



January 5, 2018

Pricing Clarifications

To all Bidders:

Please confirm if the bid must be valid for 60 days per the bid form, or 90 days per specification 001113 Advertisement for Bids.

- 90 days

Please provide Specifications for the ductwork insulation. A specification for the sound boots was provided, but we will need one for the supply air and return air duct. – see attached

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Please provide Specifications for the Earthwork scope.

- We are working on project specifications for the site, but they are very similar to the BCS Specifications - <http://www.bcsunited.net/>. Spec will be issued before contract is awarded for final cost

Please provide Specifications for the Site Utility scope.

- We are working on project specifications for the site, but they are very similar to the BCS Specifications - <http://www.bcsunited.net/>. Spec will be issued before contract is awarded for final cost

Please provide scale for MEP Site Plan, none is shown.

- Provided on addendum drawings sent on 3/11/18

Please provide details for site communications and electrical duct banks. Will they be concrete encased or direct bury?

- Conduit is direct bury and we are waiting on the plan from BTU

On sheet E2.05 Keyed note 5, it calls out to provide and install aircraft warning lights. None of these fixtures are listed on the fixture schedule. Is division 26 to provide and install these, if so please clarify a manufacture?

- Flash Technology

The spec section 262923-Variable Frequency Motor Controllers are listed on Division 26, but called out on the Mechanical schedule (sheet M4-01 to be provided with unit). Please clarify what division will be providing these.

- Mechanical contractor shall provide VFD (preferably integrated to the RTU). Contractor shall follow 26 29 23 specifications.



Drawing C2 has a note regarding irrigation "Relocated and Modified as necessary". Will drawings be provided for the existing conditions of the irrigation system? If not, What is located there now (material, size, type of outlets)? Where is the irrigation being serviced from? Is the intent to simply cut back & cap irrigation where the median is being removed? If not please provide drawings for new irrigation required for median work.

- There is an existing irrigation system in the median that services the existing landscaping in the median.

Please confirm that Low Voltage is by Owner and not included in the General Contractor's scope of work.

- By owner but conduits should be provided from the telcom room to each floor, cable by others

Please provide detail 7/S308 as shown near column line B/1 on drawing S201.

- it's not an 8 it's a 3, 7/S303

Please clarify if the reinforcement for the slab on carton form is to be #4@11" O.C. Each Way. Or one way as shown on drawing S201.

- The reinforcement noted on detail 1/S302 as #4@11" O.C. each way is located at the pour strip area. See reinforcement on S201 for one-way tension slab reinforcement and detail 1/S301 for reinforcement for shrinkage and temperature.

Please clarify the thickness and reinforcement requirements for the monument sign shown on Detail 5/S211.

- As mentioned, foundation for monument sign is just a place holder. For preliminary foundation pricing foundation was assumed to be a 3'-0" x 2'-0" x 10'-0" grade beam, reinforced with (4) - #6 bars top and bottom with #3 stirrups at 11" O.C.. Monument foundation will be designed once information is provided.

Please clarify the required spacing for sidewalk expansion joints

- The plan sheets will be updated in the construction set, but sidewalk joints shall be 6' for contraction joints and 48' for expansion joints

Please clarify if a machined 6" x 6" standup curb can be used in lieu of the curb and gutter detailed on drawing C6

- You can provide as an alternate but bid curb and gutter in base bid

Please clarify the thickness and reinforcement requirements for the sidewalks

- The plan sheets will be updated, but sidewalks shall be 4" thick 3000 psi concrete with #3 bars at 12" O.C.E.W. or #4 bars at 18" O.C.E.W.



Please provide Specifications for Site Paving and Drill Piers.

- We are working on project specifications for the site, but they are very similar to the BCS Specifications - <http://www.bcsunited.net/>. Spec will be issued before contract is awarded for final cost
- Structural specifications are listed in general notes

Please clarify if an expansion joint is required where the sidewalks tie into the curbs, if so, please provide details.

- Yes sidewalk expansion joints were required where the sidewalks tie into curbs and shall be per the sidewalk expansion joint detail on the joint plan.

Specification section 03 30 00, 3.05 Slab Jointing requires sawcut contraction joints. Please clarify if this is excluded for the structural slab on carton form.

