PART 1 GENERAL

1.01 SUMMARY

A. Related Sections:

1. 15510 - Piping (HVAC).
2. 15410 - Piping (Plumbing).
3. 15515 - Valves, Hangers, and Specialties.
4. 15540 - Pumping Equipment (HVAC).
5. 15841 - Low Pressure Steel Ductwork.
6. 15890 - Ductwork.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

2. C547-95 specification for Mineral Fiber Pipe Insulation.
5. C585-90 Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
8. D1668-95 Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing.

B. National Bureau of Standards (NBS).
C. National Fire Protection Institute: NFPA 90A.
D. Underwriters Laboratories (UL) - 723.
E. Insulation Contractors Association of South Florida Inc.

1.03 SUBMITTALS
A. Submit properly identified manufacturer's catalog cuts, performance curves, and procedures before starting work.

1.04 DELIVERY AND STORAGE
A. Protect materials from the weather during storage and installation.

1.05 QUALITY ASSURANCE
A. Materials shall be labeled, listed, or have certified test reports submitted from testing laboratory accepted by the Board.
B. Comply with the most stringent requirements between the Insulation Contractors Association of South Florida Inc. and as specified.
C. There shall be no fiberglass in contact with the HVAC airstream anywhere in the system whether protected by encapsulation or not.
D. Foam plastic insulation shall be certified by an independent third-party national recognized laboratory, that the product emits less than 1 part per million formaldehyde out gassing after 24 hours.

1.06 FIRE HAZARD RATING
A. Fire hazard rated materials shall be UL labeled or a certified test report by a Board accepted testing laboratory shall be submitted indicating compliance with specified fire hazard requirements.
B. Insulation (including adhesives) shall be fire retardant or self-extinguishing. Finishing jackets, insulation, and adhesives shall have composite fire and smoke ratings complying with ASTM E84, NFPA 255, and UL 723, as plain or on a composite basis.
C. When insulation, vapor barrier covering, wrapping materials, and adhesives are applied separately in field, each item shall be tested individually.

D. When insulation, vapor barrier covering, wrapping materials, and adhesives are factory composite systems, they shall be tested as an assembly.

E. Insulation materials, adhesives, coatings, and other accessories shall have a fire hazard rating not more than 25 for flame developed and not more than 50 for fuel contributed and smoke developed, except as follows:

1. Flexible unicellular insulation.
2. Nylon anchors for securing insulation to ducts or equipment.
3. Factory premolded 1 piece PVC fitting and valve covers

F. Flame resistance treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Insulation:

1. Armaflex.
2. Armstrong.
3. Certain-Teed.
5. Foamglas.
7. Owens-Corning.
8. Pittsburgh Corning.

B. Insulating Cement:

1. Keene Powerhouse.
2. Benjamin Foster.
3. Fibrex FBX fast set.

2.02 MATERIALS

A. Insulation: Type and thickness as specified.
1. Provide fire retardant or self-extinguishing insulation, including adhesives.
2. Finishing jackets, insulation, and adhesives shall have composite fire and smoke ratings per ASTM E84, NFPA 255, and UL 723.

B. Domestic Hot Water Supply Piping Insulation:

1. 1" thick molded fiberglass insulation with pre-sized factory applied FRJ jacket of glass cloth with longitudinal lap and butt joint strips with self-sealing adhesive.
2. Insulation may be 1/2" insulation for vertical branches to individual fixtures.
3. Minimum density of 7-1/4 pounds per cubic foot, maximum thermal conductivity factor of 0.26K at 75 degrees F. mean temperature, and alkalinity of 0.696.
4. Flame Spread: 25 or less.
5. Smoke Developed: 50 or less.
6. Accessories: Adhesives, mastics, cements, tapes for fittings, and related materials shall have the same composite ratings as listed above.

C. Solar Collector Piping Insulation:

1. Same as specified for Domestic Hot Water Supply Piping except with metal weatherproof jacket.

D. Cold Drainage Piping Drinking Fountain, and Electric Water Cooler Drain Piping Insulation:

1. Elastomeric (foam plastic) thermal insulation 1 inch thick with built-in vapor barrier rated self-extinguishing ASTM D1056.
2. Maximum thermal conductivity factor of 0.26K at 70 degrees F. mean temperature, density of 5-6 pounds per cubic foot, and a water vapor transmission of 0.1 perms.

