This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

SECTION 230719 - HVAC INSULATION

1. GENERAL
	* + 1. DESCRIPTION
				1. This section describes insulation for piping, ductwork, and equipment.
			2. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 099100, Painting
				2. Section 230529, Hangers and Supports for HVAC Piping and Equipment
				3. Section 233600, Air Terminal Units
			3. REFERENCES
				1. ASTM: American Society for Testing and Materials

Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

ASTM C1071: Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

ASTM E119: Standard Test Methods for Fire Tests of Building Construction and Materials

* + - * 1. OEEC: Oregon Energy Efficiency Code
			1. SUBMITTALS
				1. Product Data: For each type of insulation, including density, conductivity, thickness, jacket, vapor barrier and flame spread and smoke developed indexes.
				2. Shop Drawings: Detail installation of insulation for the following:

Removable covers for pump casings, accesses, etc.

Expansion joints.

Acoustical insulation including construction and installation of stainless steel jacket.

* + - 1. QUALITY ASSURANCE
				1. Regulatory Requirements:

Flame and Smoke Ratings: Installed composite flame spread not to exceed 25 and smoke developed not to exceed 50 as tested by UL 723.

Energy Codes: Oregon Energy Efficiency Code shall govern where requirements for thickness exceeds thickness specified.

* + - * 1. Protection: Protect against dirt, water, chemical or mechanical damage before, during, and after installation. Repair or replace damaged insulation at no additional cost to the Port.
				2. Source Quality Control:

Service: Use insulation specifically manufactured for service specified.

Labeling: Insulation labeled or stamped with brand name and number.

Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice or other vermin, shall not react corrosively with equipment, piping or ductwork and shall be asbestos free.

1. PRODUCTS
	* + 1. GENERAL
				1. All insulation shall be of one manufacturer.
			2. PIPE INSULATION
				1. Fiberglass: Split sectional or snap-on type with 3.5 pcf density 0.23 per inch maximum thermal conductivity (K-factor) at 75ºF mean temperature, 500ºF minimum service rating and white, vapor barrier jacket with pressure sensitive closure system. Owens Corning Fiberglas Pipe Insulation SSL II or equal.
				2. Calcium Silicate: Sectional with 14 pcf nominal density, 0.42 per inch maximum K-factor at 200ºF mean temperature and 1200ºF minimum service rating. Johns Manville Thermo 1200 or equal.
				3. Elastomeric: Expanded closed cell, 0.27 per inch maximum K-factor at 75ºF mean temperature and 220ºF maximum service rating with fitting covers. Armacell, or equal.
				4. Acoustical: 2-inch thick 8 pcf density mineral wool.
			3. BLOCK INSULATION
				1. Calcium Silicate: 1 1/2-inch thick unless specified or shown otherwise with 14 pcf nominal density, 0.42 per inch maximum K-factor at 200ºF mean temperature and 1200ºF minimum service rating. Johns Manville Thermo 1200 or equal.
				2. Fiberglass: 1 1/2-inch thick unless specified or shown otherwise with 6 pcf nominal density, 0.23 per inch maximum K-factor at 75ºF mean temperature and 450ºF minimum service rating. CertainTeed commercial board, or equal.
			4. BLANKET INSULATION
				1. Fiberglass: 1 1/2-inch thick unless specified or shown otherwise with 1.0 psf nominal density, 0.27 per inch maximum K-factor at 75ºF mean temperature, 250ºF minimum service rating. CertainTeed, Owens Corning, or equal, with facing as follows:

Exposed: ASJ all purpose facing with white Kraft paper finish, or equal.

Concealed with vapor barrier: FSK reinforced foil and paper, or equal.

Concealed without vapor barrier: Facing not required.

