**SECTION 22 07 00**

**PLUMBING INSULATION**

**BASED ON DFD MASTER SPECIFICATION DATED 10/1/12**

***This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.***

**PART 1 - GENERAL**

**SCOPE**

This section includes insulation specifications for plumbing piping and equipment. Included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 Reference Standards

 Quality Assurance

 Description

 Definitions

 Shop Drawings

 Operation and Maintenance Data

PART 2 - PRODUCTS

 Materials

 Insulation & Jackets

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PART 3 - EXECUTION

 Installation

 Piping, Valve and Fitting Insulation

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 Construction Verification Items

**RELATED WORK**

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 22 08 00 – Commissioning of Plumbing

Section 22 05 00 - Common Work Results for Plumbing

Section 22 11 00 - Facility Water DistributionSection 22 13 00 - Facility Sanitary SewerageSection 22 14 00 - Facility Storm DrainageSection 22 15 13 - General Service Compressed-Air PipingSection 22 50 00 - Pool and Fountain Plumbing SystemsSection 22 60 00 - Gas and Vacuum Systems for Laboratory and Healthcare FacilitiesSection 22 63 00 - Gas Systems for Laboratory and Healthcare FacilitiesSection 22 67 00 - Processed Water Systems for Laboratory and Healthcare Facilities

Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

Section 22 30 00 - Plumbing Equipment

**REFERENCE**

Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**

ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate

ASTM C165 Test Method for Compressive Properties of Thermal Insulations

ASTM C177 Heat Flux and Thermal Transmission Properties

ASTM C195 Mineral Fiber Thermal Insulation Cement

ASTM C240 Cellular Glass Insulation Block

ASTM C302 Density of Preformed Pipe Insulation

ASTM C303 Density of Preformed Block Insulation

ASTM C449 Mineral Fiber Hydraulic Setting Thermal Insulation Cement

ASTM C518 Heat Flux and Thermal Transmission Properties

ASTM C533 Calcium Silicate Block and Pipe Thermal Insulation

ASTM C534 Preformed Flexible Elastomeric Thermal Insulation

ASTM C547 Mineral Fiber Preformed Pipe Insulation

ASTM C552 Cellular Glass Block and Pipe Thermal Insulation

ASTM C553 Mineral Fiber Blanket and Felt Insulation

ASTM C578 Preformed, Block Type Cellular Polystyrene Thermal Insulation

ASTM C591 Preformed Rigid Cellular Polyurethane Thermal Insulation

ASTM C610 Expanded Perlite Block and Thermal Pipe Insulation

ASTM C612 Mineral Fiber Block and Board Thermal Insulation

ASTM C921 Properties of Jacketing Materials for Thermal Insulation

ASTM C1136 Flexible Low Permeance Vapor Retarders for Thermal Insulation

ASTM E84 Surface Burning Characteristics of Building Materials

MICA National Commercial & Industrial Insulation Standards

NFPA 225 Surface Burning Characteristics of Building Materials

UL 723 Surface Burning Characteristics of Building Materials

**QUALITY ASSURANCE**

Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.

**DESCRIPTION**

Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:

1. Pipe Insulation
2. Equipment Insulation

Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the DFD Project Representative.

**DEFINITIONS**

Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

**SHOP DRAWINGS**

Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

# OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

***Delete the following if there are no additional requirements.***

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. ***[A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]***

**PART 2 - PRODUCTS**

**MATERIALS**

Materials or accessories containing asbestos will not be accepted.

Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:

Insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 150.

**INSULATION AND JACKETS**

Manufacturers: Armstrong, Certainteed Manson, Childers, Dow, Extol, Halstead, H.B. Fuller, Imcoa, Knauf, Owens-Corning, Pittsburgh Corning, Rubatex, Johns-Mansville, or approved equal.

Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

RIGID FIBERGLASS INSULATION:

Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

SEMI-RIGID FIBERGLASS INSULATION:

Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.

