SECTION 23 07 00
INSULATION FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Duct insulation, jackets
2. Piping insulation, jackets
3. Equipment insulation and covering
4. Breeching insulation
5. Fire barrier duct wrap

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 21 13 – Hydronic Piping

C. Section 23 20 00 – Steam and Condensate Piping and Specialties

D. Section 23 23 00 – Refrigerant Piping and Accessories

E. Section 23 31 00 – HVAC Ducts and Casings

F. Section 23 33 19 – Acoustics

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. ASTM – American Society for Testing and Materials

1.	ASTM B209-14	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
2.	ASTM C411-17	Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
3.	ASTM C518-17	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
4.	ASTM C533-17	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
5.	ASTM C534/C534M-16	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
6.	ASTM C547-17	Standard Specification for Mineral Fiber Pipe Insulation
7.	ASTM C553-13	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

8.	ASTM C612-14	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
9.	ASTM E84-17a	Standard Test Method for Surface Burning Characteristics of Building Materials
10.	ASTM E119-16a	Standard Test Methods for Fire Tests of Building Construction and Materials
11.	ASTM E136-16a	Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C
12.	ASTM E814-13a(2017)	Standard Test Method for Fire Tests of Penetration Firestop Systems
13.	ASTM E96/E96M-16	Standard Test Methods for Water Vapor Transmission of Materials
14.	ASTM F1249-13	Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

B. INT – Intertek (formerly Omega Point Laboratories, Inc.)

C. NFPA – National Fire Protection Association

1.	NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
2.	NFPA 225	Model Manufactured Home Installation Standard
3.	NFPA 262	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

D. SS. UL – Underwriters Laboratories Inc.

1.	UL 723	Standard for Test for Surface Burning Characteristics of Building Materials
2.	UL 1978	Standard for Grease Ducts

1.04 QUALITY ASSURANCE

A. All insulation shall be in accordance with **2018 IECC & ASHRAE 90.1-2016**

B. Insulation supplier and insulation installer shall have a minimum of 5 years' successful installation experience on projects of similar scope to this project.

C. Fire-rated duct wrap installer shall have demonstrated experience on projects of similar size and complexity.

1.05 SUBMITTALS

A. Product Data: Provide product description, current Product Data Sheets, list of materials and thickness for each service or equipment scheduled, locations, and manufacturer's installation instructions.

B. Submit details of sheet metal boxes for pieces of insulated equipment. Refer to sub-Paragraph 2.06A.7.

C. Samples: Submit selection and verification samples of fire-rated duct wrap.

D. Quality Assurance / Control Submittals:

1. Test Reports: Upon request, provide fire tests from recognized laboratory.
2. Certificates: Submit manufacturer's certificate that product(s) meet or exceed specified requirements.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions during storage and installation of all products required by manufacturers of adhesives, mastics, and insulation cements.

B. Protect insulation from contact with water.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Fiberglass: Johns Manville; Knauf; Owens Corning.

B. Calcium Silicate: Johns Manville; Extol of Ohio, Inc.

C. Elastomeric: Armacell; Aeroflex.

D. Cellular Glass: Pittsburgh Corning.

E. Mastics, Adhesives and Sealers: Ductmate; Foster; IC; Childers.

1. Vapor Barrier Mastic: Foster 30-65, Childers CP-34, IC – 501. Permeance shall be 0.08 perms or less at 44 mils per ASTM E96, Procedure A**.**
2. Weather Barrier Breather Mastic: Foster 46-50, Childers CP-10/11 or approved equal.
3. Lagging Adhesive/coating: Foster 30-36, Childers CP-50AMV1 or approved equal.
4. Reinforcing Mesh: Foster Mast a Fab, Childers Chil Glas #10.
5. Calcium Silicate Insulation Adhesive: Foster 81-27, Childers CP-97, Vimasco 760.
6. Fiberglass Insulation Adhesive: Foster 85-60, Childers CP-127, or approved equal. Comply with ASTM C916, Type II.
7. Metal Jacketing/Flashing Sealant: Foster 95-44, Childers CP-76 or approved equal.