* + - * 1. Elastomeric: 1-inch thick unless specified or shown otherwise, expanded closed cell sheets, 0.27 per inch maximum K-factor at 75ºF mean temperature and 220ºF maximum service rating. Armaflex or equal.
			1. BOARD INSULATION
				1. Semi-Rigid Fiberglass: 1 1/2-inch thick unless specified or shown otherwise with 3.0 pcf density, 0.23 per inch maximum K-factor at 75ºF mean temperature, 150ºF minimum service rating and all purpose vapor barrier facing with white Kraft paper finish. CertainTeed commercial board with ASJ facing, or equal.
				2. Rigid Fiberglass: Same as semi-rigid except with 6.0 pcf density and 0.22 per inch maximum K-factor.
			2. DUCT INSULATION, INTERNAL
				1. Description: 1-inch-thick fiberglass unless specified or shown otherwise, mat-faced or dual density acoustical blanket with 1.5 pcf density, 0.28 per inch K-factor at 75ºF mean temperature and 250ºF minimum service rating rated for velocities up to 4,000 FPM. CertainTeed ToughGard Duct Board, or equal.
				2. Acoustical Absorption Coefficients: With minimum NRC of 0.65 for 1-inch and 0.85 for 2‑inch as tested in accordance with ASTM C423.
				3. Liner shall meet ASTM C1071.
			3. TERMINAL UNIT ACOUSTICAL WRAP
				1. One pound per square foot density and barium sulfate loaded vinyl material with fiberglass reinforcing. Kinetics Noise Control Model No. KNM-100B or equal.
			4. REFRACTORY DUCT INSULATION
				1. 1-inch-thick, 4 pcf density, flame spread and smoke developed ratings of zero, 2300ºF service rating. Johns Manville Cerablanket or equal.
			5. ACCESSORIES
				1. Adhesives:

Fiberglass: Johns Manville Zeston or equal.

Calcium Silicate: Foster 30-36 or equal.

Elastomeric: Armstrong 520 or equal.

Duct Insulation, Internal: Foster 85-20 or equal.

* + - * 1. Weld Pins: Duro-Dyne, with NC-1 nylon stop clips, or equal.
				2. Cements:

Insulating: Ryder Insulation Inc. or equal.

Heat Transfer: Johns Manville or equal.

* + - * 1. Wire Mesh: 1-inch mesh with 20-gauge annealed steel wire.
				2. Pipe Fitting Covers: One-piece PVC insulated pipe fitting covers. Johns Manville Zeston or equal.
				3. Grooved Coupling Insulation: One-piece PVC insulated fitting cover. Johns Manville Zeston or equal.
				4. Insulation Protection Saddles: 12-inch long, 16-gauge steel. All piping with insulation shall be Anvil Fig. 167, galvanized, or equal.
				5. Mastic:

Vapor Barrier: Design Polymerics 3040 or equal.

Outdoor Mastic: Design Polymerics 3040 or equal.

I. Metal Pipe Jacket: 0.020-inch thick stainless steel jacket with form-fitting covers, stainless steel snap straps and sealant.

* + - * 1. Cloth Facing: Presized fiberglass cloth.
				2. Tapes: Pressure sensitive, weather resistant and for temperatures up to 150ºF. Zeston Z-tape or equal.
				3. Paint: Ultraviolet resistant latex paint with special adherence capabilities to the PVC fitting covers, elastomeric, aluminum facing, Kraft paper, tapes, and adhesives. See Section 099100 for additional requirements.
			1. FIRE-RATED DUCT ENCLOSURE
				1. Morgan Advanced Materials or equal. Duct wrap ceramic fiber blanket, minimum 3‑inch thickness, ASTM E119, 2-hour rated assembly.
				2. Unifrax Fyrewrap or equal. Duct wrap glass fiber blanket, 1 1/2-inch thickness for 1‑hour rated assembly, 3-inch thickness for 2-hour rated assembly, ASTM E119.
				3. Johns Manville Super Firetemp or equal. Minimum 2 1/4-inch thickness, ASTM E119, 2-hour rated assembly.

Joint: Modified sodium silicate adhesive. Johns Manville Super Calstik or equal.

1. EXECUTION
	* + 1. GENERAL
				1. Applicators: Applicators shall be employed by a firm that specializes in insulation work.
				2. Preparation: Surfaces of piping, equipment, and ductwork shall be clean, free of oil or dirt, and dry before insulation is applied.
				3. Stamps: ASME stamps, UL labels, and similar stamps and labels shall not be covered.
				4. Any insulation that becomes damaged, water soaked, or stained shall be replaced at no additional cost to the Port.

Delete insulation requirements for locations not applicable to the project.

