

SECTION 15250 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe, duct, and equipment insulation.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 15 Section "Supports and Anchors" for pipe insulation shields and protection saddles.
 - 2. Division 15 Section "Metal Ductwork" for duct lining.

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 is designated by an r-value that represents the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity (r-value) is expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause 1 BTU per hour (1 Watt) to flow through 1 square foot at mean temperatures indicated.
- E. Thermal Conductivity (k-value): Measure of heat flow through a material at a given temperature difference; conductivity is expressed in units of Btu x inch/h x sq. ft. x deg F.
- F. Density: Is expressed in pcf.

1.4 SUBMITTALS

- A. No insulation shall be obtained or delivered to the job site until receipt of approved shop drawings.
- B. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. A complete tabular insulation schedule of all the insulation being provided under this project.
 - 2. Schedule headings shall include type of equipment (including Tag No.), Pipe (service, type), Ductwork (service, type), Insulation Type, Insulation Manufacturer, Insulation Thickness, Insulation K-value, Jacketing or Protective Covering.

3. Manufacturer's highlighted material data sheets, these should include published composite flame spread, smoke developed hazard ratings for insulation and jacketing and K-factors for insulation.
4. Provide published manufacturer's insulation application recommendations. Highlight application procedures being used on this Contract and note any deviations planned.
5. Provide when requested by <<AECM>> samples of the insulation being proposed.

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.
- B. All products or their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed above requirements.
- C. Field-Constructed Mock-Up: Before installation, erect mock-up of size and at locations indicated to demonstrate workmanship quality. Include method of attachment and finishing for each.
 1. Interior and exterior equipment.
 2. Interior and exterior duct systems.
 3. Interior and exterior piping systems.
 4. Retain and protect mock-ups during construction as a standard for judging completed unit of Work.
 5. Remove mock-ups from Project site when directed.
 6. Accepted mock-ups may become part of completed unit of Work.

1.6 SEQUENCING AND SCHEDULING

- A. Insulation shall not be installed or applied until the equipment and associated piping and ductwork has been pressure tested and the building is weatherproof.
- B. Schedule insulation application after installation and testing of heat trace tape.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

- B. 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. Cellular Glass:
 - a. Pittsburgh Corning Corporation.
 3. Flexible Elastomeric Cellular:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corporation.
 4. Calcium Silicate:
 - a. Manville.
 - b. Owens-Corning Corporation.
 5. Adhesives, coatings and mastics
 - a. Benjamin Foster
 - b. Childers Products Co.

2.2 MATERIALS – GENERAL

- A. Any treatment of jackets or facings to impart flame and smoke safety shall be permanent. Water-soluble treatments are prohibited.
- B. All duct insulation shall be in accordance with the requirements of NFPA-90A and BOCA Mechanical Code.
- C. All insulation materials shall have K-values which are less than or equal to those specified. K-values shall be measured in Btu per inch per square foot per degree F per hour.

2.3 IMS 1, FIBERGLASS PIPE INSULATION - ABOVE GRADE

- A. Material: Heavy density fiberglass pipe insulation with factory applied All-Service-Jacket or All-Service-Jacket/Self-Sealing-Lap-Jacket. Insulation shall be one piece molded fiberglass with a K-value of 0.23 at 75 deg. F mean temperature and be suitable for pipe temperatures up to 450 deg. F. All service jacket shall consist of white kraft bonded to aluminum foil reinforced with fiberglass yarn. Insulation shall be Knauf, Owens-Corning, Certainteed or Manville pipe insulation.

- B. Protective Jacket: In mechanical rooms, equipment rooms, and other spaces with exposed piping, provide a 0.016" thick aluminum jacket on all insulation (including fittings) below 7 feet above finished floor, access platform or catwalk. Elbows and tees shall be covered with PVC covers similar to Knauf Lo Smoke fitting covers.
- C. Protective Jacket: In mechanical rooms, equipment rooms, and other spaces with exposed piping, provide a field-welded 0.020" thick PVC or ABS jacket with a 25/50 flame and smoke rating on all insulation (including fittings) below 7 feet above finished floor, access platform or catwalk. Elbows and tees shall be covered with PVC covers similar to Knauf Lo Smoke fitting covers. The PVC or ABS jacket is not required for calcium silicate pipe insulation which has an aluminum jacket.
- D. Fittings: Knauf Lo Smoke PVC fittings and covers with 25/50 flame and smoke rating. Except in mechanical rooms where aluminum jackets shall be provided.