- Yes, no saw cut joints in structural slab

Please confirm Owner will be responsible for the Permit.

- Owner will cover cost of permit or will ask the GC to pay and be reimbursed.

A substation was requested for building controls.

- These can be provided as an add alternate, base bid to be per plans and spec
- JCI is an acceptable substitution. Delta Controls is not an acceptable substitution.

Landscape calls for 100% coverage, drawings don't identify sod vs hydromulch.

- All internal islands and around the building to be sod, all other areas to be hydromulched.
- Pond area to be per the plans

Are specifications available for the following:

- Insulation for sheet metal duct work. – see attached
- Insulation for refrigerant piping for the air handling units and condensing units. – see attached

There are a couple of conflicting specifications about the fire suppression. See below.

From the Specs

B. Wet-type, fire-suppression standpipe piping, **NPS 2 and smaller**, shall be the following:

- Standard-weight, black-steel pipe **with threaded ends**; uncoated, gray-iron threaded fittings; and threaded joints.

C. Wet-type, fire-suppression standpipe piping, NPS 2-1/2 to NPS 6, shall be the following:

- Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.



From Sheet P3.01

SCHEDULE 40 BLACK STEEL PIPE WITH CLASS 150 BLACK MALLEABLE IRON SCREWED FITTINGS. **PIPING 2" AND LARGER MAY BE JOINED WITH VICTAULIC FITTINGS UTILIZING ROLL GROOVES.** VICTAULIC REDUCING COUPLINGS, "FIT" OR

- It is acceptable to utilize either roll-grooved ends or threaded ends for 2" pipe. Smaller than 2" pipe shall be threaded ends. Larger than 2" pipe shall be roll-grooved ends.
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From Specs

Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a **qualified professional engineer**, using performance requirements and design criteria indicated.

From Sheet P3.01

CONTRACTOR SHALL SUBMIT TO ENGINEER THE HYDRAULIC CALCULATIONS AND PIPE/HEAD SHOP DRAWINGS, APPROVED IN WRITING BY LICENSED PROFESSIONAL ENGINEER OR CONTRACTOR'S "RESPONSIBLE MANAGING EMPLOYEE."

- State defines what an RME is. Either is fine for sprinkler design

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, supply and outdoor air.
 - 2. Indoor, return located in unconditioned space.
 - 3. Indoor, exhaust between isolation damper and penetration of building exterior.
 - 4. Outdoor, supply and return.

- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.

2.2 POLYOLEFIN BOARD INSULATION

- A. White-pigmented insulation in sheet form. Comply with ASTM C 1427.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Nomaco Insulation.
- B. Material shall have a density ranging from 1.5 to 1.8 lb/ft³ (ASTM D 1622, ASTM 3575).
- C. Material must have a maximum thermal conductivity (k) of 0.25 Btu-in/hr-ft²-°F @ 75°F mean temperature (ASTM C 518, ASTM C 177).
- D. Material must have a maximum Water Vapor Transmission rate of 0.00 Perm-in (ASTM E 96, Desiccant Method).
- E. Material up to 1" thick, when tested in accordance with ASTM E 84, shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50.
- F. Final thickness used must provide an R-value that meets or exceeds the local energy code requirement.

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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, 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 Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Polyolefin Adhesive

1. Products: Provide the following products by Nomaco.
 - a. **320** Contact Adhesive: standard air-drying contact adhesive (brush, roller, or spray applied) formulated for joining sheet insulation seams and adhering sheet insulation to duct substrate. 320 is tan / beige when dry.
 - b. **620** Contact Adhesive: same as above, but black when dry.
2. Refer to Technical Information Bulletin for a list of recommended adhesives to be used in conjunction with therna-cel sheet.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
- d. Mon-Eco Industries, Inc.; 44-05.