F. Jackets:

1. Metal: Childers; RPR Products.
2. PVC: Ceel-Co; PIC Plastics.
3. Other: Venture Tape; Polyguard, Foster Vapor Fas 62-05.

G. Pre-Molded Fittings, Valves, Strainers and Equipment Insulation: Insul-Therm International; Extol of Ohio, Inc.; or approved equal.

H. Fire Barrier Duct Wrap: 3M Duct Wrap 615+; Unifrax FyreWrap®; or approved equal.

2.02 GENERAL

A. Conform to application schedule for type and thickness of insulation.

B. Insulation, jacket, facing and adhesives shall be non-combustible material meeting Code requirements and fire and smoke hazard ratings as tested by procedure ASTM E84, National Fire Protection Association 225, and UL 723, not exceeding Flame Spread 25 and Smoke Developed 50.

C. Adhesive, mastic or insulating material shall not contain asbestos.

D. Vapor jacket permeance shall be 0.02 perms or less.

E. Jacket puncture resistance shall be 50 units (Beach) or greater.

F. Provide fire-rated duct wrap materials and systems which have been manufactured, fabricated and installed to a 2-hour Fire Resistance Rating (ASTM E119, ASTM E814):

1. Through penetration system's design assembly number(s): **[FS557W] [FS558F] [FS559W] [FS560F] [F5561F] [FS562W] [FS563W]**.
2. Duct system's design assembly number(s): **[GD531F] [GD532F].**
3. Flame-propagation and smoke-density values (UL 910 / NFPA 262):

    a. Maximum flame spread (feet): 0.01.
    b. Maximum smoke (optical density): 0.01.
    c. Average smoke (optical density): 0.00.

4. Plenum Protection system's design assembly number(s): **[PP100F] [PP101F]**.

2.03 PIPE INSULATION MATERIALS

A. Glass Fiber: ASTM C547; rigid molded, non-combustible.

1. Installed 'K' Value: 0.23 BTU-inch per hour-foot²-degree F at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Vapor Retarder Jacket: White kraft paper, vinyl coated, embossed and reinforced with glass fiber yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips.

B. Hydrous Calcium Silicate: ASTM C533; rigid molded pipe.

1. Installed 'K' Value: 0.40 BTU-inch per hour-foot²-degree F at 300 degrees F.
2. Maximum Service Temperature: 1,200 degrees F.
3. Tie Wire: 16-gauge stainless steel with twisted ends on maximum 12-inch centers.

C. Field-Applied Jackets:

1. PVC Plastic (PVC): One-piece molded type fitting covers and sheet material, gloss white. Connections shall be pressure-sensitive color-matching vinyl tape.
2. Canvas Jacket (CJ): UL Listed fabric, 6 ounce per square yard, plain weave cotton treated with dilute fire-retardant lagging adhesive.
3. Aluminum Jacket (AL): 0.016-inch thick sheet, stippled finish, with longitudinal

slip joints and 2-inch laps, die-shaped fitting covers with factory-attached protective liner.

4. Vapor Barrier Jacket (VBJ): Five ply, non-bituminous, embossed, aluminum foil/polymer laminated film with permeance rating of 0.0 as tested in accordance with ASTM F1249. Venture Clad Plus (1579CW) by Venture Tape, Polyguard Zero-Perm (indoors only), Foster Vapor Fas 62-05 or approved equal.

2.04 PIPE INSULATION SCHEDULES

A. Insulation Schedules:

Service	Temperature Range (degrees F)	Material	Runouts*	Insulation Thickness (inches) for Pipe Sizes:				
				1 and	1.25 to 2	2.5 to 4	5 to 6	8 and
Hot water heating	105 to 140	Glass fiber	0.5	1	1	1.5	1.5	1.5
Chilled water, glycol	40 to 60	glass fiber, cellular glass	0.5	1	1	1	1	1
Refrigerant	All	Elastomeric foam, glass fiber, cellular glass	1	1	1.5	1.5	1.5	1.5
Condensate drains (i.e. bodies and piping)	All	glass fiber	–	0.5	0.5	0.5	–	–
Outdoor piping subject to freezing	All	Glass fiber	–	1.5	1.5	1.5	1.5	1.5
Diesel **[engine exhaust,] [fire pump exhaust,]** silencer/muffler/precipitator	All	Calcium silicate	–	–	–	4.5	4.5	4.5

* Runouts are up to 2-inch piping directly connected to a fan coil, heat pump, AC unit, unit heater, terminal unit or radiation and not exceeding 12 feet in length.