2.4 IMS 2, CALCIUM SILICATE PIPE INSULATION - ABOVE GRADE

- A. Material: Hydrous calcium silicate, Manville Thermo-12, Owens-Corning Kaylo Insulation, <<OAE>>. Insulation shall be 2-piece molded block with K-value of 0.42 at 200 deg. F mean temperature and be suitable for temperatures up to 1200 deg. F. Insulation shall be asbestos free.
- B. Protective Jacket: The insulation shall have a factory applied 0.016 aluminum jacket.
- C. Fittings: Elbows up to 12 inches shall be insulated with premolded calcium silicate insulation, Manville Thermo-12 LD molded 90 degree elbows, <<OAE>>, or use Hamfab premolded mineral wool Cadafit 1200 <<OAE>>. Elbows over 12 inches pipe size shall be insulated with segments of calcium silicate.

2.5 IMS 3, FOAMED PLASTIC PIPE INSULATION

- A. Material: Flexible foamed plastic, Armstrong AP Armaflex pipe insulation, Rubatex R-180-FS, <<OAE>>. Insulation shall have a K-value of 0.26 at 70 deg. F mean temperature, an average density of 6 pounds per cubic foot, flame-spread rating of 25 and a smoke-developed rating of 50. Insulation shall be suitable for pipe temperatures up to 200 deg. F.

2.6 IMS 7, FOAMED PLASTIC EQUIPMENT INSULATION

- A. Material: Closed cell, foamed plastic sheet material, Armstrong Armaflex II, Rubatex R-1800-FS <<OAE>>. Insulation shall have a K-value of 0.26 at 70 deg. F mean temperature, an average density of 6 pounds per cubic foot, a smoke spread rating of 25 and a smoke-developed rating of 150 for 1/2-inch thickness and 100 for 1-inch thickness. Insulation shall be suitable for temperatures between 33 deg. F and 200 deg. F.

2.7 IMS 8, INSULATION FOR VALVES, AIR SEPARATORS, STRAINERS, PIPE SPECIALTIES AND HUMIDIFIER SEPARATOR CHAMBERS

- A. Valves, (gate valves, check valves, globe valves, plug valves, triple duty valves, steam traps, steam humidifier chambers pressure reducing valves, and control valves) and strainers for steam, steam condensate, and hot water heating service for pipe sizes 2-1/2 inches and larger shall be provided with reusable strap on insulation covers shall be complete with drawstrings, belts and buckles. Covers shall be hot caps as manufactured by Engineered Insulation Services, Inc. <<OAE>> by Insulation Technology Inc., Q-Master, or Pittsburgh-Corning.
- B. Steam drip legs and steam pressure reducing stations including gate or ball valves, check valves, strainers, unions, and traps in all sizes, shall each be insulated with one continuous

reusable strap-on insulation cover with velcro hook and loop closure system. Covers shall be Ezy-Wrap or Custom Designed insulation covers as manufactured by Engineered Insulation Technology Inc. <<OAE>> by Q-Master, or Pittsburgh-Corning.

- C. Except as otherwise noted, individual valves and strainers for steam, steam condensate, and hot water heating service (except ball valves) for pipe sizes 2 inches and smaller shall not be insulated.
- D. Air separators for hot water service shall be insulated in accordance with Specification 1; 1-1/2" thickness.
- E. All butterfly valves, wafer check valves, and ball valves shall be insulated with same material as provided on adjacent piping. Use PVC or aluminum fitting covers at each location.
- F. All odd shaped valves (gate valves, check valves, globe valves, plug valves and triple duty valves), air separators, suction diffusers, and strainers for chilled water service shall be insulated in accordance with Specification 7; 1" thickness or in accordance with Specification 1 with a field fabricated solvent welded 0.020" thickness PVC or ABS jacket. Jacket shall be as manufactured by Zeston, Topline Products, Inc. <<OAE>>.

