

GENERAL GUIDELINES FOR INSULATION WORKS

ISSUED FOR

TENDER SPECIFICATION
BHEL : PSSR : SCT : 1334

This booklet is given as a general guideline to this tenderers about insulation works, However instructions given in the drawings & other schedule issued during execution of the work shall be final and binding of the contractor.

Book No :



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GENERAL NOTES ON ERECTION OF INSULATION

1. It is important that the sheet metal covering is done, by a experienced and competent tinsmith.
2. Person, who is doing the actual job, can alter the following said methods of fixing the sheet metal, as and when necessary, only after consulting the BHEL Erection Engineer.
3. Fixing pin of corresponding thickness of insulation shall be welded by **STUD WELDING** process.
4. Circumferential and axial overlapping of outer casing should be 50 mm unless specified otherwise.
5. **FOR HORIZONTAL AND INCLINED DUCT AND PIPE:**
 - 1) All overlapping in axial direction should be at the bottom of the duct and pipe. Provision of beading and Sealing compound is not required.
 - 2) For circumferential overlapping of inclined duct and pipe, provision of beading and Sealing compound is not required.
 - 3) For circumferential overlapping of horizontal pipe and duct, provide beading. Apply Sealing compound if necessary.
- 5A. **FOR VERTICAL DUCT AND PIPE:**
 - 1) For overlapping in the axial direction provide beading. Apply Sealing compound if necessary.
 - 2) For circumferential overlapping provision of beading and Sealing compound is not required.
6. The joints of wool mattresses should be staggered in both circumferential and axial direction. The Wire netting at the joints of Wool mattresses are to be sewn together by G.I. sewing wire dia 0.71 mm.
7. In case more than one layer of Wool mattress is to be applied for pipe insulation the inner layer should be tied by two turns of G.I binding wire dia 1.22 mm at a pitch of 240 mm, and the outer layer should be tied by two turns of G.I. binding wire dia 1.22 mm at a pitch of 160 mm. The ends of the wire should be twisted and pressed in to the insulation.

8. All the overlapping of outer casing should be made such that no rain water enters into the insulation through the joints.
9. In case of insulation fixing pin welding to tubes, equal circumferential pitch is to be maintained. Use a minimum number of 4 pins, at 90 degree radial spacing.
10. The inner side of the Aluminum / G.I sheet of outer casing should be painted with two coats of anticorrosive Paint (IS:158). Retainer – Type A must be coated with Aluminum paint to avoid bi-metal corrosion or Neoprene strip must be provided between Retainer – Type A and Casing support.

The above mentioned paints are not in BHEL scope of supply

11. Self tapping screws should be fixed over the circumferential overlapping. The axial joints should be on the Casing supports and outer casing should be fixed to Casing supports with Self tapping screws at a pitch of 150 mm approximately.
12. The outer casing should be wound tightly around the insulation and then fixed with Self tapping screws when there is not any Fixing pin for insulation.
13. Loose wool can be taken from the Wool mattresses wherever required.
14. Clean the surface to be insulated of rust, dust, grease, loose scale, oil, moisture, etc.
15. Care shall be taken that flexible insulation is not unduly compressed.
16. After insulating the equipment with Calcium silicate / Mineral wool mattress, all voids in the joints shall be filled with Moldable insulation / loose mineral wool respectively.
17. Each day application of insulation should be weather proofed overnight by either with the final protective casing or with some temporary weatherproof covering so that it does not get drenched in rain.
18. The indicated thickness of insulation is the minimum requirement which should be provided. Any alteration in the thickness of insulation should be done only after getting the prior approval from the Design Engineer.
19. The layers of Wool mattresses are to be taken as indicated below:

THICKNESS IN mm	LAYER IN mm				
	1 st	2 nd	3 rd	4 th	5 th
250	50	50	50	50	50
230	50	60	60	60	
210	50	50	50	60	
200	50	50	50	50	
190	40	50	50	50	
180	60	60	60		

160	50	50	60
150	50	50	50
140	40	50	50
120	60	60	
100	50	50	
80	40	40	

20. Where junctions between two or three bodies or different dia, occur and different insulation thickness is specified the greater thickness shall be continued for a length equal to one dia of the smaller body then smoothly tapered to the required smaller thickness over a length equal to two dia of the smaller body. When there is a differential thermal expansion between these bodies, they should be insulated individually.

21. The required fixing components and outer casing sheets have been released under PG_32. The insulation materials have been released under PG-33.

22. **STORAGE INSTRUCTIONS:**

22a) Mineral wool mattress:

These materials should be stored under fully covered sheds. Stocking must be done over planks and must be out of contact with ground. Height of stacking should not exceed 3 Meters.

Once drenched in water these materials loose all the desired properties and become unsuitable for use. Drying the material does not restore the desired properties.

22b) Outer casing sheets:

Outer surfaces are meant for improving the appearances also scratch marks, dents, etc, spoil the appearance.