* + - 1. PIPE AND EQUIPMENT INSULATION APPLIED LOCATIONS
				1. For piping systems located in utility tunnels and in CUP, insulate with calcium silicate insulation, stainless steel metal jacket, in thickness listed.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Pipe Size | Heating Water | Chilled Water | Low Pressure Steam | Medium and High Pressure Steam |
| ≤ 1" | 2" | 2" | 2" | 4" |
| 1-1/4"-2" | 2" | 2" | 2" | 4" |
| 2-1/2"-3" | 2-1/2" | 2" | 2-1/2" | 5" |
| 3-1/2"-4" | 2-1/2" | 2" | 2-1/2" | 5" |
| 4-1/2"-5" | 2-1/2" | 2" | 2-1/2" | 5" |
| 5-1/2"-6" | 2-1/2" | 2" | 2-1/2" | 6" |
| ≥ 8" | 3-1/2" | 2" | 3-1/2" | 6" |

* + - * 1. For locations other than the tunnels and CUP, insulate the piping systems with glass fiber insulation, all-purpose jacket in thickness listed below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Pipe Size | Heating Water | Chilled Water | See Note 1 | Medium and High Pressure Steam |
| ≤ 1" | 1-1/2" | 1" | 2" | 2-1/2" |
| 1-1/4"-2" | 1-1/2" |  1-1/2" | 2-1/2" | 3" |
| 2-1/2"-3" | 2" |  1-1/2" | 3" | 3" |
| 3-1/2"-4" | 2" |  1-1/2" | 3" | 3" |
| 4-1/2"-5" | 2" |  1-1/2" | 3-1/2" | 4" |
| 5-1/2"-6" | 2" |  1-1/2" | 3-1/2" | 4" |
| ≥ 8" | 3-1/2" | 2" | 4" | 6" |

Low pressure steam (15 psig to 350°F), steam condensate, pumped condensate, steam vents below 8 feet above floor.

Air separators, heat exchangers, and storage tanks, 3 1/2-inch-thick.

Steam safety valve discharge and steam vents from concentrate.

Inside building, 1 1/2-inch thick for all pipe sizes.

Outside building below 8 feet above finished floor, 1 1/2-inch thick with stainless steel metal jacket.

* + - * 1. Insulate the following piping systems with elastomeric insulation in thickness listed:

Industrial cold water, 1 1/4-inch piping and smaller may use elastomeric, 1/2-inch.

Condensate drains from cooling equipment and other drains discharging cold water, 1/2-inch.

* + - * 1. Chillers:

Condensers and other hot surfaces, 1-inch thick calcium silicate or glass fiber block.

Evaporator and all other cold surfaces, 2-inch thick glass fiber block or elastomeric.

* + - * 1. Chilled water pump casings shall be 2-inch thick elastomeric.
				2. Chilled water expansion tanks shall be 2-inch thick glass fiber block or elastomeric.
				3. Where indicated, insulate low and high pressure steam with 2-inch thick acoustical insulation with stainless steel jacket.
				4. Steam trap piping need not be insulated:
				5. Insulation shall include all fittings, unions, flanges, mechanical couplings, valve bodies, valve bonnets, and piping through sleeves. Unions need not be insulated on the following systems:

Hot water heating inside building.

High and low pressure steam, inside building, 2 inches and smaller.

Steam condensate and steam pumped condensate, inside building.

* + - * 1. Valves and irregular fittings shall be insulated with section of pipe insulation and insulating cement, securely fastened, and finished with 6 oz. canvas and Foster 30-36, or equal, lagging adhesive.
				2. Expansion Joints and Flexible Connectors: Pipe insulation or block of same material and thickness as adjacent piping.
				3. Steam, Steam Condensate, Heating Water, and Chilled Water Piping in Utility Tunnels and in CUP: Insulate with calcium silicate pipe insulation same thickness as specified above, encased in stainless steel metal jacket for full length of piping.
			1. PIPING INSTALLATION
				1. General:

Joints: Coat both sides of complete joining area with applicable adhesive.

Longitudinal Joints: Make joints on top or back of pipe to minimize visibility. Except for foam plastic, seal with closure system or 3-inch-wide tape.

Butt Joints: Butt tightly together and, except for foam plastic, seal with 3-inch-wide tape or butt straps.

Multiple Layered Insulation: Joints shall be staggered.

Access: Strainer and other items requiring service or maintenance with easily removable and replaceable section of insulation to provide access.

Voids: Fill all voids, chipped corners, and other openings with insulating cement or material compatible with insulating material. In insulation with vapor barrier, coat with vapor barrier mastic.

Heat Tracing: Where piping is shown or specified to be heat traced, bed heat tape into heat transfer cement with insulation over heat tape and cement. FG or FP not allowed.

Seal joints, seams, and fittings of metal watertight jackets at exterior locations.

* + - * 1. Fiberglass Insulation: Exterior insulation encased in metal jacket.
				2. Calcium Silicate Insulation:

On systems with vapor barrier, coat complete with vapor barrier mastic.

