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For more information, contact Ideal Tape Co., Inc., 1400 Middlesex St., Lowell, MA 01851; Phone: (800) 229-9148; Fax: (800) 897-8273; Website: [www.idealtape.com](http://www.idealtape.com); Email: [info@idealtape.com](mailto:info@idealtape.com).

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## SECTION 230713 - DUCT INSULATION

### **TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

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## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."

2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:
  1. Product Data: For adhesives, indicating VOC content.
  2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  3. Product Data: For coatings, indicating VOC content.
  4. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
  5. Product Data: For sealants, indicating VOC content.
  6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  3. Detail application of field-applied jackets.
  4. Detail application at linkages of control devices.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## PART 2 - PRODUCTS

## 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. 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.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, [**Type I**] [**Type II with factory-applied vinyl jacket**] [**Type III with factory-applied FSK jacket**] [**Type III with factory-applied FSP jacket**]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.
    - f. **<Insert manufacturer's name>**.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation [**without factory-applied jacket**] [**with factory-applied ASJ**] [**with factory-applied FSK jacket**]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.
    - f. **<Insert manufacturer's name>**.

## 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a [1] [2]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M.
    - b. CertainTeed Corporation.
    - c. Johns Manville; a Berkshire Hathaway company.
    - d. Nelson Firestop; a brand of Emerson Industrial Automation.
    - e. Thermal Ceramics.
    - f. Unifrax Corporation.
    - g. **<Insert manufacturer's name>**.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
    - e. **<Insert manufacturer's name>**.
  2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.

- e. **<Insert manufacturer's name>**.
  2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. P.I.C. Plastics, Inc.
    - d. Speedline Corporation.
    - e. **<Insert manufacturer's name>**.
  2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. VOC Content: [300] **<Insert value>** g/L or less.
  2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    - b. Knauf Insulation.
    - c. Vimasco Corporation.
    - d. **<Insert manufacturer's name>**.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm (0.009 metric perm)** at **43-mil (1.09-mm)** dry film thickness.

3. Service Temperature Range: **Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C)**.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Eagle Bridges - Marathon Industries.
  - c. Foster Brand; H. B. Fuller Construction Products.
  - d. Knauf Insulation.
  - e. Mon-Eco Industries, Inc.
  - f. Vimasco Corporation.
  - g. **<Insert manufacturer's name>**.
2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms (1.2 metric perms)** at **0.0625-inch (1.6-mm)** dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C)**.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Eagle Bridges - Marathon Industries.
  - c. Foster Brand; H. B. Fuller Construction Products.
  - d. Mon-Eco Industries, Inc.
  - e. **<Insert manufacturer's name>**.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C)**.
5. Color: Aluminum.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

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

- a. Childers Brand; H. B. Fuller Construction Products.
  - b. <Insert manufacturer's name>.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: **Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C)**.
  5. Color: White.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
  5. Vinyl Jacket: White vinyl with a permeance of **1.3 perms (0.86 metric perm)** when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately **1 oz./sq. yd. (34 g/sq. m)** with a thread count of **10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm)**, in a Leno weave, for ducts.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. <Insert manufacturer's name>.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
    - d. Speedline Corporation.
    - e. **<Insert manufacturer's name>**.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: **[White]** **[Color-code jackets based on system. Color as selected by Architect]**.
- D. Aluminum Jacket: Comply with **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. ITW Insulation Systems; Illinois Tool Works, Inc.
    - c. RPR Products, Inc.
    - d. **<Insert manufacturer's name>**.
  2. **[Sheet and roll stock ready for shop or field sizing]** **[Factory cut and rolled to size]**.
  3. Finish and thickness are indicated in field-applied jacket schedules.
  4. Moisture Barrier for Indoor Applications: **[1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper]** **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper]** **[2.5-mil- (0.063-mm-) thick polysurlyn]**.
  5. Moisture Barrier for Outdoor Applications: **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper]** **[2.5-mil- (0.063-mm-) thick polysurlyn]**.
- E. Self-Adhesive Outdoor Cladding/Jacketing: **60-mil- (1.5-mm-)** thick, laminated vapor barrier with a waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a layered cross-laminated polyethylene film covered with **[white]** **[silver]** aluminum-foil facing and backed with a cold weather acrylic adhesive.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc.; an American Biltrite company; Ideal Seal 777 **[Smooth Aluminum]** **[Embossed Aluminum]** **[Smooth White]** **[or]** **[White Embossed]** or comparable product by one of the following:
    - a. Polyguard Products, Inc.
    - b. **<Insert manufacturer's name>**.
  2. Thickness: **[7.5 mils (0.19 mm)]** **[10 mils (0.25 mm)]** **[12 mils (0.30 mm)]**.
  3. Adhesion: Cold Seal acrylic adhesive, **80 ounces force/inch (2,234 g/25 mm)**.



## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc.; an American Biltrite company; 728 Cold Seal ASJ or a comparable product by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Venture Tape.
    - c. **<Insert manufacturer's name>**.
  2. Width: **3 inches (75 mm)**.
  3. Thickness: **9 mils (0.23 mm)**.
  4. Adhesion: **70 ounces force/inch (1,955 g/25 mm)** in width.
  5. Elongation: 3 percent.
  6. Tensile Strength: **45 lbf/inch (197 N/25 mm)** in width.
  7. ASJ Tape Disks: Precut disks of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with rubber or acrylic adhesive; complying with ASTM C 1136.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc.; an American Biltrite company; [**491 FSK**] [**or**] [**791 Cold Seal Acrylic FSK**] or a comparable product by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Shurtape Technologies.
    - c. Venture Tape.
    - d. **<Insert manufacturer's name>**.
  2. Width: **3 inches (75 mm)**.
  3. Thickness: **6 mils (0.15 mm)**.
  4. Adhesion (Rubber Adhesive): **100 ounces force/inch (2,793 g/25 mm)** in width.
  5. Adhesion (Acrylic Adhesive): **90 ounces force/inch (2,514 g/25 mm)** in width.
  6. Elongation: 3 percent.
  7. Tensile Strength: **35 lbf/inch (153 N/mm)** in width.
  8. FSK Tape Disks: Precut disks of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc.; an American Biltrite company; 370 White PVC Tape or a comparable product by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Venture Tape.
    - c. **<Insert manufacturer's name>**.

2. Width: **2 inches (50 mm)**.
3. Thickness: **5 mils (0.13 mm)**.
4. Adhesion: **20 ounces force/inch (559 g/25 mm)** in width.
5. Elongation: 500 percent.
6. Tensile Strength: **15 lbf/inch (66 N/25 mm)** in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with rubber or acrylic adhesive.

Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc.; an American Biltrite company; [**488 AWF rubber adhesive**] [**788 Cold Seal acrylic adhesive**] or a comparable product by one of the following:

- a. Avery Dennison Corporation, Specialty Tapes Division.
- b. Venture Tape.
- c. **<Insert manufacturer's name>**.

2. Width: **3 inches (72 mm)** nominal.
3. Thickness: [**3.0 mils (0.08 mm)**] [**4.0 mils (0.1 mm)**].
4. Adhesion: Rubber adhesive; **90 ounces force/inch (2,514 g/25 mm)** in width.
5. Adhesion: Cold Seal acrylic adhesive; **50 ounces force/inch (1,396 g/25 mm)** in width.
6. Elongation: 3 percent.
7. Tensile Strength: [**14 lbf/inch (61 g/25 mm)**] [**20 lbf/inch (88 g/25 mm)**] in width.

E. UL 181 Aluminum-Foil Tape: Vapor-retarder tape with acrylic or heat activated adhesive.

Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc.; an American Biltrite company; [**acrylic adhesive Ideal Seal 2000**] [**acrylic adhesive Ideal Seal 587 A/B**] [**or**] [**heat activated adhesive Ideal Seal 490**] or comparable product by one of the following:

- a. Avery Dennison Corporation, Specialty Tapes Division.
- b. Berry Plastics.
- c. Shurtape Technologies.
- d. **<Insert manufacturer's name>**.