2.8 IMS 9, FIBERGLASS DUCT BOARD INSULATION FOR CONCEALED LOCATIONS

- A. Material: Fiberglass, insulation board, Manville 814 Spin Glass, Owens-Corning 703, Knauf, <<OAE>>. The insulation shall have a K-value of 0.24 at 75 deg. F mean temperature and a minimum density of 3 pounds per cubic foot. The insulation service jacket shall be a factory applied Foil-Scrim-Kraft (FSK) facing consisting of aluminum foil (minimum 0.7 mil thick) reinforced with fiberglass yarn mesh and laminated to 40 pounds chemically treated fire resistant Kraft, Manville FSK, Owens-Corning FRK, <<OAE>>. Facing shall have a maximum vapor transmission rate of 0.02 perms. Board shall have a maximum application temperature rating of 350 deg. F.

2.9 IMS 11, FIBERGLASS DUCT BLANKET INSULATION FOR CONCEALED LOCATIONS

- A. Material: Fiberglass insulation blanket, Manville R-Series Microlite Type FSKL, Owens-Corning, Knauf, <<OAE>>. The insulation shall have a K-value of 0.31 at 75 deg. F mean temperature. Insulation shall be furnished with a factory applied FSK (Foil-Scrim-Kraft) facing of aluminum foil reinforced with fiberglass yarn and laminated to 40-pound fire resistant kraft. The FSK facing shall have a maximum vapor transmission rate of 0.03 perms. Blanket shall be suitable for maximum application temperature rating of 250 deg. F.

2.10 IMS 12, ACOUSTICAL DUCT LINER

- A. Ductwork and casings shall be acoustically lined on the inside of the ducts with acoustical material.
- B. Material: Duct liner shall be fiberglass, 1.5 pound per cubic foot density, Manville Linacoustic, Owens-Corning Aeroflex, Knauf <<OAE>>. Liner shall have a K-value of 0.26 at 75 deg. F mean temperature and shall be rated for duct velocities up to 4,000 feet per minute. Liner shall meet U.L. Publication 181 for erosion testing and shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined in accordance with NFPA 255.
 - 1. The liner shall meet Standards No. 90A and No. 90B of the National Fire Protection Association and shall have the Underwriters' Laboratories, Inc. label.
 - 2. Based on a No. 6 mounting in accordance with Test Method ASTM-C-423-77, the liner shall have the sound absorption coefficients as follows:

Thickness of Liner (Inches)	Sound Absorption Coefficients at Frequencies of						
	125	250	500	1,000	2,000	4,000	NRC
1"	.13	.51	.53	.78	.83	.80	.70

3. The liner facing shall have a maximum friction loss correction factor of (FLCF) of 1.16 at 3000 FPM air velocity. When tested in accordance with TIMA Test Method AHS-152-76U. The FLCF is the factor to be applied to the SMACNA guide friction loss for straight galvanized metal ducts to obtain actual air friction losses.

2.11 IMS 15, FIBERGLASS HOT WATER STORAGE TANK INSULATION - ABOVE GRADE

- A. Material: Manville 1000 Series Spin Glas, Owens-Corning Fiberglas Insul Quick, <<OAE>>. The insulation shall have a K-value of 0.42 at 200 deg. F mean temperature and a density of 3.0 pounds per cubic foot.