Cover with cloth facing secured with applicable adhesive.

Exterior insulation encased in metal jacket.

* + - * 1. Elastomeric Insulation:

Slit full length and snap around pipe.

Make cuts perpendicular to insulating surface leaving no cut section exposed.

Do not stretch insulation to cover joints or fittings.

Seal joints with adhesive. Sealing joints with tape will not be allowed.

* + - * 1. Fittings: Install insulation on all fittings.

On Elastomeric and Acoustical Insulation: Fittings covered with covers made up of mitered sections of insulation or with formed pipe fitting covers.

In Other Insulation: Fittings covered with insulation to the same level of the adjoining insulation or fill with insulating cement. Finish with pipe fitting covers or cloth facing and tape.

* + - * 1. Unions, Flanges, Mechanical Joints, Valves, Etc:

General:

As specified for fittings.

Minimum thickness same as specified for piping.

Unions: Build up insulation at least 1/2 inch beyond adjoining insulation.

Flanges: Insulation with square corners.

Flanged Valves: Insulation with square corners.

* + - * 1. Vapor Barrier Insulation:

Piping which requires vapor barrier protection shall have a continuous vapor barrier, which shall not be pierced or broken. The following piping systems require vapor barrier protection:

Chilled water.

Refrigerant suction.

Insulation for pipe requiring vapor barrier protection 3/4 inch or smaller, insulation continuous through pipe hanger, with shield at each hanger.

For pipe 1 inch and larger, 18-inch section of calcium silicate, same thickness as pipe insulation, with continuous vapor barrier jacket, with shield at each hanger.

For all piping, protect vapor barrier with pipe shield specified in Section 230529.

* + - * 1. Non-Vapor Barriered Insulation:

On piping 3/4 inches and smaller, insulation continuous through pipe hanger, with shield at each hanger.

On piping over 1 inch, 18-inch section of calcium silicate, same thickness as pipe insulation, at each hanger.

For all piping, insulation shall be protected with pipe shield specified in Section 230529.

* + - 1. EQUIPMENT INSTALLATION
				1. General: Install true and smooth. Insulation over curved surfaces shall conform to curves of surface.

Access: Access, etc., that requires service, inspection, or maintenance shall be provided with covers or sections that are easily removable and replaceable. Reinforce openings in adjacent insulation with metal beading. In vapor barriered insulation, coat joints with vapor barrier mastic.

Voids, Depressions, and Cavities: All voids, chipped corners, and other openings shall be filled with insulating cement or material compatible with insulating material.

Vapor Barriered Insulation: Where insulation is specified to have a vapor barrier, the barrier shall not be pierced or broken.

Tears, etc., shall be coated with vapor barrier mastic and patched with insulation facing or tape.

Staples shall be brush coated with vapor barrier coating.

Cover all raw edges coated with vapor barrier mastic, and seal cover to equipment surface.

Non-Vapor Barriered Insulation:

Tears, etc. shall be patched with insulation facing or tape.

Cover all raw edges and bevel neatly to the equipment surface.

Multi-layered Insulation: Joints shall be staggered.

* + - * 1. Calcium Silicate and Fiberglass Block:

Anchors: Lug nuts 10-gauge black annealed iron wire welded to metal surfaces.

Banding: Block secured to surface with 1/2-inch wide stainless steel bands maximum 18 inches on center and secured to anchors.

Insulating Cement: Block covered with insulating cement minimum thickness of 1/2‑inch with smooth finish.

Vapor Barriered System: On vapor barriered system, apply continuous coat of vapor barrier mastic.

Finish: Finish with cloth facing secured with adhesive and lapped a minimum of 2 inches. Touch up defects with finishing cement.

* + - * 1. Elastomeric Blanket: Cut insulation to size, make corners with mitering cuts to preclude raw edges, continuously cement insulation to equipment with adhesive. Cement both surfaces of joints and butt tightly together and cover raw edges with two coats of adhesive.
				2. Expansion Joints: Covered with larger size pipe insulation to allow full movement and be removable.
				3. Ball Joints: Covered with larger size pipe insulation to allow full movement, ends turned back to pipe, coat with vapor barrier mastic on joints in vapor barriered system, and finished with cloth facing cemented to insulation with adhesive.
			1. DUCT INSULATION APPLIED LOCATIONS
				1. General:

All external insulation shall have continuous vapor barriers unless specifically noted otherwise.

