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		April 2011
KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	<b>INSULATION OF PIPING &amp; EQUIPMENT</b>  <b>(PROJECT STANDARDS AND SPECIFICATIONS)</b>	

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- 1) Process Engineering Equipment Design Guidelines**
- 2) Training for Refining, Chemicals, Ethylene and Equipment Design**
- 3) Process Engineering Consulting Studies**
- 4) Process Safety Management Consulting**
- 5) HAZOP Facilitation**
- 6) Distillation Equipment Supply (Random and Structured Packing, Trays)**
- 7) Commissioning Assistance**

**KLM Technology Group believes that if you have a design, consulting, or troubleshooting project you should consider our senior consultants.**

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## SCOPE

This Project Standard and Specification gives the minimum requirements for the thermal and personnel protection insulation of piping and equipment (vessels, heat exchangers, pumps, etc) and method of application.

Equipment and piping shall be insulated for the purposes of conservation of heat, maintenance of stabilized process temperatures during atmospheric temperature changes, condensation prevention, burn prevention of personnel or limiting noise levels according to the classification nominated.

## REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

- ASTM C165 Test Method for Measuring Compressive Properties of Thermal Insulation
- ASTM C195 Mineral Fibre Thermal Insulating Cement
- ASTM C303 Test Method for Density of Preformed Block Type Thermal Insulation
- ASTM C335 Test Method for Steady-State Heat Transfer Properties
- ASTM C449 Mineral Fibre Hydraulic Setting Thermal Insulation and Finishing Cement
- ASTM C518 Test Method for Steady-State Heat Transmission Properties
- ASTM C547 Mineral Fibre Pre formed Pipe Insulation
- ASTM C552 Cellular Glass Block and Pipe Insulation
- ASTM C591 Un-faced Preformed Rigid Cellular Polyurethane Thermal Insulation
- ASTM C592 Mineral Fibre Blanket Insulation
- ASTM C612 Mineral Fibre Block & Board Thermal Insulation
- ASTM D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
- ASTM D1622 Test Method for Apparent Density of Rigid Cellular Plastics

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- ASTM D2126 Test Method for response of Rigid Cellular Plastics to Thermal & Humid Aging
- ASTM D2826 Test Method for Open Cell Content of Rigid Cellular Plastics
- ASTM D3014 Test Method for Flame Height, Time of Burning & Loss of Mass of Rigid Thermoset Cellular Plastics in a Vertical Position
- ASTM E84 Test Method for Surface Burning Characteristics of Building Materials
- ASTM E96 Test Method for Water Vapour Transmission of Materials

## **ENVIRONMENTAL DESIGN CRITERIA AND UTILITIES**

### **Design Basis Climatic Conditions**

Designs shall be based on outdoor exposure to the conditions described as normal atmospheric conditions. Conditions specific to the relevant Equipment Package & process parameters related to piping will be detailed by the contractor on individual Equipment Data Sheets as per approved P&ID's on the basis of process design criteria attached in bid package and the same shall be submitted to the company for review.

### **Design Life**

The process facilities design life requirement is 25 years.

## **GENERAL REQUIREMENTS**

The Supplier's standard designs (if applicable) which meet the performance requirements and which will operate in the marine environment for 25 years may be considered with prior approval of Company.

### **Items Requiring Insulation**

1. Items shall be insulated for the purpose of conservation of heat, temperature stabilization, personnel protection, condensation prevention (anti-sweat) or limiting noise levels.
2. Piping and equipment operating with fluid temperature in excess of 54°C or below 10°C shall be insulated as burn or freeze protection for personnel to a height of 2.1m above grade and platforms and 0.6m outside the platforms,

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walkways, etc. with the exception that lines operating above 200°C shall be fully insulated.

3. Heat transfer equipment in hot services, other than coolers and condensers, shall be completely insulated except for supporting members and flanges. Shell flanges, channel flanges and nozzle necks shall not be insulated. Nozzle necks shall be insulated to the nozzle flanges.
4. All piping and equipment operating with fluid temperatures below 27°C shall be insulated for condensation prevention ("anti-sweat"). Nozzles, components and appurtenances shall be insulated and covered with vapor barrier and weatherproof cladding.
5. All accessories (such as level controllers, level gauges, pipe bridles, etc) which are attached to insulated equipment shall be insulated with equivalent thickness and materials required for the equipment. The insulation shall not obstruct operation or necessary viewing of equipment components, drains, vents and sample points.
6. Piping that is considered a potential source of noise should be acoustically insulated.