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. All insulation shall be applied in a neat and workmanlike manner. The <<HCT>> will be required to remove and replace all insulation which is not applied in strict accordance with manufacturer's written specifications or does not present a neat appearance, as judged by <<AECM>>.
- B. Insulation shall be applied to clean dry surfaces with all joints butted firmly together. Pipe and duct insulation shall be applied after piping and ductwork has been tested and proved tight.
- C. All piping, ductwork and equipment shall be insulated as specified. All pipe and ductwork insulation shall have a vapor barrier, unless otherwise specified.
- D. Insulation shall be arranged for easy removal and replacement of equipment or piping.
- E. All exposed pipe and equipment insulation shall receive one coat of Benjamin Foster Lagtone #30-70, color <<ASAPP> by <<AECM>>. Refer to Division 9 "Painting" Section for additional painting specifications.
- F. All exposed insulated pipe, ductwork and equipment surfaces shall be painted with two (2) coats of latex enamel paint. Each coat shall be a different shade, with final coat of color selected by <<AECM>>. Refer to Division 9 "Painting" Section for additional painting specifications.
- G. All piping in exterior walls or exposed to freezing shall be provided with an additional 1 inch of fiberglass insulation with jacket.

- H. All insulation shall be continuous through wall and ceiling openings and sleeves except at fire rated and smoke rated separations where insulation shall be replaced an approved fire stopping material. Refer to Division 7 Section "Fire Stopping" for further requirements.
- I. Insulation on all cold surfaces shall be applied with a continuous, unbroken vapor seal. Hangers, supports and anchors that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
- J. All surface finishes shall be extended to protect all surfaces, ends and raw edges of insulation.
- K. Provide fiberglass insulation inserts and premolded PVC fitting covers for 90 degree, 45 degree elbows, tees, valves, and grooved pipe couplings on pipe specified herein to have fiberglass insulation. Use premolded aluminum covers for fittings on pipe specified herein to have fiberglass insulation and aluminum jacket. Covers and inserts shall be as manufactured by Zeston, Proto Lo Smoke, Knauf Lo Smoke, <<OAE>>. Premolded insulators with vapor barrier coating or covers as manufactured by Molded Acoustical Products, Inc. or Hamfab, Inc. may also be used. Field fabricated insulation fittings are not an acceptable alternative to premolded manufactured insulators or insulation inserts.
- L. Insulation inserts between the pipe and pipe hangers (or supports) for all services except steam shall be Hamfab, Inc. H-block <<OAE>> rigid pipe insulation of equal thickness to the adjoining insulation. Insulation inserts shall be provided not less than the following lengths and quantities:

PIPE SIZE	QUANTITY PER	
	LENGTH	SUPPORT POINT
1/2" to 4"	Use extended metal shields	
6" to 8"	6"	two
10" to 12"	9"	three
14" to 16"	12"	four
18" and over	Use steel protection saddles welded to pipe	

- M. Insulation inserts for steam and steam condensate lines shall be calcium silicate for piping four inches and smaller; minimum insulation insert length shall be 8". Steel protection saddles welded to the pipe shall be used for piping six inches and larger.
- N. Galvanized metal shields, 16 gauge, shall be applied between hangers or supports and the pipe insulation inserts. Shields shall be formed to fit the insulation and shall extend up to the center line of the pipe. Metal shield length shall be as specified and shall be installed with the shield centered on the hanger.

PIPE SIZE	SHIELD LENGTH
Up to 2"	12"
2-1/2" to 3"	15"
4"	20"
6" and over	Insert length plus 6"

- O. Specified adhesives, mastics and coatings shall be applied at the manufacturer's recommended minimum coverage per gallon and at an ambient and equipment temperature within the recommended range.
- P. Where applicable, stapling of insulation lap covering shall be with outward clinch staples. Staples shall be stainless steel. Use of plain steel or galvanized steel staples is not permitted.
- Q. Internal duct liners shall not be used on ductwork or terminal equipment serving operating rooms, delivery rooms, LDR rooms, nurseries or intensive care units.

3.3 EXISTING PIPE AND DUCT INSULATION

- A. Repair and paint all existing damaged pipe, equipment and duct insulation within the limits of the Contract.
- B. Existing thermal insulation disturbed in demolition or in making new connections shall be replaced with new insulation and covering to match existing work. Existing pipe (and duct) insulation shall be stripped off piping (and ductwork) to be modified or relocated to a point approximately 12" from the point of connection to new work.