White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

CALCIUM SILICATE INSULATION:

Rigid hydrous calcium silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs. per cu. ft., thermal conductivity of not more than 0.44 at 300 degrees F, maximum water absorption of 90% by volume, minimum compressive strength 140 psi at 5% deformation, rated for service range of 0 degrees F to 1,200 degrees F. Material to be visually coded or marked to indicate it is asbestos free.

***If temperatures higher than 1200 degrees F. will be encountered, specify Type II insulation, which is good for 1800 degrees F.***

ELASTOMERIC INSULATION:

Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor transmission of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

POLYOLEFIN INSULATION:

Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor transmission of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service range of -165 degrees F to 210 degrees F.

***This paragraph describes Imcoa insulation which is suitable for interior/exterior use or direct burial.***

PHENOLIC INSULATION:

Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.13 at 75 degrees F, minimum compressive strength of 31 psi parallel and 18 psi perpendicular, maximum water vapor transmission 0.117 perm inch, maximum water absorption of .5% by volume, rated for service range of -290 degrees F to 250 degrees F.

Kraft reinforced foil vapor barrier laminate all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

***This paragraph describes Childers Koolphen K insulation which has the highest insulating value per inch of specified insulations.***

EXTRUDED POLYSTYRENE INSULATION:

Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.2 at 75 degrees F, minimum compressive strength of 35 psi, maximum water vapor transmission of 1.1 perm inch, maximum water absorption of .1% by volume, rated for service range of -290 degrees F to 165 degrees F.

URETHANE INSULATION:

Rigid closed cell polyisocyanurate, minimum nominal density of 1.8 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 19 psi parallel and 10 psi perpendicular, maximum water vapor transmission of 4 perm inch, maximum water absorption of .2% by volume, rated for service range of -290 degrees F to 300 degrees F.

CELLULAR GLASS INSULATION:

Rigid closed cell, minimum nominal density of 8.5 lbs. per cu. ft., thermal conductivity of not more than 0.36 at 50 degrees F, minimum compressive strength of 100 psi, maximum water vapor transmission of 0.0 perm inch, maximum water absorption of .2% by volume, rated for service range of -450 degrees F to 900 degrees F.

FIREPROOFING INSULATION:

Mineral fiber with nominal density of 8 lbs. per cu. ft., flame spread index of 15, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F.

Jacket material shall be the same as jacket for adjacent insulation.

PVC FITTING COVERS AND JACKETS:

White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be .02 inch (20 mil).

METAL JACKETS:

.016 inch thick aluminum or .010 inch thick stainless steel with safety edge.

# INSULATION INSERTS AND PIPE SHIELDS

Manufacturers: B-Line, Pipe Shields, Value Engineered Products

Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12” and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product described above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.

Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1”x 6” block for piping through 2-1/2” and three 1” x 6” blocks for piping through 4”. Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.

Wood blocks will not be accepted.

**ACCESSORIES**

All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.

Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.

Tack fasteners to be stainless steel ring grooved shank tacks.

Staples to be clinch style.

Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

Finishing cement to be ASTM C449.

Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.

Bedding compounds to be non-shrinking and permanently flexible.

Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.

Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

**PART 3 - EXECUTION**

**INSTALLATION**

Install insulation, jackets and accessories in accordance with manufacturers instructions and under ambient temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and dry.

Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing, inspection and any necessary repairs have been successfully completed.

Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Cover and seal exposed fiberglass insulation when insulation is terminated, no raw fiberglass insulation is allowed. Provide neat and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates. Install with longitudinal joints facing wall or ceiling.

Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.

Insulation shall be continuous through sleeves and openings. Vapor barriers shall be maintained continuous through all penetrations.

Provide a complete vapor barrier for insulation on the following systems:

1. Cold water (potable and non-potable)
2. Storm Water
3. Equipment piping with a surface temperature below 65 degrees F

**PIPING, VALVE, AND FITTING INSULATION**

General:

Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2” lap on jacket seams and 2” tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.

Water supply piping insulation shall be continuous throughout the building and installed adjacent to and within building walls to a point directly behind the fixture that is being supplied.

Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor barrier is not required, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.

Insulation Inserts and Pipe Shields:

Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4” and smaller copper piping provided 12” long 22 gauge pipe shields are used.

