1 General
1.1 Materials and installations shall be in accordance with the following industry and association standards.
   - ASME Boiler and Pressure Vessel Code
   - ASME B31.1 Power Piping Code
   - ASTM Materials
   - MICA – Midwest Insulation Contractors Association

2 Design Conditions:
2.1 All insulation materials and installations shall comply with the MICA National Commercial & Industrial Commercial Insulation Standards.
2.2 All steam and condensate piping shall be provided with insulation. Fiberglass insulation with All Service Jacket (ASJ) and PVC Jacket as specified herein shall be provided with the following exception: Insulation at tunnel intersections, changes of direction, or other areas on which the piping will regularly be walked or stepped by personnel shall be calcium silicate with Aluminum Jacket. The calcium silicate shall be supplied in the same thickness as required for fiberglass in the table below.
2.3 Removable blanket insulation shall be provided on all equipment including expansion joints, valves, etc.
2.4 All components of the insulation system, including facings, mastics and adhesives, shall have a fire hazard rating not to exceed 25 for flame spread, and 50 for fuel-contributed and smoke-developed. Ratings to be determined by Underwriter’s Laboratories (UL) or other approved testing laboratory in accordance with ASTM E84, NFPA 255 and UL 723 requirements.
2.5 Consult Utilities Engineering if an application is believed to be outside of these conditions.

3 Fiberglass Insulation
3.1 Fiberglass insulation is required on steam vent piping.
3.2 Fiberglass insulation for piping shall be heavy density, molded fiberglass. The insulation may be single piece “snap-on” or two or more piece sectional insulation as required for larger sizes.
3.3 Pipe and fitting insulation fiberglass material data:
   - Density 3-1/2 lb/ft³, 650°F or greater rating
   - K Factor 0.25 at 100°F
   - Flame Spread 25 max (composite rating)
   - Smoke Developed 50 max (composite rating)
   - Fuel Contributed 50 max (composite rating)

3.4 Table of required insulation thickness in inches with PVC outer jacket for piping:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>HPS, MPS, LPS &amp; Steam Vents</th>
<th>Pumped Condensate</th>
<th>Trapped Condensate</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 2”</td>
<td>2½”</td>
<td>1”</td>
<td>1”</td>
</tr>
<tr>
<td>3”</td>
<td>4”</td>
<td>1”</td>
<td>1½”</td>
</tr>
<tr>
<td>4” to 8”</td>
<td>4”</td>
<td>1”</td>
<td>---</td>
</tr>
<tr>
<td>10” to 18”</td>
<td>4”</td>
<td>1½”</td>
<td>---</td>
</tr>
</tbody>
</table>

3.5 All fiberglass insulation shall include a factory and/or field applied all service jacket consisting of high density white Kraft paper bonded to aluminum foil and reinforced with fiberglass yarn. The piping shall be covered with PVC jacketing and the piping system shall be rated so as to meet all building codes for occupied buildings.
3.6 Fittings shall be insulated with pre-formed fiberglass pieces. The fittings shall be covered with PVC insulated fitting covers sized to fit snugly and match pipe insulation thickness.
3.7 All fiberglass insulation shall be installed per manufacturer’s recommendations.

4 Hydrous Calcium Silicate Insulation
4.1 For use only at tunnel intersections, changes of direction or other areas on which the piping will regularly be walked or stepped by personnel.
4.2 Material Data:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>14 lb/ft³</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>60 PSI (ASTM C203)</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>200 PSI (5% Compression)</td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>1.1% maximum</td>
</tr>
<tr>
<td>Flame Spread</td>
<td>0 (ASTM E84)</td>
</tr>
<tr>
<td>Fuel Contribution</td>
<td>0 (ASTM E84)</td>
</tr>
<tr>
<td>Smoke Developed</td>
<td>0 (ASTM E84)</td>
</tr>
<tr>
<td>Chloride Content</td>
<td>per ASTM C795</td>
</tr>
<tr>
<td>Asbestos Free</td>
<td>AF Identity System</td>
</tr>
<tr>
<td>K Factor</td>
<td>0.42 at 200°F (ASTM C177, C335 and C518)</td>
</tr>
<tr>
<td>Temperature Rating</td>
<td>1200°F</td>
</tr>
<tr>
<td>Standard Specification</td>
<td>ASTM C533 Type 1</td>
</tr>
</tbody>
</table>

4.3 Pipe insulation shall be moisture resistant with a smooth finish.

4.4 Pipe insulation shall be pre-formed half-sections in nominal 3'-0" lengths.

4.5 Fitting insulation shall be scored block insulation and/or segmented to insure proper fit.

4.6 Jacket shall be field applied aluminum.

4.7 Insulating cement shall meet same criteria as preformed sections.

4.8 Installation Guidelines

4.8.1 Pipe shall be insulated with pre-formed sections.

4.8.2 Fittings shall be insulated with mitered sectional pipe insulation or with pre-formed fitting covers. Block and segmented insulation shall be cut and trimmed for an accurate fit.

4.8.3 Gaps in block insulation shall be filled with insulating cement applied in layers not to exceed 1-1/2". Additional layers shall be placed after the preceding layer(s) have cured.

4.8.4 Two layered insulation where required shall have the inner layer thickness equal to half the specified thickness, or ½" less than the outer layer where this is not practical.