B. Fittings, Valves and Flanges:

1. Use factory pre-molded fittings of the same materials and thickness as the adjacent pipe insulation. Such fittings shall be applied to all 90°s, 45°s, Tee's, flanges, and valves.
2. Where pre-molded insulation fittings are not manufactured, insulate fittings, flanges, strainers and valves with mitered segments of the same density as the adjoining pipe covering. Vaporseal for cold (below dew point) applications using vapor barrier mastic with open weave glass or polyester mesh lay in while wet. Provide a final coat of vapor barrier mastic. Overlap glass mesh and outer coat adjacent covering by a minimum of 2 inches. Vapor barrier mastic shall be IC 501, Childers CP-34 or Foster 30-65. Permeance of mastic shall be 0.08 perms or less at 44 mils as tested by ASTM E96, Procedure A. Reinforcing mesh shall be Foster Mast a Fab, Childers Chil Glas #10 or approved equal.
3. Provide insulation for the removable covers and flanges of pipe strainers on cold services with built-up sections of glass fiber pipe covering, arranged to facilitate servicing of the strainer. Complete applications with vaporseals as specified above. Vapor barriers shall be sealed and continuous through guides, hangers, walls, sleeves, etc. Adhesives and coatings shall be as noted herein.
4. Insulate fittings, flanges, valves, etc. for services where calcium silicate insulation

is specified with mineral wool cement of equal thickness to the pipe insulation. Apply evenly and finish with glass cloth.

C. Jacketing Schedule:

Service	Location	Jacket Type
Chilled water	Exposed in Plant Rooms	AL
	Exterior locations	VBJ
Heating hot water	Exposed in Plant Rooms	AL
	All other locations	ASJ
Refrigerant piping	Interior locations	ASJ or painted finish
	Exterior locations	AL or VBJ
Condensate	All locations	ASJ or painted finish
Diesel engine exhaust, silencer/muffler and precipitator	All locations (not part of the prefabricated flue)	AL

2.05 DUCTWORK INSULATION

A. Materials:

1. Flexible Glass Fiber: ASTM C553, formaldehyde-free flexible blanket.

   a. Installed 'K' Value: 0.27 BTU-inch per hour-foot²-degree F at 75 degrees F.
   b. Density: 0.75 pounds per cubic foot.
   c. Vapor Barrier Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with 2-inch wide UL Listed pressure-sensitive tape and outward clinched expanded staples and vapor barrier mastic as needed. Maximum vapor barrier perm rating shall not exceed 0.02 perms.

2. Rigid Glass Fiber: ASTM C612, rigid board.

   a. Installed 'K' Value: 0.23 BTU-inch per hour-foot²-degree F at 75 degrees F.
   b. Density: 6.0 pounds per cubic foot.
   c. Vapor Barrier Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with 2-inch wide UL Listed pressure-sensitive tape and outward clinched expanded staples and vapor barrier mastic as needed.

3. Canvas Jacket: UL Listed fabric, 6 ounces per square yard, plain weave cotton treated with dilute fire-retardant lagging adhesive:. Foster 30-36; Childers CP-50AMV1 or approved equal.
4. Covering for Outdoor Ducts:

   a. Aluminum Jacket: 0.016-inch thick sheet, stucco-embossed finish, with longitudinal slip joints and 2-inch laps.
   b. Ultra-violet light-resistant painted polyvinyl chloride covering with joints secured and sealed with adhesive.
   c. Vapor Barrier Jacket (VBJ): Five ply, non-bituminous, embossed, aluminum foil/polyester laminated with permeance rating of 0.0 per as tested in accordance with ASTM F1249. Venture Clad Plus (1579CW)

by Venture Tape, Foster Vapor Fas 62-05 or approved equal.