Fittings and Valves:

Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2” band of mastic over ends, throat, seams or penetrations. On systems requiring vapor barrier, use vapor barrier mastic.

Elastomeric and Polyolefin:

Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyeolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces.

***Protective jackets should be specified for pipe insulation exposed in food handling/kitchen areas, wet areas, exterior installations or where insulation is subject to physical abuse. Jackets also need to be specified for insulations other than elastomeric and polyolefin where not factory installed. PVC fitting covers and PVC jacketing must be specified with mastic and glass fiber covering where painted finish is required.***

Protective Jackets:

Provide a protective PVC jacket for the following insulated piping:\_\_\_\_\_\_\_\_\_\_\_

Lap seams and joints a minimum of 2 inches and continuously seal with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and contraction. For sections where vapor barrier is not required and jacket requires routine removal, tack fasteners may be used.

Provide a protective metal jacket for the following insulated piping:\_\_\_\_\_\_\_\_\_\_\_\_

Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands to be constructed of the same material as the jacket. Locate seams on bottom for exterior applications.

Provide a protective covering of 2 coats of indoor/outdoor vapor barrier mastic with fabric reinforcing for the following insulated piping:\_\_\_\_\_\_\_\_\_\_\_\_

Pipe Insulation Schedule:

Provide insulation on new and existing remodeled piping as indicated in the following schedule:

***Where asbestos abatement activities require reinsulation of existing piping not remodeled, expand above description to clarify scope of insulation work.***

***More than one insulation type can be listed for a given service if appropriate. Where insulation conductivity significantly differs from schedule, reference ILHR 63.29 and Appendix A to determine appropriate thickness***

**Service Insulation Insulation Thickness by Pipe Size**

 **Types 1" and 1-1/4" 2-1/2" 5" to 6" 8" and smaller to 2" to 4" larger**

 Hot Water Supply Rigid Fiberglass 1" 1" 1.5" 1.5" 1.5"

Hot Water Circulating Rigid Fiberglass 1” 1” 1.5”

Cold Water Rigid Fiberglass 0.5” 0.5” 1” 1” 1”

Tempered Water Rigid Fiberglass 0.5" 0.5" 1"

Non-Potable Cold Water Rigid Fiberglass \* 0.5” 0.5” 1"

Non-Potable Hot Water Rigid Fiberglass \* 1” 1” 1.5"

All Horizontal Storm

Piping and 4'-0" of vertical

Piping thereafter,

& Roof Drain bodies Rigid Fiberglass 0.5" 0.5" 0.5" 0.5" 0.5"

Clearwater Waste Rigid Fiberglass \* 0.5" 0.5" 0.5" 0.5" 0.5"

\* = Elastomeric & Phenolic types are acceptable

The following piping and fittings are not to be insulated:

1. Chrome plated exposed supplies and stops (except where specifically noted).
2. Water hammer arrestors.
3. Piping unions and flanges for systems not requiring a vapor barrier.

**EQUIPMENT INSULATION**

Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.

Semi-Rigid Fiberglass:

Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic. . Use vapor barrier mastic on systems requiring a vapor barrier.

Elastomeric/Polyolefin:

Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.

Equipment Insulation Schedule:

Provide equipment insulation as follows:

**Equipment Insulation Type Thickness Remarks**

Storage Tanks Semi-Rigid Fiberglass 2"

Water Meter Elastomeric 1/2” Sheet type, fabricated for ease of removal and replacement when service is required.

Water Softener Elastomeric 1/2" Sheet type, fabricated for ease of removal and replacement when service is required.

Water Filters Elastomeric 1/2” Sheet type, pipe size type or combination of both. Fabricated

 for ease of removal and

replacement when testing and

servicing is required

R.P.B.P. Elastomeric ½” Sheet type, pipe size type or

 combination of both. Fabricated

 for ease of removal and

replacement when testing and

servicing is required

***Insulation on softener required when located in high temperature/humidity areas subject to condensation.***

# CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 22 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

END OF SECTION