- 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.
- 5. Color: Aluminum.
- 6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

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. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 POLYOLEFIN FIELD APPLIED COATING

- A. Insulation MUST be coated in OUTDOOR applications exposed either to direct sunlight or weather elements.
- B. Use a coating recommended by the manufacturer. Refer to Nomaco Technical Information Bulletin TA6 for a list of recommended coatings to be used in conjunction with polyolefin insulation.
- C. Water based latex paints are NOT recommended for coating polyolefin insulation

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
- 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. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Aluminum, fully annealed, 0.106-inch- 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. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches 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 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 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.
 - 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.
 - 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.
 - 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 50 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 and smaller, place pins 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, place pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches 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 50 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 and smaller, place pins 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 pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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.
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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 INSTALLATION OF POLYOLEFIN INSULATION

- A. Mechanical pins/fasteners are limited to the "Weld" and "Grip" versions. Pins/fasteners of the "Peel and Stick" version are not allowed (The Pressure Sensitive Adhesive of Peel & Stick pins/fasteners may fail under anticipated stresses).
- B. Polyolefin sheet insulation is manufactured with one rough (non-skin) side and one smooth skin side. Adhesive should be applied to both the rough side of the insulation (100% coverage) and the duct (100% coverage). Rough side of sheet must be bonded to the duct.
- C. Never stretch polyolefin insulation to cover the surface of the duct. Rather it is preferable to cut insulation 1/4" longer than the duct and adhere it to the duct under slight compression. This will provide tight fitting joints.
- D. Care should be taken to insure that all joints are sealed properly. Poorly sealed joints may result in undesired heat loss or condensation.
- E. Seams and butt joints should be staggered if multiple layers are applied. The smooth surface of polyolefin sheet should be mechanically "roughed" when adhering multiple layers.
- F. Polyolefin sheet must be adhered to the duct using mechanical fasteners/pins (in addition to adhesive) on a minimum of 24" centers. Refer to the manufacturers installation diagrams for recommended pin placement.
- G. The recommended contact adhesives are all subject to specific service temperature ranges. The contact adhesive manufacturer should be contacted to verify correct application for service temperatures anticipated.
- H. It is very important that contact adhesive be allowed to flash fully prior to joining two impermeable substrates such as polyolefin insulation and sheet metal. Contact adhesive will not continue to flash under an impermeable substrate and therefore, will not set up properly.
- I. The flash time of a contact adhesive is dependent upon relative humidity and temperature. Relatively speaking, the lower the temperature or the higher the relative humidity, the longer the time required for the contact adhesive to fully flash.
- J. A contact adhesive will be slightly tacky, yet dry to the touch when fully flashed.

- K. Polyolefin insulation must be coated or jacketed for protection from sunlight and the elements when being used in outdoor applications. Before applying the protective coating, the surface of the insulation must be clean and free of any dust, dirt, scale, moisture, oil and grease.
- L. The recommended coatings are all subject to specific application and service temperatures. The manufacturer should be contacted to verify correct utilization for anticipated temperatures.
- M. Follow all manufacturers specific guidelines and instructions for the entire installation and coating of the polyolefin insulation.

3.6 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 laps at longitudinal seams and 3-inch- 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 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 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 o.c. and at end joints.

3.7 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."

3.8 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 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.

3.9 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 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.

3.10 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 exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. 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.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.0-lb/cu. ft. nominal density. Installed R-Value shall meet or exceed the prevailing energy code requirement and be a minimum of R-6.
- B. Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.0-lb/cu. ft. nominal density. Installed R-Value shall meet or exceed the prevailing energy code requirement and be a minimum of R-6.
- C. Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.0-lb/cu. ft. nominal density. Installed R-Value shall meet or exceed the prevailing energy code requirement and be a minimum of R-6.
- D. Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.0-lb/cu. ft. nominal density. Installed R-Value shall meet or exceed the prevailing energy code requirement and be a minimum of R-6.

3.12 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. Supply-Air Duct and Plenum Insulation: Polyolefin board, 2 inches thick minimum. Installed thickness shall be such that the minimum R-Value shall meet or exceed the prevailing energy code requirement.
- C. Return-Air Duct and Plenum Insulation: Polyolefin board, 2 inches thick minimum. Installed thickness shall be such that the minimum R-Value shall meet or exceed the prevailing energy code requirement.
- D. Outdoor-Air Duct and Plenum Insulation: Polyolefin board, 2 inches thick minimum. Installed thickness shall be such that the minimum R-Value shall meet or exceed the prevailing energy code requirement.

END OF SECTION 230713