B. Schedule:

Service	Material	Thickness (inches)
[Exhaust ducts] within 10 feet of exterior openings	Flexible glass fiber	1.5
[Exhaust ducts] exposed to outdoor air; ventilation equipment casings	Flexible glass fiber	1.5
Supply ducts (cooling and heating systems)	Flexible glass fiber	1.5 (min. R value of 4.2)
Supply and return ducts in unconditioned spaces (attics, outdoors, crawlspaces, equipment rooms)	Rigid glass fiber	2 (min. R value of 8.0)
[Combustion air ducts]	Rigid glass fiber	2
Outside air intake ducts	Rigid glass fiber	2
Supply plenums (cooling and heating systems)	Rigid glass fiber	2 (min. R value of 8.0)
Return and relief ducts in mechanical rooms	Rigid glass fiber	2 (min. R value of 8.0)
Grease duct	Fire-rated duct wrap (two layers)	1½ (for each layer)

C. Wherever external duct insulation is specified and internal acoustic treatment of equivalent insulating effect is also required by the Drawings or Specifications for the same location, the external insulation may be omitted.

2.06 EQUIPMENT INSULATION

A. Materials:

1. Flexible Fiberglass Blanket: ASTM C553.

   a. Installed ‘K’ Value: 0.24 at 75 degrees F.
   b. Maximum Service Temperature: 450 degrees F.
   c. Density: 6.0 pounds per cubic foot.
   d. Vapor Retarder Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with UL Listed pressure-sensitive tape and outward clinch expanding staples and vapor barrier mastic as needed. Maximum vapor barrier perm rating shall not exceed 0.02 perms.

2. Rigid Fiberglass Board: ASTM C612.

   a. Installed ‘K’ Value: 0.23 BTU-inch per hour-foot²-degree F at 75 degrees F.
   b. Maximum Service Temperature: 450 degrees F.
   c. Density: 6.0 pounds per cubic foot.
   d. Vapor Retarder Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with UL Listed pressure-sensitive tape and outward clinch expanding staples and vapor barrier mastic as needed. Maximum vapor barrier perm rating shall not exceed 0.5 perms.

3. Rigid Fiberglass Board: ASTM C612, non-combustible.

    a. Installed 'K' Value: 0.23 BTU-inch per hour-foot²-degree F at 75 degrees F.
    b. Maximum Service Temperature: 850 degrees F.
    c. Density: 3.0 pounds per cubic foot.
    d. Facing: 1-inch galvanized hexagonal wire mesh stitched on one face of insulation.

4. Hydrous Calcium Silicate: ASTM C533, rigid molded block.

    a. Installed 'K' Value: 0.40 BTU-inch per hour-foot²-degree F at 300 degrees F.
    b. Maximum Service Temperature: 1,200 degrees F.
    c. Attachment: Insulation shall be securely banded in place, tightly butted, joints staggered and secured with 16 gauge stainless steel wire or ½-inch by 0.015 inch galvanized steel bands on 12-inch maximum centers for large areas.

5. Elastomeric Foam: ASTM C534, flexible cellular elastomeric, molded or sheet.

    a. Installed 'K' Value: 0.27 BTU-inch per hour-foot²-degree F at 75 degrees F.
    b. Maximum Service Temperature: 220 degrees F.

6. Apply the vaporseal board by mechanical fasteners such as Graham pins and speed washers. Seal joints with an adhesive, as approved and reinforced with a glass cloth membrane over vinyl mastic, or self-sealing matching tape. Cover pinheads with adhesive, as specified. If vaporseal board is wired, use sheet metal edges to protect the corners of the board from the wire. Seal edges and joints.
7. Enclose removable covers or heads for equipment, (such as coolers, strainers, heat exchangers and pumps) in aluminum sheet metal boxes for easy removal with fiberglass board applied to inside of sheet metal boxes of thickness as described above. Provide lifting handles for removal of boxes.
8. Install equipment insulation in accordance with manufacturer's instructions.

