual sections of these specifications.

- C. The Contractor shall clearly mark the item by size or capacity that is being submitted for compliance to the documents.

## 1.5 QUALITY ASSURANCE

- A. Equipment and Component Selection: Equipment and components of different power, dimensions, capacities, and ratings than the basis of design may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, equipment spaces, etc. are modified as required. No additional costs will be approved for these modifications, if equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements at capacities indicated in Contract Documents.
- B. The Contractor shall be responsible for any and all deviations from the construction documents. The Contractor, at his expense, shall coordinate and provide all modifications associated with deviations, including approved alternates and manufacturers, from the basis of design. Any deviation affecting structural systems shall require the approval and the stamp of a registered structural engineer.
- C. All work shall meet or exceed the standards and procedures of the entities listed below and in Division 1 sections. In case of a conflict between standards, the more stringent shall be followed.

AABC	Associated Air Balance Council
ADC	Air Diffusion Council
AGA	American Gas Association
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BOCA	Building Officials and Code Administrators International, Inc.
CISCA	Ceiling and Interior Systems Contractors' Association
CISPI	Cast Iron Soil Pipe Institute
CSA	Canadian Standards Association

ETL	ETL Testing Laboratories, Inc.
IBR	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
MICA	Midwest Insulation Contractors' Association, Inc.
MSS	Manufacturers' Standardization Society
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
NICA	National Insulation Contractors' Association
NRCA	National Roofing Contractors' Association
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
UL	Underwriters Laboratories Inc.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

## 1.7 WORKMANSHIP

- A. All work shall be performed by competent mechanics and Subcontractors using proper tools and equipment to produce first-quality work. All work shall be neatly installed, accessible for maintenance, and complete with all accessories required.
- B. Products shall be installed in accordance with manuals, guidelines, or instructions furnished by the product manufacturer.
- C. All work must conform to 2012 International Mechanical Code and WSSC Plumbing Code or to the applicable codes (Building, Plumbing, Fire, etc.) for Montgomery County and the State of Maryland, and to regulations of those authorities having jurisdiction, such as local inspectors.

## 1.8 ACCESSIBILITY

- A. All equipment shall be installed in such a way that all components requiring access (such as panels, disconnect switches, circuit breakers, starters, and accessories) are so located and installed that they may be serviced, reset, replaced, recalibrated, etc., by service technicians in accordance with the manufacturer's recommendations. If any equipment or components are located in such a position that this Contractor cannot comply with the above, the Contractor shall notify the Engineer in writing before equipment is installed.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All products shall be new, of first-line quality, and of the grade and type shown on the drawings and specified herein.
- B. All products shall be in current production with no notice having been given that such product is to be drastically changed, modified, or discontinued from current production by the manufacturer proposed. All products shall have parts and service availability.
- C. The supplier, by submitting, certifies that the equipment being proposed is proper for the application intended, and that it has the capacity either specified or suitable for the purpose.

## PART 3 - EXECUTION

### 3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Coordinate the equipment and work of other divisions for rough-in requirements.

### 3.2 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment including, but not limited to, the following:
  - 1. Coordinate mechanical systems, 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.
  - 6. Where mounting heights are not detailed, noted, 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 materials 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.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install insulation to facilitate service, maintenance, and repair or replacement of equipment components in accordance with manufacturers' recommendations.
11. Install access panels or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Section 15050 "BASIC MECHANICAL MATERIALS AND METHODS."

### 3.3 CUTTING AND PATCHING

- A. General: Protect installed work and adjacent installations during cutting and patching operations.
- 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. Provide temporary steel lintels above opening in masonry, concrete, or weight bearing structures.
  6. Upon written instructions from the Engineer, uncover and restore work to provide for 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, ducts, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by work under this contract. In no case is work allowed to be abandoned in place, unless otherwise noted on the drawings.
- 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.

- F. Patch existing finished surfaces and building components with new materials to match the existing materials. Use experienced installers. Installers must be qualified in the use of materials and methods required for the surface and building components being patched. Qualification shall be by certification, trade association membership, or by demonstration.

