SECTION 23 07 13
HVAC DUCT INSULATION

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 ADDITIONAL RELATED DOCUMENTS

A. Related Sections include the following:

1. Division 23 Section "Common Work Results for HVAC" for definitions of some terms used in this Section.

    a. Definition of the term 'Mixed Air': An airstream containing, in some or all system operating modes, a fraction of outdoor air mixed with return air.

1.3 SUMMARY

A. This Section includes duct and plenum insulation; accessories and attachments; and sealing compounds.

1.4 ACTION SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program offered by the Contractor, insulation material manufacturer, or trade association relating to the installation of duct insulation for commercial, industrial and institutional applications. Installers shall also have no less than one (1) year of relevant experience.

B. Installation Standards: The application of insulation shall conform to the Midwest Insulation Contractors Association's (MICA) "*National Commercial and Industrial Insulation Standards*", 8th Edition, except where the content of this Section conflicts.

C. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer material containers with appropriate markings of applicable testing and inspecting agency.

1. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, for all insulation and jacketing materials used indoors.

D. Minimum Insulation Thicknesses and R-Values: Conform to requirements of ASHRAE Standard 90.1-2016 and the 2018 International Energy Conservation Code (IECC), or the requirements of this Section, whichever is most demanding.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

B. Protect materials from dirt and water. If insulation materials are dirtied or wetted, they shall not be installed, or shall be removed from the ductwork if wetted or soiled after installation.

1.8 COORDINATION

A. Coordinate clearance requirements for insulation application during the preparation of ductwork shop drawings and coordination drawings, and during ductwork system installation.

1.9 SCHEDULING

A. Schedule insulation application after successful leakage and pressure testing duct systems, and acceptance by the Architect / Engineer. Insulation application may begin only on segments of ducts that have satisfactory test results.

B. Schedule the application of insulation on cold duct systems to occur during the winter months, or with the cooling system de-energized. Substrates shall be completely dry at the time of application. Do not restore cooling service until the insulation installation is complete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Glass Mineral-Fiber Insulation:

a. CertainTeed Corp.
b. Johns Manville, Inc.
c. Knauf Insulation.
d. Manson Insulation Inc.
e. Owens-Corning Fiberglas Corp.
f. Or equal as approved by the Professional.

2.2 INSULATION MATERIALS

A. General Requirements: All insulation materials shall comply with the following:

1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
2. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

B. Glass Mineral-Fiber Board Thermal Insulation for Interior Use: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 3.0 PCF density, with a factory applied white, paintable, all-service jacket (ASJ) manufactured from kraft paper, fiberglass reinforcing scrim, and aluminum foil backing, complying with ASTM C 1136, Type I.

1. 3.0 PCF materials shall have a maximum thermal conductivity of 0.23 Btu-in./h-ft2- °F.
2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

C. Glass Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type III, 3/4 PCF density, without facing and with aluminum, foil-scrim-kraft (FSK) jacket manufactured from kraft paper backing, reinforcing fiberglass scrim, and aluminum foil; complying with ASTM C 1136, Type II.

1. 3/4 PCF materials shall have a maximum thermal conductivity of 0.29 Btu-in./h-ft2- °F.
2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

2.3 JACKET TAPES

A. For use on factory jackets.

B. FSK Jacket Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces' force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. All-Service Jacket (ASJ) Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces' force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd.

1. Tape Width: 4 inches.

B. Bands: 3/4-inch-wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

1. Welded Pin Holding Capacity: 100 lb. for direct pull perpendicular to the attached surface.

E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel or stainless steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated. Stainless steel pin and washer materials shall be used on stainless steel or aluminum ducts.

1. Adhesive: Single component moisture curing adhesive recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
2. Peel and stick (self-adhesive) type pins are <u>not</u> acceptable.

2.5 CORNER ANGLES

A. Aluminum Corner Angles: 0.040-inch thick, minimum 2 by 2 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

2.6 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Ensure that insulation is clean and dry, and in good mechanical condition with all factory applied vapor or weather barriers intact and undamaged.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements during and after installation for a minimum period of 24 hours.

C. On cold surfaces where a vapor barrier is required (e.g. supply ductwork), insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

D. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

E. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.

F. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

G. Apply multiple layers of insulation with longitudinal and end seams staggered.

H. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

I. Keep insulation materials dry during application and finishing.

J. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

K. Apply insulation with the least number of joints practical.

L. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

M. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

N. Insulation Terminations and Penetrations: For insulation application where vapor retarders are indicated, seal ends and cut penetrations with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

O. Install corner angles on external corners of insulation on ductwork in exposed mechanical or finished spaces and outside the building before covering with jacketing.

P. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.

Q. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

R. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.