B. Mastics, Adhesives, and Sealants:

1. Apply in accordance with the manufacturers written instructions.

C. Equipment Insulation Schedule:

Service	Material	Thickness (inches)
Hot water, chilled water and glycol expansion tanks and fill tanks, air separators, chemical bypass feeder	Flexible glass fiber	2
Glycol and chilled water pumps	Glass fiber board	2
Chiller evaporator and connections	Elastomeric foam	1.5
Breeching	Calcium silicate, non-combustible rigid fiberglass board	4
Exposed supply fans (cooling systems)	Glass fiber board	2

2.07 FIRE-RATED DUCT WRAP

A. Provide products and materials as follows:

1. Nominal 1½-inch thick, 6 pounds per cubic foot density, inorganic, non-asbestos, non-combustible, bio-soluble, high temperature, core insulation blanket.
2. Flexible, full encapsulation, integral to the duct wrap to provide 2-hour fire resistive enclosure assembly per codes and standards listed in Paragraph 1.02 of this document.
3. Blanket fiber materials shall be tested per EU regulatory requirements, Directive 97/69/EC for bio-solubility, and verified by an independent laboratory.
4. Provide rated access doors (for clean-outs as required) to maintain 2-hour rating and required clearance.
5. Provide firestop sealants, tape, insulation pins, clips, banding and other components as per manufacturers' instructions to ensure installation complies with the complete tested system and corresponding Design Listing(s).
6. Aluminum foil tape: Acceptable to wrap material manufacturer.
7. Filament tape: Minimum ¾-inch wide.
8. Banding material and banding clips:

    a. Material: Carbon steel or stainless steel.
    b. Width: Minimum ½ inch.
    c. Thickness: Minimum 0.015 inch.

9. Insulation pins:

    a. Material: Copper-coated steel.
    b. Size: Minimum 12 gauge.

10. Speed clips:

    a. Material: Galvanized steel.
    b. Type and size: Minimum 1½ inches square or 1½ inches diameter round or equivalent sized insulated cup-head pins.

11. Access door hardware:

    a. Type: Threaded rods with ¼-inch wing nuts and ¼-inch washers.
    b. Material: Galvanized steel.
    c. Diameter: ¼ inch.
    d. Length: 4½ inches to 5 inches.

12. Access door hardware:

    a. Type: Hollow tubing to fit threaded rods.
    b. Material: Steel.
    c. Length: 4 inches.

13. Fire barrier silicone sealant: Manufacturer designation: **[1000 N/S] [1003 S/L] [2000+]**.

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that ductwork has been tested for leakage in accordance with Section 23 31 00 – HVAC Ducts and Casings before applying insulation materials.

B. Verify that all surfaces are clean, dry and free of dirt, duct, debris, moisture or foreign material.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.

B. Verify piping has been pressure-tested as specified in Section 23 21 13 – Hydronic Piping before applying insulation materials to pipe joints.

