PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install insulation on above ground refrigerant piping and fittings as described in Contract Documents.
   2. Furnish and install insulation for cooling tower and chilled water piping systems as described in Contract Documents.
   3. Furnish and install insulation for hot water heating and return piping system as described in Contract Documents.
   4. Furnish and install insulation for steam and condensate piping system as described in Contract Documents.

B. Related Sections:
   1. Section 23 0501: General Mechanical Requirements

1.2 DELIVERY, STORAGE, AND HANDLING

A. Keep materials and work dry and free from damage.

B. Replace wet or damaged materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refrigeration Piping System:
   1. Thickness:

<table>
<thead>
<tr>
<th>Pipe Size, Outside Diameter</th>
<th>Insulation Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>One inch and smaller</td>
<td>1/2 Inch</td>
</tr>
<tr>
<td>1-1/8 to 2 inch</td>
<td>3/4 Inch</td>
</tr>
<tr>
<td>2-1/8 inches and larger</td>
<td>One inch or two layers of 1/2 inch</td>
</tr>
</tbody>
</table>

   a. One inch 25 mm sheet for fittings as recommended by Manufacturer.
   b. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
      1) AP Armaflex by Armacell.
      2) Nitrolite by Nitron Industries. White only for exterior.
      3) Rubatex.

   2. Joint Sealer:
      a. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
         1) Armaflex 520 by Armacell.
         2) BFG Construction Adhesive No. 105.
         3) Rubatex R-373.

   3. Insulation Tape:
a. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
   1) Armaflex AP Tape by Armacell.
   2) FT182 Tape by Nitron Industries.
   3) R-180-FS Tape by Rubatex.

4. Exterior Finish:
   a. For application to non-white, exterior insulation.
   b. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
      1) WB Armaflex Finish by Armacell.
      2) Protective Coating 67x944 by Rubatex.

B. Hydronic Cooling Piping System:
1. Fiberglass, with integral vapor barrier jacket, designed for cooling system piping application.
2. Cooling Tower Piping: 1-1/2 inches 38 mm thick.
3. Chilled Water Piping:
   a. Fluid Temperature Range: 40 to 55 deg F 4 to 13 deg C.
   b. Indoor:
      
      | Pipe Size          | Thickness       | Pipe Size          | Thickness       |
      |-------------------|-----------------|-------------------|-----------------|
      | One Inch and Less | 1/2 Inch        | 25 mm and Less    | 13 mm          |
      | 1/1-4 Inch to 2 Inch | 3/4 Inch    | 33 to 50 mm       | 19 mm          |
      | 2-1/2 Inch and Larger | One Inch  | 63 mm and Larger  | 25 mm          |

1) Category Four Approved Product. See Section 01 6000 for definition of Categories.
   a) VaporWick Pipe Insulation by Owens-Corning Fiberglas.

2) Type Two Acceptable Products:
   a) Micro LOK AP-T plus by Johns Manville.
   b) Knauf pipe insulation with ASJ-SSL jacket by Knauf.
   c) SSL II pipe insulation with ASJ-SSL jacket by Owens-Corning Fiberglas.
   d) Equal as Approved by Architect before use. See Section 01 6000.

   c. Outdoor:
      
      | Pipe Size          | Thickness       | Pipe Size          | Thickness       |
      |-------------------|-----------------|-------------------|-----------------|
      | One Inch and Less | One Inch        | 25 mm and Less    | 25 mm          |
      | 1/1-4 Inch to 2 Inch | 1-1/4 Inch  | 33 to 50 mm       | 32 mm          |
      | 2-1/2 Inch and Larger | 1-1/2 Inch | 63 mm and Larger  | 38 mm          |

1) Type Two Acceptable Products:
   a) Micro LOK AP-T plus by Johns Manville.
   b) Knauf pipe insulation with ASJ-SSL jacket by Knauf.
   c) SSL II pipe insulation with ASJ-SSL jacket by Owens-Corning Fiberglas.
   d) Equal as Approved by Architect before use. See Section 01 6000.

   d. Vapor Barrier Adhesive: As recommended by Insulation Manufacturer.

4. Insulation Jacketing:
   a. Aluminum Insulation Jacketing: 0.016 inch 0.4 mm thick aluminum with 3/16 inch 0.4 mm corrugations and factory attached moisture barrier.
   b. Fastening Devices: 3/4 inch 19 mm wide by 0.20 inch 0.5 mm thick aluminum strapping.
   c. Fitting Covers: Pre-formed aluminum and attached with sheet metal screws and strapping.

5. Hydraulic Setting Insulating Cement:
   a. Class Two Quality Standard. See Section 01 6000.
      1) Ramco Finishing Cement 1200.

6. Weather Barrier Mastic:
   a. Water based vinyl-acrylic mastic coating.
   b. Class Two Quality Standard. See Section 01 6000.
      1) Childers / Foster CP-10 / CP-11.