E. Emergency Generator Exhaust and Gas Boiler Flue Insulation:

1. 3 inches thick hydrous calcium silicate on pipe, fittings, and muffler.
2. 3 inches thick Temp Matt on flexible connections.
3. Fasteners: 14 gage galvanized iron wire on 9 inch centers.
5. Finish: 1200 degree F. glass cloth.
6. Maximum thermal conductivity factor of 0.5 K at 500 degrees F. mean temperature and a density of 11 pounds per cubic foot.

F. Hot Water Storage Tank Insulation:
1. 3 inch thick block insulation with V-grooves.
2. Secure with 24 gage galvanized wire or 1/2" wide galvanized bands on 12 inch centers.
3. Finish with exposed smooth coat of insulating cement and when dry apply Foster GPM mastic with glass cloth reinforcing.

G. Heat Exchanger Insulation:
1. 1-1/2" thick calcium silicate applied in sectional form or lags cut to fit, apply dry.
2. Fasteners: 24 gage galvanized wire or 1/2" wide galvanized bands on 12 inch centers.
3. Finish: Smooth coat of insulating cement and finish with 1200 degrees F glass cloth applied with fire resistant adhesive.
4. Density of 14 lbs. per cubic foot and factor thermal conductivity of 0.42K.

H. Tape: As recommended by the insulation manufacturer or 3M adhesive EC-1329.

I. Insulating Cement: All-purpose mineral wool cement.

J. Glass Cloth Jacket: Factory sized white, standard weight, with 1-1/2" minimum longitudinal pressure sealing lap and seal strips for butt joints.

K. Vapor Barrier Jacket:
1. Flame resistant glass fiber adhered to outside of a 1 mil aluminum foil sheet with longitudinal pressure sealing lap and seal strips for butt joints.
2. End cement perm rating shall not exceed 0.05.

L. Weatherproof Metal Jacket (Exterior Above Ground Only):
1. Damage and corrosion resistant, longitudinal seam closure, joint construction capable of locking insulation and jacket securely in place.
2. Seal and weatherproof butt joints with factory supplied 2 inch wide "snap-straps" lined with plastic sealing compound secured with outer holding band.

M. Molded Fiberglass Pipe Insulation:
   1. Rigid molded sectional pipe covering with integral factory jacket.
   2. Comply with ASTM C547.
   3. Maximum Thermal Conductivity: 0.23K factor at 75 degrees F. mean temperature.
   4. Alkalinity: Less than 0.6 percent.

N. Foamed Plastic Insulation:
   1. Closed cell.
   2. Comply with ASTM C534.
   3. Maximum Thermal Conductivity: 0.27K factor at 75 degrees F. mean temperature.
   4. Water Vapor Permeability: 0.1 perms.

O. Cellular Glass Insulation:
   1. Comply with ASTM C552
   2. Maximum Thermal Conductivity: 0.33 K factor at 75 degrees F.
   3. Water Vapor Permeability: 0.00 perm-in.

P. Flexible Fiberglass Ductwrap Blanket Insulation:
   1. 2.2/2.3 inches thick, 3/4" pcf density fiberglass blanket with UL approved aluminum foil vapor seal facing reinforced with fiberglass scrim, laminated to 30 lb. kraft paper, R = 6.5.
   2. Comply with ASTM C553, TYPE I, Class B-4.
   3. Maximum Thermal Conductivity: 0.24K factor at 75 degrees F.

Q. Rigid Fiberglass Ductboard Insulation:
   2. Maximum Thermal Conductivity: 0.24K factor at 75 degrees F.
   3. Provide scrim foil facing having a minimum 3 pcf density, 2 inches thick.
R. Accessories:

1. The following accessories shall be used in the application of thermal insulation:

   a. PVC fittings cover and PVC jacketing:
      1) Certain-Teed "Snap Form".
      2) Manville Corp. "Zeston".
      3) Proto.

   b. Vapor Seal Mastic:
      1) Benjamin Foster 30-86 or 30-25.
      2) Childers CP-30.

   c. Lagging Adhesive:
      1) Benjamin Foster 81-42W.
      2) Childers CP-50.