C. Continue insulation and vapor barrier through penetrations.

D. Piping, Valve and Accessories Insulation:

1. Locate insulation and cover seams in least visible locations where exposed.
2. Neatly finish insulation at supports, protrusions, and interruptions.
3. Provide insulated pipes, fittings, valves and accessories conveying fluids below ambient temperature with continuous vapor retarder jackets with self-sealing laps. Insulate complete system and provide molded flexible polyvinyl chloride jacket(s) for all fittings and valves. Vaporseal all below ambient jacket seams with vapor barrier mastic as recommended by the insulation manufacturer.
4. For insulated pipes, fittings, valves and accessories conveying fluids above ambient temperature, secure jackets with self-sealing lap. Bevel and seal ends of insulation at equipment, flanges and unions.
5. Protect pipe insulation at hangers, guides, and rollers with 20-gauge galvanized metal shields, one-third the insulation circumference in width and minimum 10 inches in length up to 2½-inch pipe size, 12 inches in length on pipes 3-inch and larger, on the outside of the insulation and vapor barrier or jacket. Center shield on hanger and hold shield in place by straps or by manufactured centering tabs or channels on the shield itself. Do not pierce the insulation with hangers.
6. Provide insert between support shield and piping. Fabricate of calcium silicate, rigid phenolic or other heavy density non-deforming insulating material suitable for temperature. Length of insulation inserts shall match support shield length as specified.
7. For exterior applications or locations where abrasion or damage may occur, provide weather protection jacket. Insulated pipe, fittings, accessories joints, and valves shall be covered with ultra-violet light-resistant painted polyvinyl chloride, Foster Vapor Fas 62-05 flexible jacketing or aluminum jacket. Jacket seams shall be located on bottom side of horizontal piping.
8. Apply prefabricated sectional insulation for straight pipes neatly fitted around the piping, and sealed with adhesive. Apply adhesive to only one side of each joint and not to pipe surface.
9. Seal all joints with Foster 30-65 or Childers CP-34 fire-resistant vapor barrier mastic. Oversized pipe sections or board type insulation may be used to fabricate and install insulation around pipe specialties. All void spaces shall be firmly filled with flexible insulation to support oversized pipe insulation.
10. Secure sectional insulation with 0.02-inch thick by ½-inch wide aluminum bands

manufactured by Childers, or RPR Products nylon ties, on 24-inch centers for pipe sizes 2 inches and larger. Install at least two (2) bands per section of insulation.

11. Insulate **chilled water** vertical riser support clamps.
12. Insulate and thoroughly vaporseal control valve bodies where the valve actuator penetrates the insulation.
13. Thoroughly vaporseal the ends of all **chilled water** pipe, valve and fitting insulation sections to prevent condensation from wicking between sections.
14. Replace any self-sealing insulation or lap that is found to be not sealing properly. Do not use staples to secure the insulation or coverings.

15. Thermal Insulation for Diesel Engine Exhaust Piping:

    a. Insulate the muffler/silencer and precipitator with three layers of 1½-inch thick hydrous calcium silicate, installed over spacers to allow a 1-inch air space between pipe and insulation. Include all flexible pipe connections.
    b. Stagger joints for the first, second and third layers.
    c. Apply aluminum jacket (ASTM B209) over outer layer of insulation as specified.
    d. Wrap or pack all protrusions through the insulation with refractory fiber. Seal all chips, joints and cracks.
    e. Provide expansion joints in the insulation and aluminum jacket as recommended by the manufacturer to allow for movement of the flexible pipe connections, and differential expansion between the diesel engine exhaust pipe, insulation and jacket.
    f. Refer to Section 23 51 00 “Breechings, Chimneys and Stacks” for exhaust from the silencer/muffler or precipitator to outside the building.

E. Equipment Insulation:

1. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. As required, secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor-retardant cement.
3. Provide cold equipment containing fluids below ambient temperature with vapor-retardant jackets.
4. For insulated equipment containing fluids above ambient temperature, provide jacket with or without vapor barrier.
5. Cover insulation with metal mesh and finish with ½-inch thick insulating cement, or aluminum jacket.
6. Do not insulate over sight glasses, visual level or flow indicators, nameplates or ASME stamps. Bevel and seal insulation around these items.
7. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage to insulation or vapor barrier.
8. Refer to Section 23 51 00 “Breechings, Chimneys and Stacks” for boilers, stacks and breechings.
9. Hot equipment insulation shall be covered with ½-inch thick insulating cement over copper-clad hexagonal wire.
10. Cold equipment insulation shall be covered with ½-inch thick insulating cement over vaporseal mastic and copper-clad hexagonal wire.

F. Ductwork Insulation:

1. Provide insulated ductwork conveying air below ambient temperature with continuous vapor-retardant jacket. Seal all vapor-retardant jacket seams, punctures, tears and penetrations with UL Listed tapes and vapor-barrier mastic.
2. Provide insulated ductwork conveying air above ambient temperature with or without vapor-retardant jacket. Where service access is required, bevel and seal ends of insulation.
3. Continue insulation through non-fire-rated walls, sleeves, hangers, and other duct penetrations.
4. The underside of ductwork 24 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18 inches on center. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed, and then, when required, sealed with the same tape as specified above.
5. For exterior applications, provide internal duct insulation.