4.8.5 Staggered joint construction shall be used for all systems.

4.8.6 Multiple layer systems shall have staggered joints in both directions.

4.8.7 All voids, chipped corners or other openings in insulation sections or blocks shall be filled.

4.8.8 Tie wires shall be No. 14 black wire. At least four (4) wires shall be used per three (3) feet of length. Wires shall be placed prior to jacketing and shall be at right angles to the pipe axis. Diagonally wound wires are not acceptable.

4.8.9 End wires shall be placed 3" from the end of each insulation section in addition to the tie wires.

4.8.10 End and tie wires shall be tightly twisted together and pressed into the insulation so as to leave no projection visible on the finished surface.

4.8.11 Bolt on type support rings shall be furnished and installed by the insulation contractor on all vertical multiple layer piping insulation with a rise exceeding three feet.

4.8.12 Fittings less than 3" may be insulated with troweled-on high temperature insulating and finishing cement applied in layers not to exceed 1-1/2" thick. Each layer shall be reinforced with chicken wire. **Note:** Utility piping in tunnels, steam pits and trenches less than 3" shall be insulated with fiberglass unless specifically called out on drawings as calcium silicate.

4.8.13 Control valves, expansion joints and other equipment requiring regular maintenance or access shall be insulated with removable blanket. Fiberglass insulation in pre-formed sections shall be supplied for all other valves (shut-off, drain, vent, etc.).

4.8.14 A field applied PVC jacket shall be applied to all calcium silicate insulated piping and fittings as the base bid unless noted.

5 Insulation Blankets

5.1 Insulation Covers for up to 500°F System

5.1.1 Insulation Core: 2" Type E needled fiberglass, 6-7 lbs. density with a k Factor of 0.26 at 100°F

5.1.2 Inner, Outer & Gusset Jacketing: 17 oz./sq.yd. Teflon coated fiberglass cloth

5.1.3 Thread: Teflon coated fiberglass

5.1.4 Fastening Devices: Belts made of jacketing material with S.S. double D rings.
5.1.5 Identification Tags: 304 S.S. tag embossed with description of item & Purdue Item Number

5.2 Insulation Covers for over 500°F System

5.2.1 Insulation Core: 2" Type E needled fiberglass, 6-7 lbs. density, with a K factor of 0.26 at 100°F.

5.2.2 Outer Jacketing (Cool Side): 17 oz./sq.yd. silicone impregnated fiberglass cloth

5.2.3 Inner Jacketing (Hot Side) & Gussets (Sides/Edges): 18 oz./sq.yd. high temperature pure fiberglass cloth rated to 1200°F.

5.2.4 Inner & Gusset Casing: 304 S.S. Mesh, 0.008" diameter

5.2.5 Thread: 304 S.S., 10 ply

5.2.6 Fastening Devices:

5.2.7 1.5" Wide straps made of outer jacketing material and fastened with S.S. double D rings.

5.2.8 Identification Tags: 304 S.S. embossed with description of item & Purdue Item Number.

5.3 The covers have to be fabricated in one piece whenever possible, including bonnet being attached to the valve body jacket. The jacket will be sewn inside-out and then turned correct side out before inserting the insulation core. Thus, all seams are inside seams except the final closing seam, which will be a finished outside closing seam. Gussets will be separate pieces sewn to the inner (hot face) and the outer (cold face) jacket surfaces. Identification tags will be riveted to the outer jacket.

5.4 Blankets must fit tight to the component and to Purdue Representative’s satisfaction.

5.5 Manufacturer must provide a conditional five (5) year warranty against defects in design, workmanship and materials for each cover.

6 Jacketing

6.1 Jacket shall be the All Service Jacket (ASJ) (ASJ for Fiberglass only) covered with PVC Jacket. Minimum PVC thickness shall be 0.030 inches. The flame spread/smoke developed rating shall be 25/50.

6.2 Commercially available pre-molded PVC insulated fitting covers shall be used over pipe fittings and manual valves. Minimum PVC thickness shall be 0.030 inches. The flame spread/smoke developed rating shall be 25/50.

6.3 Removable insulation blankets as used on expansion joints and valves shall use the flexible, commercially supplied jacket integral with the blanket.

6.4 Jacketing and insulated fitting covers shall be secured with tack, tape or adhesive as approved by Purchasers representative.

6.5 Contractor shall furnish and install the jacketing over the steam and condensate piping and the valve insulation systems specified herein.

6.6 Fire rated insulation and jacket shall be provided at all fire rated wall penetrations.

7 Noise Control Insulation

7.1 Pressure regulating valves shall be supplied with insulation for the purposes of noise reduction, as well as heat conservation and burn protection. This insulation shall be removable, for maintenance access and manufactured and/or approved by the Pressure Regulating Valve Manufacturer.

8 Installation Guidelines

8.1 Insulation shall be installed so that it fits snugly and securely around all pipes, fittings and equipment. There shall be no gaps in insulation coverage and all seams shall be sufficiently taped or sealed to prevent excessive heat from escaping.

8.2 All PVC jacketing shall be warranted for a period of not less than one year from the time of installation against melting, burning, cracking or deformation caused by excessive heat due to gaps in the insulation coverage.