   d. Breather Mastic:
      1) Benjamin Foster 45-00 or 30-86.
      2) Childers CP-10.

   e. Insulation Bonding Adhesive (to metal):
      1) Benjamin Foster 85-20, or 85-15.
      2) Childers CP-82.

   f. Insulating and Finishing Cement:
      1) Fibrex Inc. FBX Super Blend Cement.
      2) Manville Corp. No.375 Insulating and Finishing Cement.
      3) Keene Corp. Super Powerhouse.

   g. Coatings: Sealfas G-P-M mastic or accepted equivalent.

   h. Fire Resistive Mastic: As manufactured by Benjamin Foster or accepted equivalent.

   i. Sealants: 81-33 as manufactured by Benjamin Foster or accepted equivalent.

   j. Staples: Type 304 or 316 stainless steel outward clinching type.

   k. Wire: 16 gage, copper weld wire.
1. Bands: 3/4 by 0.015" thick galvanized steel.

m. Glass Fabric:
   1) Woven open mesh type glass fabric conforming to ASTM D1668.
   2) Type I asphalt treated for below ground use.
   3) Type III light color organic resin treated for aboveground or below ground use.

n. Insulation Jackets:
   1) Jackets inside building shall comply with fire hazard classifications as specified. Insulation jackets shall not support mold growth.
   2) Vapor Barrier Jackets:
      a) For Cold Pipelines (-30 degrees F. to 60 degrees F.): Perm rating not more than 0.05, ASTM E96 Procedure A. Puncture resistance not less than 50 beach units.
      b) For Air-conditioning Ducts: Perm rating not more than 0.05, ASTM E96, Procedure A. Puncture resistance not less than 25 beach units.

2.03 SYSTEMS INSULATION BY TYPE

A. Chilled Water Supply and Return Piping Insulation:

1. 1-1/2" diameter and smaller - copper, aboveground:
   a. Foamed Plastic Pipe Insulation: 1 inch thick.
   b. Provide vapor barrier mastic for areas subject to conditions of 90 degrees F or 85 percent relative humidity or higher.

2. 2" to 4" diameter - aboveground:
   a. Cellular Glass Insulation.
   b. Thicknesses as follows:
      1) 2 inches thick for interior ceilings not subject to over 90 degrees F. or 85 percent relative humidity.
      2) 2-1/2" thick for areas subject to conditions of 90 degrees F or 85 percent relative humidity or higher, such as exterior or perimeter corridors.
and walkways, whether exposed or concealed, or in ceilings or breezeways.

3. 5" to 10" diameter - aboveground:
   a. Cellular Glass Insulation.
   b. Thicknesses as follows:
      1) 2-1/2" thick for interior ceilings not subject to over 90 degrees F. or 85 percent relative humidity.
      2) 3 inches thick for areas subject to conditions of 90 degrees F or 85 percent relative humidity or higher, such as exterior or perimeter corridors and walkways, whether exposed or concealed, or in ceilings or breezeways.

4. Underground, all sizes.
   a. Cellular Glass Insulation: 2 inch thick with factory applied jacket.

B. Interior Domestic Hot Water Supply/Return Piping Insulation:
   1. Molded Fiberglass Pipe Insulation: 1 inch thick with pre-sized factory applied FRJ jacket of glass cloth with longitudinal lap and butt joint strips with self-sealing adhesive.
   2. Contractor's Option: Foamed plastic insulation, 1 inch thick.

C. Electric Water Cooler Drain, Cold Drainage Piping Refrigerant Suction Piping, and Interior Condensate Drain Piping Insulation:
   1. Foamed Plastic Insulation: 1 inch thick with field applied vapor barrier mastic at joints.

D. Interior Concealed Ductwork Insulation:
   1. Flexible fiberglass Ductwrap Blanket Insulation:
      a. 2.2 inches thick, 3/4 pcf density.
      b. 2.0 inches thick, 1-1/2 pcf density.

E. Interior or Exterior Exposed Ductwork Insulation:
1. Rigid Fiberglass Ductboard Insulation: 2 inches thick, 3 pcf density, with field applied fab and mastic finish consisting of a 10 x 10 glass fabric imbedded in 2 coats of a white breather weather barrier mastic.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install insulation according to applicable codes and regulations.

