SECTION: 2.10

THERMAL INSULATION

1.0 Scope

1.1 The scope of work covers thermal insulation for:

a) Cold Insulation
   i) pipes
   ii) ducts

b) Hot Insulation **(N.A)**
   i) pipes
   ii) ducts
   iii) exhaust flues

1.2 The choice of insulation and application shall be as specified in the various sections.

2.0 External Thermal Duct Insulation

2.1 Duct located INDOOR spaces shall be insulated to the following thickness:

Location	Layer	Thickness	Material
a) **Non-air conditioned spaces**			
i) Cold supply duct with air at 12^0C		25	Class O Nitrile rubber with black treated woven glass cloth external surface.
ii) Cold return duct with air at 24^0C	One	25	Same as above
b) **Air conditioned spaces**			
i) Cold Supply duct with air at 12^0C	One	13	Class O Nitrile rubber with black treated woven glass cloth external surface.
ii) Return duct with air at 24^0C	One	13	Same as above

2.2 Nitrile Rubber for duct insulation shall apply as follows:

Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work. Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubber sheets to size with sufficient allowance in dimension. Cutting of nitrile rubber sheets shall be done with adjustable blade to make 900 cut in thickness of nitrile rubber sheet. Hacksaw or blades are not acceptable tools for cutting the insulation.

Material shall be fitted under compression and no stretching of material shall be permitted. A film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface. When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond. All longitudinal and transverse joints shall be sealed by providing 6 mm thick 50 mm wide nitrile rubber tape. The adhesive shall be strictly as recommended by the manufacturer.

Where ducts penetrates walls / floor it shall be suitable flashed and provided with water proofing (external Agency for exposed crossings) before application of the Insulation

3.0 **Pipe Insulation**

3.1 Cold Pipe Insulation

All chilled water, refrigerant, and condensate drain piping shall be insulated in the manner specified herein. Before applying insulation, all pipes shall be brushed and cleaned. All MS pipes shall be provided with a coat of zinc chromate primer. Thermal insulation shall be applied as follows or as specified in drawings or schedule of quantity:

Pipe nominal bore	Thk. for non-coastal places **(NA)**	Thk. for coastal places
15mm – 25mm	30 mm	30 mm
32mm – 80mm	40 mm	40 mm
100mm – 400mm	50 mm	50 mm
Above 400mm	50 mm	50 mm

Insulating material in tube form shall be sleeved on the pipes. On piping, slit opened tube from insulating material shall be placed over the pipe and adhesive shall be applied as suggested by the manufacturer. Adhesive must be allowed to tack dry and then press surface firmly together starting from butt end and working towards centre. Wherever flat sheets shall be used it shall be cut out in correct dimension using correct tools. Scissors or Hacksaw-blade shall not be allowed. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations. All longitudinal and

transverse joints shall be sealed by providing 6 mm thick, 50 mm wide nitrile rubber tape. The adhesive shall be strictly as recommended by the Manufacturer. The insulation shall be continuous over the entire run of piping, fittings and valves. All valves, fittings, joints, strainers etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

Direct contact between pipe and hanger shall be avoided. Hangers shall pass outside the sheet metal protections saddle, which cover section of PUF gutti of sufficient length to support the pipe without crushing the insulation. The vapor barrier shall be lapped over the saddle and securely cemented to it.The minimum thickness of the glavanised steel saddle shall be 1.8 mm. For exposed chilled water piping especially in external runs in the buildings and in plant room , Vertical Multiservice riser shafts the insulated piped services with the vapour barrier as explained in point no 18.7 and shall be additionally cladded with 0.8 mm thick stucco aluminium sheets

Manufacturer's installation manual shall be submitted and followed for full compliance. All insulation work shall be carried out by skilled workmen specially trained in this kind of work. All insulated pipes shall be labeled (S.R. or R.R.) and provided with 300 mm wide band of paint along circumference at every 1200 mm for colour coding. Direction of fluid shall also be marked. Un-insulated MS pipes shall be painted throughout and direction of fluid marked. All painting shall be as per relevant BIS codes.

4.0 **Equipment, Vessels & Tanks**

4.1 Insulation of Pumps for cold applications shall be the same as for the connected pipes. The pump surface shall be thoroughly cleaned and painted with one coat of bituminous paint. Hot bitumen is applied at 1.5 kg/sqm and the insulation slabs are cut and stuck to cover the entire surface. All joints shall be sealed and the insulation covered with 20 mm x 0.63 mm galvanised steel wire mesh and covered with a thick layer of hot bitumen and then clad with 0.8 mm aluminium sheet using sheet metal screws. Pump insulation and the cladding shall be carried out in such a manner that pump split sections (Wherever applicable) or pipe connections could be disconnected without disturbing the pump insulation.