3.4 INSULATION NOT REQUIRED

- A. Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
 - 1. Gravity relief air ductwork.
 - 2. Exhaust air ductwork (except as otherwise noted).
 - 3. Exhaust air plenums
 - 4. Return air ductwork (except as otherwise noted)
 - 5. Condenser water piping. (Insulate heat traced piping outdoors)
 - 6. Filter effluent piping. (Insulate heat traced piping outdoors).
 - 7. piping).
 - 8. Screwed and soldered unions except in chilled water piping.
 - 9. Hot water pumps
 - 10. Condenser water pumps
 - 11. Filter effluent pumps
 - 12. Piping and valve rigs within 5 feet of terminal equipment on hot water systems. (For design HWS temps of 130 deg. F or less)

3.5 INSULATION REQUIRED

- A. The following HVAC work installed by the <<HCT>> shall be insulated with the type and thickness of insulation noted:
 - 1. Unfiltered and filtered fresh (outdoor) air ductwork and plenums; Specification 9 or Specification 10, 1" thickness.
 - 2. Filtered fresh (outdoor) air ductwork and plenums; Specification 12, 1" thickness.
 - 3. Supply air ductwork; Specification 9 OR 10, 1" thickness, or Specification 11, 2" thickness.
 - 4. Supply air ductwork; Specification 12, 1" thickness (except as otherwise noted).

5. High pressure supply air ductwork (upstream of air terminal boxes); Specification 9 or 10, 1" thickness, or Specification 11, 2" thickness.
6. Low pressure supply air ductwork (downstream of air terminal boxes); Specification 12, 1" thickness (except as otherwise noted).
7. Supply air ductwork and terminal air boxes serving operating rooms, trauma rooms, LDR rooms, nurseries, recovery rooms, intensive care rooms, and isolation rooms; Specification 9, 1" thickness.
8. Supply air ductwork within 15 feet downstream of humidifiers; Specification 9 or 10, 1" thickness or Specification 11, 2" thickness.
9. Return air ductwork; Specification 9 or 10, 1" thickness or Specification 11, 2" thickness.
10. Return air ductwork; Specification 12, 1" thickness.
11. Mixed air ductwork and mixing boxes, Specification 9 or 10, 1" thickness, or Specification 11, 2" thickness.
12. Mixed air ductwork; Specification 12, 1" thickness.
13. Exhaust air ductwork (downstream of backdraft damper); Specification 9 or 10, 1" thickness.
14. Supply air, exhaust air, and relief air ductwork located outdoors; Specification 14, 2" thickness.
15. Return air fan; Specification 13.
16. Exhaust air fan; Specification 13.
17. Flexible duct connections; Specification 7, 3/4" thickness

3.6 IMS 9, FIBERGLASS DUCT BOARD INSULATION INSTALLATION FOR CONCEALED LOCATIONS

- A. Application: All ducts shall be insulated on the outside. All insulation shall be applied with edges tightly butted. Insulation shall be impaled on pins welded to the duct and secured with white prefinished fastening caps. Spacing of pins shall be as required to hold insulation firmly against duct surface, but not less than one (1) pin per square foot. All joints and speed clips shall be sealed with heat or pressure sensitive vapor barrier tape to match the facing. AGM Insul Hangers may be used in lieu of welded pins where suitable for the application.
 1. If, through space or size restriction, or other causes, the welded pin method is impossible, the insulation shall be secured to the duct with Benjamin Foster 85-20 Adhesive. The adhesive shall cover the entire surface of the metal when applied to the underside of horizontal ducts but may be spotted for application to top and sides. Insulation shall be additionally secured with No. 16 gauge stainless steel wire on not more than 12-inch centers. Corner metal angle shall be used to protect edges of insulation. Joints shall be sealed as above.