7. Canvas: 4 oz 68 g.

C. Hot-Water-Heat Piping Systems:
1. Piping Insulation:
   a. Heavy density fiberglass with fire retardant vapor barrier jacket with self-sealing laps. Thickness shall be 1-1/2 inches 39 mm on heating supply and return lines.
   b. Performance Standard: Fiberglas heavy density with ASJ-SSL jacket by Owens-Corning.
   c. Category Four Approved Manufacturers. See Section 01 6000 for definitions of Categories.
      1) Manson.
2) Johns Manville.
3) Owens-Corning.

2. Vapor Barrier Adhesive: As recommended by Insulation Manufacturer.

3. Covers For Valves And Fittings:
   a. Category Four Approved Manufacturers. See Section 01 6000 for definitions of Categories.
      1) Zeston by Johns Manville.
      2) Speedline.

4. Shields: 22 ga 0.8 mm by 12 inch 300 mm long galvanized steel.


6. Weather Barrier Mastic:
   a. Water based vinyl-acrylic mastic coating.
   b. Class Two Quality Standard: Childers / Foster CP-10 / CP-11.

7. Canvas: 4 oz 68 g

D. Hot-Water-Heat Piping System:
1. Insulation Thickness: For piping exposed to outdoor air, increase thickness by 1/2 inch 50 mm.

<table>
<thead>
<tr>
<th>Piping System Types</th>
<th>Fluid Temp Range, Deg F</th>
<th>Insulation Thickness for Size of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>One to 2 Inch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-1/2 Inch and Larger</td>
</tr>
<tr>
<td>Low Pressure / Temp</td>
<td>120 to 200</td>
<td>1-1/2 Inches</td>
</tr>
<tr>
<td>Low Temp</td>
<td>60 to 120</td>
<td>2 Inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Piping System Types</th>
<th>Fluid Temp Range, Deg C</th>
<th>Insulation Thickness for Size of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>25 to 50 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>63 mm and Larger</td>
</tr>
<tr>
<td>Low Pressure / Temp</td>
<td>95 to 121</td>
<td>38 mm</td>
</tr>
<tr>
<td>Low Temp</td>
<td>48 to 95</td>
<td>50 mm</td>
</tr>
</tbody>
</table>

a. Type Two Acceptable Products:
   1) Micro LOK AP-T plus by Johns Manville.
   2) Knauf pipe insulation with ASJ-SSL jacket by Knauf.
   3) SSL II pipe insulation with ASJ-SSL jacket by Owens-Corning Fiberglas.
   4) Equal as Approved by Architect before use. See Section 01 6000.

2. Insulation Jacketing:
   a. Aluminum Insulation Jacketing: 0.016 inch 0.4 mm thick aluminum with 3/16 inch 0.4 mm corrugations and factory attached moisture barrier.
   b. Fastening Devices: 3/4 inch 19 mm wide by 0.20 inch 0.5 mm thick aluminum strapping.
   c. Fitting Covers: Pre-formed aluminum and attached with sheet metal screws and strapping.

3. Hydraulic Setting Insulating Cement:
   a. Class Two Quality Standard. See Section 01 6000.
      1) Ramco Finishing Cement 1200.

4. Weather Barrier Mastic:
   a. Water based vinyl-acrylic mastic coating.
   b. Class Two Quality Standard. See Section 01 6000.
      1) Childers / Foster CP-10 / CP-11.

5. Canvas: 4 oz 68 g

E. Steam-Heat Piping System:
1. Fiberglass with integral vapor barrier jacket designed for use on steam systems.
2. Insulation Thickness: For piping exposed to outdoor air, increase thickness by 1/2 inch 50 mm.

<table>
<thead>
<tr>
<th>Piping System Types</th>
<th>Temperature Range, Deg F</th>
<th>Insulation Thickness for Size of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>One to 2 Inches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-1/2 to 4 Inches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 Inches and Larger</td>
</tr>
<tr>
<td>Steam</td>
<td>306 to 450</td>
<td>1-1/2 Inches</td>
</tr>
<tr>
<td>Steam Condensate</td>
<td>Any</td>
<td>2 Inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Piping System Types</th>
<th>Temperature Range, Deg C</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>25 to 50 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>63 to 100 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125 mm and Larger</td>
</tr>
<tr>
<td>Steam</td>
<td>150 to 232</td>
<td>38 mm</td>
</tr>
<tr>
<td>Steam Condensate</td>
<td>Any</td>
<td>50 mm</td>
</tr>
</tbody>
</table>

Project Number: 3
Project Name: HVAC Piping Insulation
Project Date: 0719
Section 23 0719
a. For piping exposed to outdoor air, increase thickness by 1/2 inch 50 mm.
3. Vapor Barrier Adhesive: As recommended by Insulation Manufacturer.
4. Hydraulic Insulating Cement:
   a. Class Two Quality Standard. See Section 01 6000.
      1) Ramco Finishing Cement 1200.
5. Weather Barrier Mastic:
   a. Water based vinyl-acrylic mastic coating.
   b. Class Two Quality Standard. See Section 01 6000.
      1) Childers / Foster CP-10 / CP-11.
6. Canvas: 4 oz 68 g.