Internally lined ductwork need not be insulated.

* + - * 1. Medium Pressure Supply Ductwork:

Exposed: Rectangular ductwork insulated with rigid fiberglass board. Round ductwork insulated with semi-rigid fiberglass board.

Concealed: Insulated with fiberglass blanket.

* + - * 1. Low Pressure Supply Ductwork:

Exposed: All exposed rectangular supply ductwork shall be internally lined, 1-inch thick.

Concealed: Internally line the first 5 feet after terminal units. After the first 5 feet, externally wrap ductwork.

Terminal units 2000 CFM and greater: As specified in Section 233600.

Flex duct: Factory insulated.

* + - * 1. Return Air Ductwork/Plenums: Internally lined throughout, 1-inch thick.
				2. Exhaust Ductwork: Not insulated.
				3. Outside Air Ductwork/Plenums: Internally line, 2-inch-thick, unless external insulation is indicated.
				4. Blank Off Panels: Internally line with 2-inch-thick insulation.
				5. Ductwork at Exhaust Fans: Internally line 20 feet upstream and downstream of fans, including all branch ductwork within 20 feet, 1-inch thick.
			1. DUCTWORK INSTALLATION
				1. General:

Install insulation in accordance with the manufacturer’s instructions.

The vapor barrier shall be continuous. Tears, holes, staples, etc. shall be coated with vapor barrier mastic and patched with facing or tape. Joints between insulation and access shall be provided with vapor barrier mastic.

Insulation at access panels shall be removable or attached to panel with edges of panel and opening reinforced with metal beading.

* + - * 1. External Blanket Insulation:

Secure insulation to ductwork with 20-gauge snap wires 24 inches on center and at all joints.

Lap joints and seams a minimum of 3 inches, and sealed with jacket tape.

* + - * 1. Board Insulation:

Space rectangular ducts with weld pins a maximum of 18 inches on center in both directions.

All corners shall be made with joints; bending insulation around corners will not be allowed.

All joints and seams shall be butted tight together.

Butt joints with 3-inch-wide tape.

Finish corners with 3-inch-wide tape.

* + - * 1. Internal Duct Liner:

The coated surface shall face air stream.

Weld pins spaced maximum of 15 inches on center in both directions and within 2 inches of all corners and joints. Weld pins flush with liner surface.

Complete duct surface coated with adhesive and insulation pressed tightly thereto.

Edges at terminal points shall be provided with metal beading and heavily coated with adhesive.

All joints and corners shall be heavily coated with adhesive.

Damaged areas shall be replaced or heavily coated with adhesive.

* + - * 1. Plenums: Insulation on floors protected by wire mesh.
				2. Blank Off Panels: Insulation, enclosed with sheet metal on all sides. All joints with vapor barrier mastic and taped.
				3. Volume Dampers: Where volume dampers do not allow for continuous insulation, terminate insulation clear of handle sweep and finish edges to maintain vapor barrier and to prevent damage to the insulation.
			1. TERMINAL UNIT ACOUSTICAL WRAP
				1. Install in accordance with the manufacturer’s instructions on all variable and constant volume terminal units with maximum air volumes over 2000 cfm.
			2. REFRACTORY DUCT INSULATION
				1. Install at beam penetrations as shown on the drawings.
				2. Adhere to duct with Foster 81-93, or equal. Secure with 16-gauge stainless steel wire bands at 3 inches on center.
			3. DUCT ENCLOSURE - FIRE RATED
				1. Installation: Install in accordance with the manufacturer’s instructions.
				2. Joints:

Attached boards shall be cemented and attached to one another. Mating surfaces shall be “buttered” with a 1/8-inch layer adhesive.

Secure fiberglass type material with stainless steel banding (Type 304).

* + - * 1. Support: The duct enclosure may be hung from a conventional “trapeze” arrangement. Adequate support shall be provided at the bottom of vertical runs. On multi-story penetration, support with an angle iron collar attached to the duct.
				2. Expansion: Adequate clearance shall be provided at the end of all straight runs to allow for expansion of the metal duct inside the enclosure.
			1. FIELD QUALITY CONTROL
				1. Field Test: All systems shall be tested and approved prior to installation of insulation.
				2. Existing Insulation:

Repair existing insulation damaged during construction.

Make neat connections where new and existing insulation meet.

Where existing piping, ductwork, or equipment is removed, cover existing surfaces neatly to match existing.

END OF SECTION 230719