3.7 IMS 10, FIBERGLASS DUCT BOARD INSULATION INSTALLATION FOR MECHANICAL ROOMS AND EXPOSED LOCATIONS

- A. Application: All ducts shall be insulated on the outside. All insulation shall be applied with edges tightly butted. Insulation shall be impaled on pins welded to the duct and secured with speed clips. The protruding end of the pins shall be cut off flush after the speed clips have been FSK or ASJ patched. Spacing of pins shall be as required to hold insulation firmly against duct surface, but not less than one pin per square foot. All joints and speed clips shall be sealed with heat or pressure sensitive vapor barrier tape to match the facing.
1. If, through space or size restriction, or other causes, the welded pin method is impossible, the insulation shall be secured to the duct with Benjamin Foster 85-20 Adhesive. The adhesive shall cover the entire surface of the metal when applied to the underside of horizontal ducts but may be spotted for application to top and sides. Insulation shall be additionally secured with No. 16 gauge stainless steel wire on not more than 12-inch centers. Corner metal angle shall be used to protect edges of insulation. Joints shall be sealed as above.
 2. All areas are to be reinforced with corner bead of heat or pressure sensitive vapor barrier tape. Apply tack coat of Benjamin Foster 30-36 Sealas at 60 to 70 square foot per gallon by spray or brush. Apply jacket onto wet coating, smoothing to avoid wrinkles.

3.8 IMS 11, FIBERGLASS DUCT BLANKET INSULATION INSTALLATION FOR CONCEALED LOCATIONS

- A. Application: Insulation shall be cut slightly longer than circumference of duct to insure full thickness at corners. All insulation shall be applied with edges tightly butted and stitched with staples.
1. Insulation shall be secured to the sheet metal ductwork with adhesive such as CMC 17-465, Foster 85-20 <<OAE>>. The adhesive shall cover the entire surface of the sheet metal when applied to the underside of horizontal duct but may be applied in strips or spots for application to top and side with a minimum of 50 percent coverage.
 2. Tape the stitched seam with 4-inch wide pressure sensitive aluminum foil tape. The insulation shall be additionally secured to the bottom and sides of all horizontal rectangular ducts 24" or wider and to the sides of vertical rectangular ducts 24" or wider by means of welded pins and speed clips. Weld pins shall be spaced 18" on center. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier shall be thoroughly sealed where the pins have pierced through with a tape of the same material by applying a vapor barrier adhesive to both surfaces as recommended by the manufacturer.
 3. All joints and penetrations of the vapor barrier shall be sealed with 3" pressure sensitive aluminum foil tape. All cuts or tears shall be sealed with strips of the aluminum foil tape.

3.9 IMS 12, ACOUSTICAL DUCT LINER INSTALLATION

- A. Application: Duct liner shall be applied to the flat metal sheet with a 100 percent coverage of fire resistive adhesive, Benjamin Foster 81-99 <<OAE>>. The duct liner shall be cut to assure snug corner joints. The surface designed to be exposed shall face the air stream. On horizontal runs, tops of ducts over 12 inches in width and sides over 16 inches in height shall be additionally secured with welded pins and speed clips or Gripnails on a maximum of 16-inch centers. On vertical runs, welded pins and speed clips shall be spaced on a maximum of 16-inch centers on all width dimensions over 12 inches. Pins shall start within 3 inches of the leading edge of all cross joints within the duct section and spaced at a maximum of 6 inches on center around the perimeter of the duct. Pins shall be cut virtually flush with the liner surface. All exposed edges and the leading edge of all cross joints of the liner shall be coated with fire resistive adhesive, Benjamin Foster 85-20, <<OAE>>.

1. For preformed ducts, liner shall be applied to all surfaces with a 100 percent coverage of fire resistive adhesive, Benjamin Foster 85-20, Miracle PF-101 or 102, <<OAE>>. All exposed edges shall be coated with the same adhesive used to secure the duct liner to the metal surface. The leading edge of all cross joints shall be covered with metal nosing. In addition to the adhesive, ducts over 12 inches shall have liners additionally secured with welded pins and speed clips or Gripnails on a maximum of 15-inch centers. Pins shall be cut virtually flush with the liner surface.
- B. The dimensions of ductwork as listed on the Drawings show the free area required. Ducts to be acoustically lined shall have sheet metal size increased to allow for liner and still maintain air path dimensions.