3.03 FIRE BARRIER DUCT WRAP

A. Site Verification of Conditions:

1. Verify that site conditions are acceptable for installation of fire barrier wrap.
2. Do not proceed with installation of fire barrier wrap until unacceptable conditions are corrected.

B. Surface Preparation: Ensure that surfaces of all openings and penetrating items are clean, dry, frost-free and free of dust.

C. Comply with installation requirements of fire-tested assembly design.

D. Fire Barrier Duct Wrap Installation:

1. To minimize waste, roll out fire barrier duct wrap material tautly before measuring.
2. Wrap fire barrier duct wrap blanket around the perimeter of the duct and cut to a length to overlap itself not less than 3 inches so that the overlap made by adjacent blankets forms a longitudinal overlap.
3. Seal all cut edges of the blanket and any tears in the foil scrim with aluminum foil tape.
4. Telescoping 3-Inch Overlap Wrap Method: Install each blanket overlapping the adjacent blanket, so that each blanket has one edge exposed and one edge covered by the next blanket and the visible edges of the perimeter overlaps all point in the same direction.
5. Checkerboard 3-Inch Overlap Wrap Method: Install blankets with both edges exposed alternating with blankets with covered edges so that the visible edges of the perimeter overlaps alternate their directions and appear on every other blanket.
6. Butt Joint with Collar Method: Install adjacent blankets butted tightly together with a 6-inch wide collar of fire barrier duct wrap centered over the joint, overlapping each blanket by 3 inches minimum.
7. Banding Only:

    a. Filament tape may be used to temporarily hold the blanket in place until

the banding is applied.

b. Apply steel banding around the duct 1½ inches from each edge of the blanket and maximum 10½ inch centers.

c. Place banding around the material and tighten so as to sufficiently hold the fire barrier duct wrap in place against the duct, compressing the foil but not cutting the foil.

8. Additional Pinning to Prevent Sagging of the Wrap:

a. For ducts 24 inches and larger in width, additional pins are required to support the blanket on the bottom horizontal surface and on the outside face of a vertical duct run.

b. Space pins a maximum of 10½ inches apart in the direction of the blanket width and a maximum of 12 inches apart in the direction of the blanket length.

9. Mechanical Fastening with Pins Only:

a. Weld insulation pins to the duct in the centers of the overlaps a minimum of 1½ inches from each edge of the blanket and spaced a maximum of 10½ inches on center along perimeter overlap, and a maximum of 10½ inches on center along longitudinal overlaps.

b. Impale blanket over pins and hold in place by galvanized speed clips.

c. Insulation pins that extend beyond the blanket wrap shall be turned down to eliminate sharp points.

d. Install insulated cup-head pins at the same spacing requirements of the insulation pins.

10. Access Door Installation:

a. Weld four (4) galvanized steel threaded rods, ¼-inch diameter by 4½ to 5 inches long to the duct at the corners of the door opening.

b. Place four (4) steel tubes, each 3 inches long, over the rods to act as protection for the fire barrier duct wrap when fastening the door.

c. Weld four (4) insulation pins to the door panel for installation of the blanket.

d. Cut one (1) layer of fire barrier duct wrap approximately the same size as the access panel and impale over the insulation pins on the panel, fitting this layer tightly against the wrap surrounding the access door opening with no through openings.

e. Cut a second layer of fire barrier duct wrap so as to overlap the first layer by a minimum of 1 inch and impale over the pins so that both layers are locked in place with galvanized speed clips.

f. Turn down pins that extend beyond the outer layer of fire barrier duct wrap to avoid sharp points on the door.

g. Place insulated door panel over the threaded rods and hold in place with washers and wing nuts.

3.04 PROTECTION

A. Protect installed work from damage due before and after installation.

END OF SECTION 23 07 00

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