2. Width: [**2.5 inches (63.5 mm)**] [**3 inches (76.2 mm)**].
3. Thickness: [**4.3 mils (0.11 mm)**] [**4.6 mils (0.12 mm)**] [**7.0 mils (0.18 mm)**].
4. Adhesion: [**60 ounces force/inch (1,676 g/25 mm)**] [**72 ounces force/inch (2,011 g/25 mm)**].
5. Tensile Strength: **25 lbs/inch (109 N/25 mm)**.

## 2.10 SECUREMENTS

A. Aluminum Bands: **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch (0.51 mm)** thick, [**1/2 inch (13 mm)**] [**3/4 inch (19 mm)**] wide with [**wing seal**] [**or**] [**closed seal**].

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

- a. ITW Insulation Systems; Illinois Tool Works, Inc.
- b. RPR Products, Inc.
- c. **<Insert manufacturer's name>**.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) AGM Industries, Inc.
    - 2) Gemco.
    - 3) Hardcast, Inc.
    - 4) Midwest Fasteners, Inc.
    - 5) Nelson Stud Welding.
    - 6) **<Insert manufacturer's name>**.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, **0.030 inch (0.76 mm)** thick by **2 inches (50 mm)** square.
  - c. Spindle: [**Copper- or zinc-coated, low-carbon steel**] [**Aluminum**] [**Stainless steel**], fully annealed, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Gemco.
    - 2) Midwest Fasteners, Inc.
    - 3) **<Insert manufacturer's name>**.
  - b. Baseplate: Perforated, nylon sheet, **0.030 inch (0.76 mm)** thick by **1-1/2 inches (38 mm)** in diameter.
  - c. Spindle: Nylon, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated, up to **2-1/2 inches (63 mm)**.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Harcast, Inc.
      - 4) Midwest Fasteners, Inc.
      - 5) <Insert manufacturer's name>.
    - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    - c. Spindle: [Copper- or zinc-coated, low-carbon steel] [Aluminum] [Stainless steel], fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive-backed base with a peel-off protective cover.
  4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, [galvanized-steel] [aluminum] [stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Harcast, Inc.
      - 4) Midwest Fasteners, Inc.
      - 5) Nelson Stud Welding.
      - 6) <Insert manufacturer's name>.
    - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Gemco.
      - 2) Midwest Fasteners, Inc.
      - 3) <Insert manufacturer's name>.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

- D. Wire: [**0.080-inch (2.0-mm) nickel-copper alloy**] [**0.062-inch (1.6-mm) soft-annealed, stainless steel**] [**0.062-inch (1.6-mm) soft-annealed, galvanized steel**].
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. C & F Wire.
    - b. **<Insert manufacturer's name>**.

## 2.11 CORNER ANGLES

- A. PVC Corner Angles: [**30 mils (0.8 mm)**] **<Insert dimension>** thick, minimum **1 by 1 inch (25 by 25 mm)**, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: [**0.040 inch (1.0 mm)**] **<Insert dimension>** thick, minimum **1 by 1 inch (25 by 25 mm)**, aluminum according to **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.1 PREPARATION

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

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.

- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
  - 3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [**2 inches (50 mm)**] [**4 inches (100 mm)**] o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least **2 inches (50 mm)**.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least **2 inches (50 mm)**.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- 3.4 INSTALLATION OF MINERAL-FIBER INSULATION
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **[100] [50] <Insert number>** percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions **18 inches (450 mm)** and smaller, place pins along longitudinal centerline of duct. Space **3 inches (75 mm)** maximum from insulation end joints, and **16 inches (400 mm)** o.c.
  - b. On duct sides with dimensions larger than **18 inches (450 mm)**, place pins **16 inches (400 mm)** o.c. each way, and **3 inches (75 mm)** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. 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. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches (50 mm)** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch (13-mm)** outward-clinching staples, **1 inch (25 mm)** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below **50 deg F (10 deg C)** at **18-foot (5.5-m)** intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches (75 mm)**.
  5. Overlap unfaced blankets a minimum of **2 inches (50 mm)** on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of **18 inches (450 mm)** o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch- (150-mm-)** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches (150 mm)** o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **[100] [50] <Insert number>** percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:



- a. On duct sides with dimensions **18 inches (450 mm)** and smaller, place pins along longitudinal centerline of duct. Space **3 inches (75 mm)** maximum from insulation end joints, and **16 inches (400 mm)** o.c.
  - b. On duct sides with dimensions larger than **18 inches (450 mm)**, space pins **16 inches (400 mm)** o.c. each way, and **3 inches (75 mm)** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. 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. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches (50 mm)** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch (13-mm)** outward-clinching staples, **1 inch (25 mm)** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below **50 deg F (10 deg C)** at **18-foot (5.5-m)** intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches (75 mm)**.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch- (150-mm-)** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches (150 mm)** o.c.

### 3.5 FIELD-APPLIED JACKET INSTALLATION

#### A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with **1-1/2-inch (38-mm)** laps at longitudinal seams and **3-inch- (75-mm-)** wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

- B. Where PVC jackets are indicated, install with **1-inch (25-mm)** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with **2-inch (50-mm)** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches (300 mm)** o.c. and at end joints.

### 3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

### 3.7 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: [**Two**] **<Insert number>** finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to [**one**] **<Insert number>** location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.9 DUCT INSULATION SCHEDULE, GENERAL

#### A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

#### B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

### 3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber **[blanket]** **[board]**, **[1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]** <Insert dimension> thick and **[0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]** nominal density.
- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber **[blanket]** **[board]**, **[1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]** <Insert dimension> thick and **[0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]** nominal density.
- C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber **[blanket]** **[board]**, **[1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]** <Insert dimension> thick and **[0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]** nominal density.

- D. Concealed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
- E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated [blanket] [or] [board]; thickness as required to achieve 2-hour fire rating.
- F. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
- G. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
- H. Exposed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
- I. Exposed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
- J. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated [blanket] [or] [board]; thickness as required to achieve 2-hour fire rating.

### 3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
- C. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
- D. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

- E. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
- F. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber [blanket] [board], [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

### 3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.
  - 2. [PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
  - 3. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
  - 4. Self-Adhesive Foil Laminate with acrylic adhesive, [Smooth Aluminum] [Embossed Aluminum] [White Embossed].
  - 5. <Insert jacket type>.
- D. Ducts and Plenums, Exposed:
  - 1. None.
  - 2. [PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
  - 3. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
  - 4. Self-Adhesive Foil Laminate with acrylic adhesive, [Smooth Aluminum] [Embossed Aluminum] [White Embossed].
  - 5. <Insert jacket type>.

### 3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.

2. [PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
  3. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
  4. Self-Adhesive Foil Laminate with acrylic adhesive, [Smooth Aluminum] [Embossed Aluminum] [White Embossed].
  5. <Insert jacket type>.
- D. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
  2. Self-Adhesive Foil Laminate with acrylic adhesive, [Smooth Aluminum] [Embossed Aluminum] [White Embossed].
  3. <Insert jacket type>.
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. [Painted ]Aluminum, [Smooth] [Stucco Embossed] with [1-1/4-Inch- (32-mm-) Deep Corrugations] [2-1/2-Inch- (65-mm-) Deep Corrugations] [4-by-1-Inch (100-by-25-mm) Box Ribs]: [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
  2. Self-Adhesive Foil Laminate with acrylic adhesive, [Smooth Aluminum] [Embossed Aluminum] [White Embossed].
  3. <Insert jacket type>.

END OF SECTION 230713