3.10 IMS 13, VANEAXIAL FAN ACOUSTICAL/THERMAL WRAP INSTALLATION

- A. Application: As a minimum, vaneaxial fans and ductwork shall be insulated with acoustical thermal wrap as follows:
1. Vaneaxial fan – all
 2. Vaneaxial fan ductwork upstream to sound attenuator or upstream to far end of rectangular to round inlet cone, whichever is further.
 3. Vaneaxial fan ductwork downstream to far end of round to rectangular discharge cone.
 4. Ductwork acoustical lining (Specification 12) requirements will commence outside of these limits.
 5. All access doors and lubrication openings shall be cut out of the insulation blanket with the cutouts fitted individually to each access opening.

3.11 IMS 17, RECTANGULAR FIBERGLASS DUCT BOARD INSTALLATION (FDB)

- A. All fabrication details shall be in accordance with the latest edition of the Manville Fabrication Manual and the SMACNA Fibrous Glass Manual Duct Construction Standards.
- B. All transverse and longitudinal seams shall be stapled with 9/16 inch minimum outward clinch staples approximately 2 inches on center.
- C. Closure system for use on Manville Micro-Aire duct board shall be Manville Therm-Lock tape with automatic bond indicator, Nashua 324 pressure sensitive tape <<OAE>>.
- D. Straight runs on duct span of 24 inches and greater shall be supported every 4 feet and straight runs on duct span less than 24 inches shall be supported every 8 feet. Also supports shall be provided at all fittings.
- E. For reinforcement, use the Tie Rod System or the SMACNA Schedule for reinforcement.
- F. When electric, steam, or hot water heater coils are mounted in fiberglass ductwork, provide 12-inch long sheet metal duct sleeves, with one flanged end, inserted inside the fiberglass duct and attach coil to the flanged ends. Each flanged section shall be individually supported from the structure above.
- G. Installation shall also meet the following requirements:
1. No misalignment of joints shall exceed a 3/8-inch offset at the joint.

2. Where male/female joints and staple flaps are not utilized for joint connection, 8-inch long cross strips of therm-lock tape on 12-inch centers shall be used across the joint.
 3. All joints shall be firmly seated as evidenced by no air gaps under the tape.
 4. All temperature sensitive dots on the therm-lock closure tape shall be black.
 5. All tears in the facing shall be covered with heat or pressure sensitive vapor barrier tape.
 6. Any tears in the glass surface shall be heavily buttered with approved duct liner adhesive.
 7. Installation of metal accessories shall be firmly held with mechanical fasteners.
 8. Any movable dampers shall utilize internal metal sleeving.
- H. The <<HCT>> shall purchase ductwork from a factory qualified fabricator who maintains and utilizes factory authorized construction standards and quality control procedures.
- I. Fiberglass duct board shall not be used in the following applications:
1. Within two inches of high temperature heating coils.
 2. In equipment rooms.
 3. For velocities or pressure beyond recommendations.
 4. Within six feet of fresh air intakes or outside grilles.

3.12 IMS 18, PREFORMED ROUND FIBERGLASS DUCTBOARD INSTALLATION (FDB)

- A. All straight sections must be joined using the premolded male/female slip joints and sealed with Manville Therm-Lock PFR <<OAE>>. Tape shall overlap at least 3".
- B. Ells (45 degrees and 90 degrees) straight branch connections (45 degrees and 90 degrees), 90-degree wide throat branch connections, reducers, wyes and tie wyes should be fabricated by a Factory Qualified Fabricator using Manville <<OAE>> construction plates and approved procedures.
- C. Sections shall be supported every 36" for sizes up to 7" diameter and every 72" for sizes 8" diameter and over and at joints, using 1-1/2 wide stainless steel sheet metal straps. Tape strap to duct to restrict movement. Hanger loops should be fastened by bolts or self-tapping metal screws.
- D. <<HCT>> shall purchase ductwork from a factory qualified fabricator who maintains and utilizes factory authorized construction standards and quality control procedures.
- E. Fiberglass duct board shall not be used in the following applications:
1. In equipment rooms.
 2. Within six feet of fresh air intakes or outside grilles.
 3. No fittings within six diameters downstream of a fan.