B. Except as specified, install materials according to manufacturer's recommendations and specifications for obtaining conformance to construction documents.

C. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use and samples required for acceptance shall have manufacturer's stamp or label attached listing manufacturer, brand name, and a description of material.

D. Provide allowances for expansion/contraction, and wall and manhole penetrations.

E. Run continuous through wall, floor, and ceiling penetrations.

F. Insulation materials shall not be applied until:

1. Test results specified in other sections of these specifications are completed and accepted.
2. Rust, scale, dirt, and any other foreign material have been removed.
3. Ductwork or piping material are clean, dry, joints firmly butted together, and tightly sealed at all joints, seams, and fittings.

G. Wrap butt joints with a 3 inch wide strip of the same material as the jacket.

H. Provide aluminum jackets over the insulation where sealant is required.

I. Insulation shall be kept clean and dry at all times.
J. Duct Materials:

1. Internal duct lining is not allowed.
2. Duct materials solid exposed to the airflow shall be noncombustible metal.
3. Duct insulation for thermal or acoustical purposes shall be separated from airflows by solid metal.
4. Provide natural noise attenuation procedures, as recommended in ASHRAE, Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), and industry good engineering practices.
5. Fiberglass ducts or ductboards shall not be used to convey air.

K. Protection Shield: Where pipe or tubing insulation pass through hangers, provide:

1. For Piping 4 inches and smaller: A protection shield, 180 degree arc, 16 gage galvanized sheet metal covering, minimum 12 inches long.
2. For Piping Larger than 4 inch diameter: A protection shield, 180 degree arc, 16 gage galvanized sheet metal covering, minimum 18 inches long.
3. Hangers not exceeding maximum spacing distances recommended by insulation manufacturer to prevent crushing or compressing insulation.

L. Ductwork sizes shown on drawings are actual internal "air side" dimensions.

M. Flanges, Fittings, and Valves on Insulated Piping:

1. Provide pre-molded glass fiber fittings wired or taped on and adhered with canvas jacket.
2. Terminate insulation and jacket neatly and finish with insulating cement troweled to a bevel and of the same thickness as adjoining insulation.
3. Vapor seal insulation on cold systems.

N. Vapor Barriers:

1. Intact and continuous.
2. Do not install with staples.

O. Omit Pipe Insulation From the Following:

1. Screwed unions, except at "cold drains" and air-
conditioning wastes. Terminate insulation neatly at both sides of unions with insulation cement.
2. Discharge lines from safety and relief valves.
3. Nickel or chrome plated piping.

P. All ductwork shall be insulated, except as noted below:
1. Outside air intake ductwork.
2. Exhaust air ductwork.
3. Supply air ductwork, exposed in air-conditioned spaces. (Note: Ceiling plenums, and mechanical equipment rooms are not to be considered air-conditioned spaces.)

Q. Ceiling supply air registers located on perimeter rooms and corridors shall be field insulated with flexible fiberglass ductwrap insulation as specified. Insulation shall cover the upper body and installation flanges.

R. All appurtenances subject to condensation shall be protected as necessary and covered with vapor seal mastic.

3.02 APPLICATIONS

A. Molded Fiberglass Pipe Insulation Installation (Hot Water Supply/Return):
1. Tightly butt together sections of insulation on pipe runs sealing longitudinal seams of jacket with self-sealing laps. Position longitudinal seam so seam is on bottom to prevent dirt and moisture infiltration. Seal end joints with 3 inch wide straps of vapor barrier tape. Seal ends of insulation with vapor seal mastic at valves, fittings and flanges.
2. Cover valves, fittings, and flanges with insulation similar to adjacent pipe covering, or one piece PVC cover sections as specified.

B. Foamed Plastic Insulation Installation (Return Suction Piping, Interior Condensate Drains, and Electric Water Cooler Drains):
1. Insulation shall be slipped on pipe without slitting. Butt joints shall be sealed with the manufacturer's recommended adhesive.
2. Where slip-on techniques are not possible, the insulation shall be carefully slit and applied to the
pipe. Seal joints with the manufacturer’s recommended adhesive.