### 3.4 CLEANING AND PAINTING

- A. Thoroughly clean all equipment, and remove all dust, dirt and debris from the area. Make any necessary corrections, or repair/replace any damaged materials or equipment. Leave the entire work area in a thoroughly clean and orderly manner.
- B. Any finished surfaces that have been scratched or discolored shall be touched up or repainted with paint to match the original color. Painting shall be corner to corner and edge to edge for damaged and repaired surfaces. If any part has been bent, broken, or otherwise damaged, it shall be replaced prior to final review (Punch list).

END OF SECTION 15010

## **SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS**

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Conditions of the Contract (General, Supplementary, and other Conditions), Specifications, and addenda, apply to this section.

#### 1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.
  - 1. Mechanical sleeve seals.
  - 2. Labeling and identifying mechanical systems and equipment is specified in Division 15 Section "Mechanical Identification."
  - 3. Installation requirements common to equipment specification sections.
  - 4. Mechanical demolition.
  - 5. Cutting and patching.
  - 6. Painting and finishing.
  - 7. Access Doors and Panels.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. NP: Nylon plastic.
  - 4. PE: Polyethylene plastic.
  - 5. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. CR: Chlorosulfonated polyethylene synthetic rubber.
  - 2. EPDM: Ethylene propylene diene terpolymer rubber.

#### 1.4 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Specification Sections.

#### 1.5 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code - Steel."
- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

## 1.6 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work.
- E. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces.
- F. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

## 1.7 PROJECT CONDITIONS

- A. Conditions Affecting Selective Demolition: The following project conditions apply:
  1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent occupied areas. Remove protection and barriers after demolition operations are complete.
  2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas and coordinate the outages with the occupants or those otherwise affected.
- B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. Mechanical Sleeve Seals:
  - a. Calpico, Inc.
  - b. Metraflex Co.
  - c. Thunderline/Link-Seal.

### 2.2 MECHANICAL SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

### 2.3 PIPING SPECIALTIES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - a. Underdeck Clamp: Clamping ring with set screws.
5. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with one mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.
  - a. Penetrating Pipe Deflection: five percent without leakage.
  - b. Housing: Ductile-iron casting having water stop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
  - c. Pipe Sleeve: AWWA C151, ductile-iron pipe.

- d. Housing-to-Sleeve Gasket: Rubber or neoprene, push-on type, of manufacturer's design.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
- 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
  - 2. OD: Completely cover opening.
  - 3. Cast Brass: One piece, with set screw.
    - a. Finish: Polished chrome-plate.
  - 4. Cast Brass: Split casting, with concealed hinge and set screw.
    - a. Finish: Polished chrome-plate.
  - 5. Stamped Steel: One piece, with set screw and chrome-plated finish.
  - 6. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.

## 2.4 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
- 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psig, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.5 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Elastomeric Joint Sealers: Provide the following types:
- 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for use in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
  - 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.

3. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. One-Part, Nonacid-Curing, Silicone Sealant:

- 1) "Chem-Calk N-Cure 2000," Bostic Construction Products Div.
- 2) "Dow Corning 790," Dow Corning Corp.
- 3) "Silglaze N SCS 2501," General Electric Co.
- 4) "Silpruf SCS 2000," General Electric Co.
- 5) "864," Pecora Corp.
- 6) "Rhodorsil 5C," Rhone-Poulenc, Inc.
- 7) "Spectrum 1," Tremco, Inc.
- 8) "Spectrum 2," Tremco, Inc.
- 9) "Dow Corning 795," Dow Corning Corp.
- 10) "Rhodorsil 6B," Rhone-Poulenc, Inc.
- 11) "Rhodorsil 70," Rhone-Poulenc, Inc.
- 12) "Omniseal," Sonneborn Building Products Div.
- 13) "Chem-Calk 100," Bostik Construction Products Div.
- 14) "Gesil N SCS 2600," General Electric Co.

b. One-Part, Mildew-Resistant, Silicone Sealant:

- 1) "Dow Corning 786," Dow Corning Corp.
- 2) "SCS 1702 Sanitary," General Electric Co.
- 3) "863 #345 White," Pecora Corp.
- 4) "Rhodorsil 6B White," Rhone-Poulenc, Inc.
- 5) "Proglaze White," Tremco Corp.
- 6) "OmniPlus," Sonneborn Building Products Div.

C. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus five percent.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

- a. "Chem-Calk 600," Bostik Construction Products Div.
- b. "AC-20," Pecora Corp.
- c. Sonolac," Sonneborn Building Products Div.
- d. "Tremco Acrylic Latex 834," Tremco, Inc.

- D. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
    - a. "Dow Corning Fire Stop Foam," Dow Corning Corp.
    - b. "Pensil 851," General Electric Co.
    - c. "SpecSeal" Series 100
- E. Exterior Sealant: One part, high performance, polyurethane sealant complying with ASTM C920 shall be used for all exposed exterior applications. Sealant and accessories shall be installed per manufacturer's instructions and recommendations.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, and are limited to the following:
    - a. "Vulkem 116," Tremco, Inc.

## 2.6 ACCESS DOORS

- A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
- B. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
1. For installation in masonry, concrete, ceramic tile, or wood paneling: one-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
  2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
  3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- C. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175; factory-applied prime paint.

1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- D. Locking Devices: Flush, screwdriver-operated cam locks.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers' offering products which may be incorporated in the work include, but are not limited to, the following:
1. Bar-Co., Inc.
  2. J.L. Industries.
  3. Karp Associates, Inc.
  4. Milcor Div. Inryco, Inc.
  5. Nystrom, Inc.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Seal sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.
  2. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials meeting assembly requirements of UL Fire Resistance Directory.

### 3.2 PAINTING AND FINISHING

- A. Follow paint manufacturer's recommendations for surface preparation and application of paint.
- B. Apply paint to exposed items according to the following, unless otherwise indicated:
1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.

3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
  5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
  6. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
  7. Interior and Exterior Natural Gas Piping: Use two coats of OSHA safety yellow over rust-inhibitive metal primer.
  8. All interior exposed ductwork, duct insulation and air devices: Color shall match the existing adjacent area.
- C. Do not paint piping specialties with factory-applied finish.
- D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.3 DEMOLITION

- A. Disconnect, demolish, and remove Work specified in Division 15 Sections.
- B. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed insulation in its entirety.

### 3.4 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical insulation installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

### 3.5 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
  2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

3. Comply with recommendations of ASTM C920 for use of polyurethane joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around mechanical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

### 3.6 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face frames plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

END OF SECTION 15050

## **SECTION 15145 - HANGERS AND SUPPORTS**

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Conditions of the Contract (General, Supplementary, and other Conditions), Specifications, and addenda, apply to this section.

#### 1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical systems piping.

#### 1.3 DEFINITIONS

- A. Terminology used in this Section is defined in MSS SP-90.

#### 1.4 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Specification Sections.

- B. Product data for each type of hanger and support.
- C. Welder certificates signed by Contractor certifying that welders comply with requirements specified.

## 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 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, Article 100.
  - 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
  - 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 average compressive strength, waterproofed treated wood, 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.



## 2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Grout: ASTM C 1107, Grade B, nonshrink, 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, 28-day compressive strength.
  - 3. Water: Potable.
  - 4. Packaging: Premixed and factory-packaged.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Replace pipe hangers where new installation thickness is greater than removed insulation thickness.
- B. Comply with ANSI/MSS-SP-58-2009 for pipe hanger selections and applications that are not specified in piping specification Sections.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- 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.
- 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. Install

additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.

- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- H. 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.
- I. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- J. 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.
- K. Insulated Piping: Comply with the following installation requirements.
  - 1. Clamps: Insulate around existing clamps. Seal at penetrations by hanger rod.
  - 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:

<u>NPS (Inches)</u>	<u>LENGTH (Inches)</u>	<u>THICKNESS (Inches)</u>
1/4 to 2	8	0.048
2-1/2 to 6	12	0.060
8	18	0.075

- 4. Insert Material: Two inches longer than the protective shield.
- 5. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

### 3.3 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

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

### 3.4 ADJUSTING

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

### 3.5 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touching Up: Clean and touch-up painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15145

## **SECTION 15190 - MECHANICAL IDENTIFICATION**

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Conditions of the Contract (General, Supplementary, and other Conditions), Specifications, and addenda, apply to this section.