2.2 MANUFACTURERS

A. Contact Information:
   2. BFG Industries, West Columbia, SC  (800) 845-2220 or (803) 796-1380 or B F Goodrich Co
      Canada Ltd, Kitchener, ON  (519) 742-3641.
   9. Owens-Corning, Toledo, OH  www.owenscorning.com or Owens-Corning Canada Inc,
      Willowdale, ON  (416) 733-1600.
  10. Ramco.
  12. Speedline

PART 3 - EXECUTION

3.1 PREPARATION

A. Before application of insulating materials, brush clean surfaces to be insulated and make free from
   rust, scale, grease, dirt, moisture, and any other deleterious materials.

B. Use drop cloths over equipment and structure to prevent adhesives and other materials spotting the
   work.

3.2 INSTALLATION

A. Refrigeration system Piping System:
   1. General:
      a. Install insulation in snug contact with pipe.
         1) Insulate flexible pipe connectors.
         2) Insulate thermal expansion valves with insulating tape.
         3) Insulate fittings with sheet insulation and as recommended by Manufacturer.
      b. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of
         insulation to a minimum.
      c. Provide 6 inch 150 mm long, 20 ga one mm galvanized steel sleeve around pipe insulation
         at each support. Extend insulation through pipe support clamps.
      d. Do not install insulation on lines through clamp assembly of pipe support. Butt insulation up
         against sides of clamp assembly.
      e. Stagger joints on layered insulation. Seal joints in insulation.
      f. Install insulation exposed outside building so ‘slit’ joint seams are placed on bottom of pipe.
g. Paint exterior exposed, non-white insulation with two coats of specified exterior finish.

2. System Requirements:
   a. Condensing Units: Install insulation on above ground refrigerant suction piping and fittings, including thermal bulb, from thermal expansion valve.
   b. Split System Heat Pump Units: Install insulation on above ground refrigerant liquid and suction piping and fittings.

B. Hot Water Heating System:
   1. Pipes:
      a. Butt joints firmly together.
      b. Seal vapor barrier longitudinal seam overlap with vapor barrier adhesive.
      c. Wrap butt joints with 4 inch 100 mm strip of vapor barrier jacket material cemented with vapor barrier adhesive.
      d. Finish with bands applied at mid-section and at each end of insulation.
   2. Valves And Fittings:
      a. Insulate by one of following methods:
         1) With hydraulic setting insulating cement, or equal, to thickness equal to adjoining pipe insulation.
         2) With segments of molded pipe insulation securely wired in place.
      b. Finish fittings and valves with canvas coated with weather barrier mastic or securely fitted Zeston covers.
   3. Pipe Hangers: Provide shields at each pipe hanger to protect pipe insulation from crushing.

C. Hot-Water-Heat System, Chilled Water System, and Steam System:
   1. General:
      a. Fit insulation tightly against surfaces to be insulated and provide with tight joints.
      b. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible damage to insulation will result from inspection or repairs of piping or equipment.
      c. Use broken-joint construction in application of two-layer covering.
      d. Fill cracks and depressions with hydraulic setting insulating cement mixed to thick plastic paste. Apply by hand in several layers to make up total specified thickness. Final layer shall have smooth uniform finish before application of covering.
      e. Apply one heavy brush coat of sizing to canvas before painting.
   2. Piping:
      a. Seal longitudinal laps with vapor barrier adhesive.
      b. Wrap butt joints with 4 inch 100 mm strip of vapor barrier jacket material cemented with vapor barrier adhesive.
      c. Wrap end joints where insulation butts into vertical surfaces or equipment with factory furnished strips of vapor barrier jacket material, cemented with vapor barrier adhesive.
   3. Valves, Fittings, Flanges, And Victaulic Couplings:
      a. Do not apply insulation over flanged joints or Victaulic Couplings until piping has been brought up to operating temperature and flange bolts have been fully tightened.
      b. Insulate flanges, valves, and special accessories with covering equal in temperature resistance and thickness to that of connecting piping.
      c. Fittings for pipe sizes 2 inches 50 mm and smaller may be insulated with hydraulic setting insulating cement, or equal, to thickness equal to adjoining pipe insulation. Apply final coat of weather barrier mastic over hydraulic setting insulating cement.
      d. Insulate fittings for pipe sizes 2-1/2 inches 63 mm and larger with segments of molded insulation securely wired in place and coated with skim coat of hydraulic setting insulating cement. Apply weather barrier mastic and fitting tape finishing with final coat of weather barrier mastic.
      e. Finish fittings regardless of pipe size with canvas and coat with vapor barrier adhesive.
      f. Insulate valves so wheel, stem, and packing nut are exposed.
   4. Aluminum Insulation Jacketing:
      a. Install on cooling tower and chilled water exterior piping.
      b. Space strapping as recommended by Jacketing Manufacturer.
3.3 FIELD QUALITY CONTROL

A. Method of installing insulation shall be subject to approval of Architect. Sloppy or unworkmanlike installations are not acceptable.

3.4 CLEANING

A. Leave premises thoroughly clean and free from insulating debris.

3.5 PROTECTION

A. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

END OF SECTION