1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

S. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Seal insulation to roof flashing with vapor-retarder mastic.

T. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

U. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

V. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 GLASS MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives to duct, plenum, fittings and transitions surfaces according to manufacturer's recommended coverage rates.
2. Install anchor pins and speed washers on all four sides of horizontal ducts and all four sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3-inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.

c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not over-compress insulation during installation.

3. Impale insulation over anchors and attach speed washers.
4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers on all sides of ducts and plenums.

1. Apply adhesives to duct, plenum, fittings and transitions surfaces according to manufacturer's recommended coverage rates.
2. Space anchor pins as follows:

a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3-inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not over-compress insulation during installation.

3. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
5. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 DUCT SYSTEM APPLICATIONS - GENERAL REQUIREMENTS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Field-insulate the following plenums and duct systems listed below, and those listed in the application schedule articles located elsewhere in this Section:

1. Indoor concealed supply- mixed air-, and outside-air ductwork.
2. Indoor exposed supply-, mixed air-, and outside-air ductwork.
3. All ductwork located outdoors and exposed to weather.
4. Ducts scheduled to receive insulation in the schedules at the end of this Section.

C. Insulate, as specified for the connecting ductwork, the outside of damper frames, silencers, duct coil casings, and similar duct accessories and equipment that form an air conveying portion of the duct wall, except for access doors and smoke, fire, and combination smoke-fire damper sleeves.

D. Items Not Field-Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums, casings, air terminal units (i.e. VAV boxes), and filter boxes and sections.
3. Flexible connectors.
4. Vibration-control devices.
5. Testing agency labels and stamps.
6. Nameplates and data plates.
7. Factory insulated access panels and doors in air-distribution systems.
8. Motorized damper shafts and manual volume damper quadrants.
9. Life Safety Damper sleeves unless required by the damper's UL listing or installation instructions.
10. Factory pre-insulated double-wall ducts. Refer to Division 23 Section "Ductwork" and the Drawings for those ducts required to be double wall.

3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

A. Refer to Division 23 Section "Common Work Results for HVAC" for definitions of 'conditioned' and 'unconditioned' spaces, as well as 'exposed' and 'concealed' installations.

B. Minimum R-Values scheduled below are in units of h-ft2- °F./ Btu, at 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518. For blanket insulation, they shall be 'as-installed' R-values and thicknesses with 25% compression.

1. Provide additional insulation thickness than the minimum thicknesses scheduled below if required to meet the minimum R-value indicated.

C. Service: Supply-air, mixed air, and outside-air ducts, concealed in indirectly conditioned spaces (e.g. ceiling plenums, shafts, etc.). Exception: DOAS Supply ducts.

1. Material: 3/4 PCF glass mineral-fiber blanket with aluminum foil-scrim-kraft (FSK) jacket.
2. Minimum Thickness: 1-1/2 inches.
3. Number of Layers: One.
4. Vapor Retarder Required: Yes.
5. Minimum R-Value: 4.2

D. Service: Supply-air, return-air, mixed air, and outside-air ducts, exposed in basement Mechanical Equipment Rooms (basement and attic) and similar un-finished, but indirectly conditioned, spaces.

1. Material: Rigid glass mineral-fiber board, 3 PCF density, with white, paintable all-service jacket (ASJ). Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
2. Minimum Thickness: 1 inches.
3. Number of Layers: One.
4. Vapor Retarder Required: Yes.
5. Minimum R-Value: 4.3

E. Service: Supply-air, mixed air, and outside air ducts, exposed in finished, conditioned spaces.

1. Material: Rigid glass mineral-fiber board, 3 PCF density, with white all-service (ASJ) jacket. Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
2. Minimum Thickness: 1 inches.
3. Number of Layers: One.
4. Vapor Retarder Required: Yes.
5. Minimum R-Value: 4.3
6. NOTE: Refer to the Drawings and Division 23 Section "Ductwork" for those ducts required to be double wall instead of the above specified board insulation.

F. Service: Supply-air, return-air, and mixed air ducts, located in unconditioned spaces such as uninsulated and ventilated lofts, attics, and crawl spaces.

1. Material: 3/4 PCF mineral-fiber blanket with aluminum foil-scrim-kraft (FSK) jacket.
2. Minimum Thickness: 3 inches.
3. Number of Layers: One or two. If two layers are used, the inner layer shall be un-faced / un-jacketed.
4. Vapor Retarder Required: Yes.
5. Minimum R-Value: 8.4

G. Service: Portions of exhaust duct and plenum systems between an isolation motorized or backdraft damper and the duct system termination at a louver, gravity ventilator, gooseneck, or similar discharge opening to the exterior.

1. Insulate as specified above for outdoor air ductwork.

END OF SECTION