3.13 IMS 19, ACOUSTICAL EQUIPMENT INSULATION INSTALLATION

- A. Application: All surfaces shall be insulated on the outside with two 2-1/2" layers of insulation. All insulation shall be applied with edges tightly butted. Insulation shall be impaled on pins glued to the outside surface and secured with speed clips. The protruding end of the pins shall be cut off flush after the speed clips have been applied and a caulking bead of RTV applied before application of the finish FSK patch. Spacing of pins shall be as required to hold insulation firmly against outside surface, but not less than one pin per square foot. All joints and speed clips shall be sealed with Manville Therm-Lock tape to match the facing.
1. In addition to speed clips, each layer of insulation shall be secured to the outside surface of the vessel or previous insulation layer with Benjamin Foster 85-20 Adhesive. The adhesive shall cover the entire surface when applied to the lower surfaces (3 o'clock to 9 o'clock), but may be applied in strips for application to top surfaces with a minimum of 50 percent coverage. Insulation shall be additionally secured with No. 16 galvanized wire on no more than 12-inch centers. Corner metal angle shall be used to protect edges of insulation. Joints shall be sealed as above.
 2. All areas are to be reinforced with corner bead of Manville Therm-Lock tape. Apply tack coat of Benjamin Foster 30-36 Sealfas at 60 to 70 square foot per gallon by spray or brush. Apply jacket onto wet coating, smoothing to avoid wrinkles.
 3. Finally, apply one layer of 20 gauge galvanized steel to the entire exterior surface use drive slips at all longitudinal joints; butt joints will generally not be permitted. Provide butt joints only where required for access and service.

3.14 IMS 20, FACTORY APPLIED PIPE INSULATION FOR BELOW GROUND INSTALLATION

- A. Application: Polyurethane foam insulation shall be factory injected into the annular space between the carrier pipe and the jacket with one shot to a nominal thickness as outlines in this Specification. Where heat tracing is required one or two strips of wire mold raceway shall be tack welded to the carrier pipe prior to the one shot insulation process.
1. End seals shall be factory applied and bonded to the carrier pipe and jacket. End seals may be altered and field applied in accordance with the manufacturer's recommendations when field alterations are required.
 2. In ductile iron pipe; fittings shall not be insulated. Fittings will be encased in concrete.
 3. In steel piping systems, fittings shall be factory insulated with urethane, jacketed with a fitting cover and wrapped with 30 mil polyethylene/butyl rubber laminate tape. Prior to joining the pipe a piece of sleeve stock with an inside diameter slightly larger than the outside diameter of the adjacent piping jacket (as required) shall be slid onto the end of the adjacent pipe. After field welding, pressure testing and heat tracing the carrier pipe, two hemispherical sections of urethane insulation are positioned over the joined carrier pipe and the sleeve stock is centered over the joint. Using pressure sensitive self adhering tape, overlap the ends of the sleeve with one circumference wrap with a three inch overlap OR using heat shrink tape and complete the seal with a soft flame burner.
- B. Backfill: A 4" layer of sand or fine gravel shall be placed and tamped in the trench to provide a uniform bedding for the pipe. The entire trench width shall be evenly backfilled with a similar material as the bedding in 6" compacted layers to a minimum height of 6 - 12" above the top of the insulated piping system. The remaining trench shall be evenly and continuously backfilled in uniform layers with suitable excavated soil.
- C. Where piping extends from underground into adjacent aboveground spaces the carrier shall be insulated through the wall penetration for a distance of between 6 and 9 inches so that a proper vapor seal can be installed and maintained.

- D. All preinsulated piping shall be handled in accordance with the insulation fabricator's recommendation.
- E. Provide the services of the pipe insulation manufacturer certified field representative who shall visit the site at least once a week and prior to any piping section being buried.

END OF SECTION 15250