## 1.2 SUMMARY

- A. This Section includes mechanical identification materials and devices.

## 1.3 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Specification Sections.
- B. Product data for identification materials and devices

## 1.4 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

## 1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices after completion of covering and painting where devices are applied to surfaces.

## PART 2 - PRODUCTS

### 2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Products specified are manufacturer's standard products of categories and types required for each application as referenced in other Division-15 Sections. Where more than single type is specified for listed application, selection is Installer's option, but provide single selection for each product category.
- B. Pipes: Full-band pipe markers, extending 360 degrees around pipe at each location. Labels shall be set around the pipes with field installed high strength cement around pipes.
- C. Lettering: Use piping system terms as indicated on the drawings and abbreviate only as necessary for each application length.
  - 1. Arrows: Either integrally with piping system service lettering (to accommodate both directions), or as separate unit, on each pipe marker to indicate direction of flow.

## PART 3 - EXECUTION

### 3.1 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
  - 1. Plastic markers, with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.
    - a. Fasten markers on pipes 4 inches and smaller, using the following method:
      - 1) Adhesive lap joint in pipe marker overlap.
  - 2. Locate pipe markers and color bands as follows wherever piping is exposed in finished spaces, machine rooms, and exterior non-concealed locations.
    - a. Near each valve and control device.
    - b. Near each branch connection. Mark each pipe at branch, where flow pattern is not obvious.
    - c. Near penetrations through walls, floors, ceilings, or enter non-accessible enclosures.
    - d. At access doors, manholes, and similar access points that permit view of concealed piping.
    - e. Near major equipment items and other points of origination and termination.
    - f. Spaced at a maximum of 25-foot intervals along each run. Reduce intervals to 10 feet in congested areas of piping and equipment.

### 3.2 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices which have become visually blocked by work of this Division or other Divisions.

END OF SECTION 15190

## **SECTION 15250 - MECHANICAL INSULATION**

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Conditions of the Contract (General, Supplementary, and other Conditions), Specifications, and addenda, apply to this section.

## 1.2 SUMMARY

- A. This Section includes preformed, rigid and flexible pipe, insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections: The following sections contain requirements that relate to this section. However, requirements shall not be limited to those sections listed:
  - I. Section 15145 "HANGERS AND SUPPORTS" for pipe insulation shields and protection saddles.

## 1.3 DEFINITIONS

- A. Hot Surfaces: Normal operating temperatures of 100 Deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 Deg F.
- D. Thermal Resistivity: "R-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly one-inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.
- E. Density: Is expressed in lb/cubic ft (pcf).

## 1.4 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Specification Sections.
- B. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories.

## 1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

## 1.6 SEQUENCING AND SCHEDULING

- A. Schedule insulation application after testing of piping systems.

## 1.7 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  2. Insulation application at pipe expansion joints for each type of insulation.
  3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  4. Removable insulation at piping specialties and equipment connections.
  5. Application of field-applied jackets.
- C. Samples: For each type of insulation and jacket. Identify each Sample, describing product and intended use. Submit Samples in the following sizes:
  1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN50).
  2. Sheet Form Insulation Materials: 12 inches (300 mm) square.
  3. Jacket Materials: 12 inches (300 mm) long by NPS 2 (DN50).
  4. Manufacturer's Color Charts: Show the full range of colors available for each type of field-applied finish material indicated.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
- E. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. Glass Fiber:

- a. CertainTeed Corporation.
- b. Knauf Fiberglass GmbH.
- c. Manville.
- d. Owens-Corning Fiberglas Corporation.

2. Flexible Elastomeric Pipe Insulation

- a. Armacell International (Armaflex)

## 2.2 GLASS FIBER

A. Material: Inorganic glass fibers, bonded with a thermosetting resin.

B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant aluminum foil (foil-scrim-kraft) having self-sealing lap.