4.2 Insulation of pumps for hot application shall be the same as for connected pipes and application similar to cold application. The insulation shall be held in position with wire netting as above but shall not be covered with hot bitumen. Aluminium cladding shall be done over the insulation.

4.3 All vessels and tanks shall be insulated according to the connected pipe. All vessels & tanks shall be thoroughly cleaned with wire brush and rendered free of milscale. Apply the surface with hot bitumen at 1.5 kg/sqm and stick the rigid insulation (in segments for cold insulation) holding it in position with 20mm x 0.63 mm galvanised wire mesh. Apply hot bitumen at 2.5 kg/sqm over the finished surface and wrap it with 6mm tar felt with 50mm over lapping. Retain the tar felt with 1 mm galvanised steel wire and finish with 0.63 thick aluminum cladding.

5.0 **Under deck roof insulation**

5.1 Under-deck insulation shall be carried out using Phenotherm 35kg / m^3 or 48 Kg/m^3 resin bonded fibre glass regid boards so that the R-value of the insulation along should be not less than 3.5m2.C/w2. This is generally equivalent to 75mm expanded polystyrene. The tender shall, propose the insulation system and get it approved by the consultant before execution.

5.2 The surface shall be thoroughly cleaned with wire brush. 75x 75 x 0.8 mm channel runners shall be provided at 600 mm centre to centre spacing. Apply hot bitument at 1.5 kg/sqm and stick the slabs between the runners blinding both sides of the slab with bitumen at 2kg/sqm. Hold the slabs in position with 20 x 0.63mm galvanised wire netting. Finish the insulation in the manner specified below.

5.3 Under deck roof insulations finished neatly with 10mm gypsum board and fixed with sheet screws or as specified in schedule of work.

6.0 **Over deck roof insulation with expanded polystyrene shall be applied as follows:**

i) The U-factor of the insulation shall be the same as for under deck insulation and applied as specified below.

ii) Clean the surface of the roof slab thoroughly.

iii) Spread industrial air blown bitumen 85/25 conforming to IS 702-1961 uniformly on the concrete surface at the rate of 2.5 kg/sqm.

iv) Press heavy density ($20kg/m^3$) polystyrene slabs of appropriate thickness (75mm) on to the surface after blinding the polystyrene slab with hot bitumen at 1.5 kg/sqm. Expanded polystyrene should have a conductivity of not more than 0.03 w/m°C at 10 deg.C mean temperature.

v) Seal all the joints between adjacent slabs with bitumen and cover the surface with "Sealfas" 2 coats with MAST-A-FAB to build up to 3mm thickness.

vi) Lay 20 mm thick sand cement plaster (ratio 1:4) over 22 gauge 20 mm galvanised chicken wire mesh.

vii) Build cement mortar fillet all round at the junction of the roof slab and the parapet walls. This is done by constructing a fillet of cement plaster at the junction of roof slab and parapet walls.

7.0 **Insulation under raised false floor shall be carried out as follows:**

i) Clean the surface thoroughly and make it free from dust and other particles.
ii) Place rigid Phenotherm foam sheets 35 Kg/m^3 density, 30 mm thick on the floor in between the false floor supports.
iii) Seal the joints between adjacent slabs with aluminium tape 50 mm wide.
iv) Cover the floor insulation with 20 mm thick sand cement plaster (Ratio 1:4) over 22 gauge galvanised chicken wire mesh or "Sealfas" 2 coats.
v) Give two coats of suitable polyurethane paint to render the surface dust proof.

8.0 **Mode of Measurement**

8.1 All duct insulation shall be measured on the basis of the duct prime surface area and excluding all openings for grilles, diffusers but including all flanges, dampers etc.

8.2 In case of bends, tapers etc. the duct prime surface shall be determined on the basis of average dimensions.

8.3 All pipe insulation shall be in linear measure along the centre line of the pipe, over all fittings, excluding flanges and valves.

8.4 Each independent flange insulation shall be measured as 300 mm equivalent length of piping. Insulation of flanges associated with equipment (equipment and mating flange) and valves (flanged or screw-ended valves with flanged tail pipes) shall form part of the valve or equipment.

8.5 Insulation of valves together with the flanges as above shall be measured as 600 mm long equivalent length of piping.

8.6 All pump insulation shall be measured as 1500 mm long piping of diameter equal to the suction size of the pump and this shall include the cost of insulation of the suction and discharge flanges.

8.7 All equipment and roof and floor insulation shall be measured on the prime surface of the area to be insulated.