## Exclusions

The following hot parts shall not be insulated, except for burn protection:

- Man ways, manholes and inspection openings on hot vessels.
- Code inspection plates and nameplates
- Connectors and tube unions on fin-tube heat exchang
- Flanges of piping and equipment in hot service
- Expansion and rotating joints

## MATERIALS

### General

All new materials shall be used. Materials showing any evidence of containing contamination or moisture shall not be used.

Insulation materials for equipment and piping shall be suitable for the application, operation, and temperature and be compatible with the contained fluids.

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Insulation materials shall have the following properties:

- Completely free from all forms of asbestos.
- Water-soluble chloride and fluoride ion concentrations as low as possible, 20ppm by mass maximum.
- Chemically neutral, with pH preferably between 7 and 8 in the wet condition.
- Non-combustible and odorless at operating temperatures.
- Have sufficient compressive strength that the method of fixing and finish shall not damage the insulation.

Phenolic and polyisocyanurate (polyurethane) foams shall not be used for services, which may exceed 100°C because these produce toxic smoke when burning.

Any wire mesh reinforcement shall be stainless steel grade 316L.

### **Classifications**

The Line schedule and the Piping and Instrument Diagrams shall indicate the thickness and insulation classification required.

The following insulation classifications are described in this Specification:

- **C** Low temperature insulation designated for processes with operating temperatures below 21°C where heat gain is undesirable, or for the prevention of condensation on pipes and equipment with operating temperatures below 27°C.
- **H** Heat conservation insulation designated for all processes (except heat transfer fluids) with operating temperatures at or above 25°C.
- **PP** Personal protection insulation designated for equipment and vessels with operating temperatures in excess of 54°C or below 10°C.

### **Materials for Low Temperature Services (Class C)**

The following materials shall be used for piping and vessel insulation for Class C:

- Preformed or foamed-in-place polyurethane for piping up to and including DN900.
- Polyurethane blocks, segments or foamed in place sections for piping and vessels greater than DN900.

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Polyurethane foam shall conform to ASTM C591, Type 11, with a flame spread rating not exceeding 25 in accordance with ASTM E84. Higher density and higher strength foam may be used as load bearing insulation if the properties are approved.

Insulating material used on austenitic steel surfaces shall contain less than 20ppm leachable chlorides and a minimum of 20ppm sodium silicate for each part per million of leachable chlorides.

Foamed in place polyurethane foam shall, as a minimum, conform to the following:

- Density of the core shall be between 30 and 35kg/m<sup>3</sup>.
- Thermal Conductivity shall not exceed 0.019 W/mK when the foam is new and cured. This value shall be based on a mean temperature of 25°C as determined in accordance with ASTM C518.
- Flammability shall be guaranteed to have a flame spread classification not exceeding 75 in accordance with ASTM E84.
- Compressive Strength in accordance with ASTM D1621 shall be not less than 170kN/m.
- Closed Cell Content shall not be less than 90%. The cell structure shall be uniform throughout the core and the average cell size shall be no more than 0.40mm. Elongated cells shall be no longer than three times the smallest dimension. These requirements are to be verified in accordance with ASTM D2856, Procedure A.
- Dimensional Stability :the maximum volumetric change shall not be more than 6% after 7 days exposure at 75+3°C and 100+0/-3% relative humidity in accordance with ASTM D2126.
- The permeability shall not exceed 2.5perm in accordance with ASTM C335.
- Friability: A 6mm cube, when properly cured, shall not powder when crushed.
- Vapor barrier coatings shall cover insulation completely before weatherproofing is installed and have the following characteristics:
  - o They must be compatible with the process piping insulation
  - o They must be flexible at the lowest temperature to which they are exposed
  - o Permeability shall not exceed 0.03 perm in accordance with Procedure E of ASTM E96 for the thickness used.
  - o Minimum dry film thickness shall equal or exceed 0.76mm
  - o Flame spread rating shall not exceed 30 in accordance with ASTM E84.
  - o They shall be weatherproof and non-absorbent and shall constitute a vapor barrier.