C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.

1. Thermal Conductivity: 0.23 average maximum, at 75°F Thermal Coefficient temperature.
2. Density: 3 pcf.

D. Preformed Pipe Insulation and Fittings: ASTM C 547, Class 1, rigid pipe insulation, jacketed.

1. Thermal Conductivity: 0.23 average maximum at 75°F Thermal Conductivity:
2. Density: 4.0 pcf average.

E. Adhesive: Produced under the UL Classification and Follow-up service.

1. Type: Non-flammable, solvent-based.
2. Service Temperature Range: Minus 20 to 180 deg F.

F. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

## 2.3 FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.

1. Tubular Materials: ASTM C534, Type I.



2. Sheet Materials: ASTM C534, Type II.
- B. Thermal Conductivity: 0.30 average maximum at 75 deg F.
- C. Coating: Water based latex enamel coating recommended by insulation manufacturer for Exterior installations.

## 2.4 INSULATING CEMENTS

- A. Mineral Fiber: ASTM C 195.
  1. Thermal Conductivity: 1.0 average maximum at 500 ° Thermal Conductivity
  2. Compressive Strength: 10 psi at 5 percent deformation.

## 2.5 ADHESIVES

- A. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
  1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
  2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

## 2.6 JACKETS

- A. General: All-purpose, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- B. Exterior Exposed Pipe Insulation:
  1. Aluminum Jacket: Factory cut and rolled to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
    - a. Finish and Thickness: Smooth finish, 0.016 inch (0.25 mm) thick.
    - b. Jacket Band: Stainless steel, Type 304, 3/4-in. wide
    - c. Moisture Barrier: 1-mil-thick, heat-bonded, polyethylene or kraft paper.
- C. Interior Exposed Pipe Insulation (Chiller/Boiler Rooms)
  2. PVC Jacketing: High-impact, ultra-violet resistant PVC, 20-mils thick, roll stock ready for shop or field cutting and forming to indicated sizes.
    - a. Adhesive: As recommended by insulation manufacturer.

- b. Colors to match owner's system designation colors.
- c. All insulation in the boiler/chiller equipment rooms shall be covered with color-coded PVC jacket. (No painting shall be accepted in lieu of jacket.) A sample of the jacketing must be reviewed and approved by the MCPS Project Coordinator prior to installation.
- d. Color code and labeling shall be as follows:

<u>Piping System</u>	<u>Pipe Marker Designation</u>	<u>Pipe Color</u>
Chilled Water Supply	CWS	Dark Blue
Chilled Water Return	CWR	Dark Blue
Heating Water Supply	HS	Orange
Heating Water Return	HR	Orange
Dual Temperature Supply	DTS	Yellow
Dual Temperature Return	DTR	Yellow
Domestic Cold Water	CW	Green
Domestic Hot Water	HW	Red
Domestic Hot Water Circulating	HWC	Red
Natural Gas	Gas	OSHA Yellow
Drains	D	-
Overflows	OF	-

- 2. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil- (0.75-mm-) thick, high-impact, ultraviolet-resistant PVC.
  - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps,
  - b. Adhesive: As recommended by insulation material manufacturer.

## 2.8 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.
  - 1. Tape Width: four inches.
  - 2. Cloth Standard: MIL-C-20079H, Type I.
  - 3. Tape Standard: MIL-C-20079H, Type II.
- B. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

## 2.9 SEALING COMPOUNDS

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.
  - 1. Water Vapor Permeance: 0.08 perm maximum.
  - 2. Temperature Range: Minus 20 to 180°F
  
- B. Weatherproof Sealant: Flexible elastomer-based, vapor-barrier sealant designed to seal metal joints.
  - 1. Water Vapor Permeance: 0.02 perm maximum.
  - 2. Temperature Range: Minus 50 to 250°F
  - 3. Color: Aluminum.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.
  
- B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.
  - 1. Follow cement manufacturer's printed instructions for mixing and portions.