3. Insulate valves and fittings with fabricated foamed plastic insulation, or one piece PVC cover sections as specified.

4. Provide mastic vapor barrier for chilled water service insulation for areas subject to conditions of 90 degrees F or 85 percent relative humidity or higher.

C. Cellular Glass Insulation Installation (Chilled Water Supply/Return):

1. Interior aboveground.
   a. Each length of insulation shall be secured with two wires. Insulation shall be applied with all joints fitted to eliminate voids. Voids shall be eliminated by refitting or replacing insulation. Do not fill voids with joint sealer.
   b. On any straight run over 40 feet, install an expansion joint consisting of a 2 inch wide section of foamed plastic. Finish over this section with glasfab and mastic.
   c. Finish concealed piping with factory installed white all purpose jacket, all joints and seams sealed with fire rated adhesive. Finish elbows and fittings with breather mastic reinforced with white open weave membrane with maximum mesh opening of 10 \times 10 \text{ per inch}.
   d. For exposed piping in machine rooms and similar spaces, finish with breather mastic reinforced with white open weave membrane with maximum mesh opening of 10 \times 10 \text{ per inch}. Then apply second coat of breather mastic and brush lightly with a wet brush to a smooth finish.

2. Exterior Aboveground:
   a. Same as interior aboveground.
   b. Finish with 0.016" aluminum jacket secured with 1/2" aluminum bands and seals, aluminum screws, or pop rivets on 9 inches on center. Elbows, valves, and fittings shall be finished with preformed aluminum fitting covers. Seam shall be placed at bottom. Caulk all joints to prevent water intrusion.
3. Exterior Underground:
   a. Same as interior aboveground.
   b. Finish with factory applied jacket, self-sealing, nonmetallic consisting of special bituminous resin, reinforced with an aluminized mylar film and a release paper. Finish jacket shall be not less than 70 mils thick and weigh not less than 39 lbs. per 100 sq.ft.
   c. Provide a minimum of 6 inches of clean sand all around underground insulated piping. Provide one foot above the 6 inches of sand cover with rock free backfill.

D. Flexible Fiberglass Ductwrap Blanket Insulation Installation:
   1. Apply insulation to duct with joints tightly butted. Prepare stretch-out dimensions and cut out insulation so a 2 inch minimum overlap is created that will overlap the facing and insulation at the other end, and the adjoining seam. Install so insulation is not excessively compressed at duct edges. Foil face shall be on outside. Seams shall be stapled approximately at 6 inches on center with outward clinching staples.
   2. On ductwork having a 24 inch or larger dimension, insulation shall be secured to the bottom of the duct with mechanical fasteners spaced at not more than 18 inches on center, and held in place with washers or clips. Cut off protruding pin after clips are secured.
   3. Seal all insulation joints, pinheads, tears, punctures, washers, clips, and staples with 2 coats of a vapor barrier mastic type sealant, reinforced with 1 layer of 4 inch woven glass fabric.

E. Rigid Fiberglass Ductboard Insulation Installation:
   1. Apply insulation tightly and smoothly to duct.
   2. Secure insulation on the sides and bottom of duct by impaling insulation over pins or anchors located not more than 18 inches apart and held in place with washers or clips.
   3. Cut off protruding pins after clips are secured and seal with vapor barrier mastic.
   4. Apply insulation with joints tightly butted.
   5. Seal ductwork joints, punctures, and pin heads with a vapor barrier mastic type sealant.
6. Insulation shall be continuous through walls and floors except at fire dampers and at combination smoke/fire dampers.

7. Finish with field applied fab and mastic finish consisting of a 10 x 10 glass fabric imbedded in 2 coats of a white breather weather barrier mastic.

F. Equipment:

1. Chilled Water Pump Casings and Expansion Tanks:
   a. Insulate with not less than 2 inches of cellular glass block insulation finished with a 1/2" thick coat of insulating cement reinforced with 1 inch hexagonal mesh wire cloth, followed by a 1/2" thick coat of hard finish insulating cement.
   b. Apply casing insulation in 2 removable sections to ease pump maintenance.

G. Electric Duct Heaters:

1. Insulate all sides of electric duct heaters (except control panel side) installed in supply air ducts, as specified for supply air ductwork.

END OF SECTION