### 3.2 INSTALLATION, GENERAL

- A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system. Install insulation in accordance with the latest National Commercial and Industrial Insulation Standards. Due to field conditions and requirements of maintaining a sealed vapor barrier, contractor may be required to install Armacell insulation instead of fiberglass insulation in a few places. The MCPS Project Coordinator or MCPS representative, Building Dynamics, LLC, will advise where this will occur on specific projects. Contractor shall install insulation as directed at no extra cost to the Owner.
  
- B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.
  
- C. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.
  
- D. Install insulation with smooth, straight, and even surfaces.

- E. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.
- F. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.
- G. Seal Ends: Taper ends at 45 degree angle and seal with lagging adhesive.
- H. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.
- I. Keep insulation materials dry during application and finishing.

### 3.3 PIPE INSULATION INSTALLATION, GENERAL

- A. Tightly butt longitudinal seams and end joints. Bond with adhesive.
- B. Stagger joints on double layers of insulation.
- C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.
- D. Apply insulation with a minimum number of joints.
- E. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Cover circumferential joints with butt strips, at least three inches wide, and of same material as insulation jacket. Secure with adhesive.
  - 3. Longitudinal Seams: Overlap seams at least 1 inch. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
  - 4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.
  - 5. At penetrations in jackets for thermometers and pressure gauges, fill and seal voids with vapor barrier coating.
  - 6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least two inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.
- F. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket

for exterior insulation outside roof flashing at least two inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.

- G. Floor Penetrations: Extend pipe insulation through floor. Fill void between floor and pipe insulation with mineral wool with the top of void sealed with ¼ inch Hilti FS-One Firestop Sealant. Provide a ½-inch bead of Hilti FS-One Firestop around the pipe insulation at joint with top of floor.
- H. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Seal Vapor barrier. Seal around penetration with joint sealer.
- I. Fire-Rated Walls and Partitions Penetrations: Extend insulation at penetrations through fire-rated walls and partitions. Fill void between wall and pipe insulation with mineral wool. Seal around penetration with Specseal Series 100 firestopping or equivalent fire-resistant joint sealer with UL System rating.
- J. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.
  - 1. Use same material and thickness as adjacent pipe insulation.
  - 2. Overlap nesting insulation by two inches or one-pipe diameter, whichever is greater.
  - 3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
  - 4. Insulate elbows and tees smaller than three-inch pipe size with premolded insulation.
  - 5. Insulate elbows and tees three inches and larger with premolded insulation or insulation material segments. Use at least three segments for each elbow.
  - 6. Cover insulation with two layers of lagging adhesive to a minimum thickness of 1/16-inch. Install glass cloth between layers. Overlap adjacent insulation by two inches in both directions from joint with glass cloth and lagging adhesive.
- K. Hangers:
  - 1. Apply insulation continuously through hangers.
  - 2. Install saddles, shields, and inserts as specified in Section 15145 "HANGERS AND SUPPORTS."
  - 3. For fiber glass insulated piping, provide treated wood or high density insert section (calcium silicate) continuous with adjoining pipe insulation and jacket.
    - a. Piping less than 2-in. diameter pipe: none.

- b. Piping 2-in. to 6-in. diameter pipe: 14-in. long.
  - c. Piping 6-in. to 10-in. diameter pipe: 20-in. long.
- 4. Insulation protection saddles and shields 2-in. shorter than insert sections.
  - 5. No hanger shall be embedded in insulation.
  - 6. Cover insulation inserts with jacket material matching adjacent pipe insulation.

### 3.4 GLASS FIBER PIPE INSULATION INSTALLATION

- A. Bond insulation to pipe with lagging adhesive.
- B. Seal exposed ends with lagging adhesive.
- C. Seal seams and joints with vapor barrier compound.

### 3.5 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

- A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.
- B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.
  - 1. Miter cut materials to cover soldered elbows and tees.
  - 3. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.
- C. Exterior Piping: Coat insulation with two coats of WB Armaflex Finish. Follow manufacturer's Applications instructions. Cover with aluminum jacket.

### 3.6 HIGH DENSITY INSULATION INSERT INSTALLATION

- A. Apply insulation according to the manufacturer's written instructions and as follows:
  - 1. Secure single layer of insulation to pipe with stainless-steel bands. Tighten bands without deforming the insulation material.
  - 2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch soft annealed, stainless-steel wire. Secure outer layer with stainless-steel bands.
  - 3. On exposed applications, without metal jackets, finish insulation with a skim coat of mineral-fiber, hydraulic -setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on

one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

- B. Pressure treated wood dowel may used in lieu of high density insulation insert.

### 3.7 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket where indicated, directly over bare insulation or insulation with factory-applied jackets.
  - 1. Apply jacket smooth and tight to surface with 2-inch (50 mm) overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch- (1.6 mm) thick coats of jacket manufacturer's recommended adhesive.
  - 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

### 3.8 FINISHES

- A. Paint finished insulation as specified in Section 15010 and 15050.
- B. Provide PVC covers on all exposed pipe insulation in boiler/chiller rooms.

### 3.9 APPLICATIONS

- A. General: Materials and thicknesses are specified in schedules at the end of this Section.
- B. Interior and Exterior Piping Systems: Unless otherwise indicated, insulate the following piping systems:
  - 1. Heating/cooling water.
  - 2. Domestic hot/cold and hot water recirculating water.
  - 3. Refrigerant.
  - 4. Interior condensate drain.

### 3.10 PIPE INSULATION SCHEDULES

- A. General: Abbreviations used in the following schedules include:

1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A-Aluminum, SS-Stainless Steel, G-Glass Cloth.
2. Pipe Sizes: NPS - Nominal Pipe Size.

B. Domestic Cold Water, All Sizes (interior): 1/2-inch thick glass fiber.

INTERIOR CONDENSATE DRAIN PIPING (35 TO 75 DEG F) EXPOSED AND CONCEALED

<u>PIPE SIZES (NPS)</u>	<u>MATERIALS</u>	<u>THICKNESS IN INCHES</u>	<u>VAPOR BARRIER REQ'D</u>	<u>FIELD-APPLIED JACKET</u>
3/4 TO 2	FLEXIBLE ELASTOMERIC	1	YES	NONE
2-1/2 TO 4	FLEXIBLE ELASTOMERIC	1	YES	NONE

HEATING/COOLING AND HEATING HOT WATER (40 TO 250 DEG F) EXPOSED AND CONCEALED

<u>PIPE SIZES (NPS)</u>	<u>MATERIALS</u>	<u>THICKNESS IN INCHES</u>	<u>VAPOR BARRIER REQ'D</u>	<u>FIELD-APPLIED JACKET</u>
TO 2	GLASS FIBER	1-1/2	YES	A
	CALCIUM SILICATE	1	YES	A
	FLEXIBLE ELASTOMERIC	1	YES	A
2-1/2 TO 4	GLASS FIBER	1-1/2	YES	A
	CALCIUM SILICATE	1-1/2	YES	A
	FLEXIBLE ELASTOMERIC	1-1/2	YES	A
5 TO 10	GLASS FIBER	2	YES	A
	CALCIUM SILICATE	2	YES	A
	FLEXIBLE ELASTOMERIC	1-1/2	YES	A

Notes:

1. Provide field-applied jacket as follows: aluminum for exterior
2. Coordinate installation with heat trace. Refer to other specifications.



3. Install Flexible Elastomeric (Armaflex) insulation inside unit ventilators and fan coil units.

INTERIOR REFRIGERANT SUCTION (35 TO 100 DEG F) EXPOSED AND CONCEALED

<u>PIPE SIZES (NPS)</u>	<u>MATERIALS</u>	<u>THICKNESS IN INCHES</u>	<u>VAPOR BARRIER REQ'D</u>	<u>FIELD-APPLIED JACKET</u>
TO 1-1/4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1	YES	NONE
	FLEXIBLE	3/4	YES	NONE
	ELASTOMERIC			
1-1/2 TO 4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
	FLEXIBLE	3/4	YES	NONE
	ELASTOMERIC			

END OF SECTION 15250

**END OF APPENDIX A**