23. Typical insulation arrangement drawings are indicated below.

- | | | |
|----|--------------------------|------------------------------------|
| 1) | Tees | 4-00-235-08546 |
| 2) | Elbows | 4-00-235-08547 |
| 3) | Flanges | 4-00-235-08548 |
| 4) | Expansion joint for pipe | 4-00-235-08549 |
| 5) | Expansion piece for duct | 3-00-235-06258 &
3-00-235-06259 |
| 6) | Manhole door for duct | 3-00-235-06260 |

INSULATION OF DRUM END

MATERIAL:

- 1) FLAT 50 X 6
- 2) FIXING PIN INSLN DIA – 6
- 3) RETAINER TYPE – A
- 4) G.L. BINDING WIRE DIA – 1.22 / 0.914
- 5) WOOL MATTRESS
- 6) OUTER CASING
- 7) SELF TAPPING SCREW – M4 X 13
- 8) G.L. SEWING WIRE DIA – 0.71 / 0.914

APPLICATION:

Install Flat 50 x 6 circumferential bands to fit snugly around the drum.

Flat 50 x 6 lattice bar 8 numbers should be radially placed over the dished end and contouring the same and it is to be welded over circumferential bands.

Weld the Fixing pins to the lattice bars circumferential bands.

Fix the Wool mattress.

Position the Retainer and tack weld to the Pin.

Tie with Binding wire across the Pins.

Fix the outer casing strips by Self tapping screws.

INSULATION OF PIPES AND BUNCH OF TUBES

MATERIAL:

- 1) WOOL MATTRESS
- 2) G.L. SEWING WIRE DIA-0.71 / 0.914
- 3) G.L. BINDING WIRE DIA – 1.22 / 0.914
- 4) OUTER CASING
- 5) SELF TAPPING SCREW – M4 x 13

APPLICATION:

Fix the insulation over the bunch of tubes / pipes.

Tie the insulation with G.I. binding wire circumferentially.

Fix the outer casing sheet with self-tapping screws.

**INSULATION OF VERTICAL PIPES
(WELDING OF FIXING PINS NOT PERMITTED ON PIPES)**

MATERIALS:

- | | |
|-------------------------------|---------------------------------------|
| 1) FIXING PIN INSLN DIA – 6 | 9) FLAT 50 x 6 |
| 2) RETAINER TYPE – A | 10) PACKING CLOTH – 3 MM TK |
| 3) CASING SUPPORT – 850MM | 11) HEX HD BOLT M8X40 |
| 4) OUTER CASING | 12) HEX NUT M8 |
| 5) WOOL MATTRESS | 13) PNCHD WASHER A9 |
| 6) SELF TAPPING SCREW – M4X13 | 14) GI BINDING WIRE DIA – 1.22 /0.914 |
| 7) CLAMP | 15) GI SEWING WIRE DIA – 0.71 / 0.914 |
| 8) SUPPORTING SHEET | 16) SHEET 3.15x30x3000 |

APPLICATION:

At every three meters provide the Clamps over the pipe with bolt but and washer by using packing cloth in between the pipe and clamp. Fix the sheet 3.15x30x3000 over the pipe and weld to the clamps. Weld the fixing pin over the sheet. Consult the Welding engineer before welding.

Weld the Flat to the Clamps.

Weld the Supporting sheets to the Flats.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Pins.

Tie the insulation to the pipe with GI biding wire circumferentially.

Fix the casing support to the Retainer by using two numbers of Self tapping screws, fixed diagonally for each Retainer.

Fix the outer casing sheet with self tapping screws.

INSULATION OF VALVE

MATERIAL:

- 1) SM CLAMP FOR DETACHABLE INSULATION TYPE – A (To be used up to 200 mm overall dia)
- 1)a SM CLAMP FOR DETACHABLE INSULATION TYPE – B (To be used above 200 mm overall dia)
- 2) WOOL MATTRESS
- 3) OUTER CASING
- 4) SELF TAPPING SCRES – M4 x 13
- 5) G.I SEWING WIRE DIA – 0.71
- 6) SNAP HD RIVET 3 x 8
- 7) CHS SCREW M4 x 20
- 8) HEX NUT M4

APPLICATION:

The sheeting shall be made in two halves and the Sheet metal clamp mounted.

Wool mattress thickness according to adjacent pipe lines shall be pressed in to two halves.

The two halves shall be fitted over the valve to be insulated and locked by Sheet metal clamp.

Self tapping screws shall be used for clamping the two edges of the outer sheet casing when the length of the valve is more.

After assembling the Clamp put a bit of GI Binding wire as a pin through 1.6 mm hole provided.

INSULATION OF DUCT / FLAT SURFACE

MATERIALS:

- | | |
|-----------------------------|--------------------------------------|
| 1) FIXING PIN INSLN DIA – 6 | 5) GI BINDING WIRE DA – 1.22 / 0.914 |
| 2) WOOL MATTRESS | 6) CASING SUPPORT – 650 MM |
| 3) OUTER CASING | 7) SELF TAPPING SCREW M4 x 13 |
| 4) RETAINER TYPE – A | 8) GI SEWING WIRE DIA – 0.71 / 0.914 |

APPLICATION:

Weld the Fixing pin over the Duct / Flat surface.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Fixing pins.

The GI Binding wire dia 1.22 shall be wound across the Fixing pins diagonally underneath the Retainer Type – A.

Fix the Casing support – 650 long to the Retainer Type – A by using two numbers of Self tapping screws, fixed diagonally for.

Retainer Type – A.

Fix the outer casing by using Self tapping screws.

DUCT STIFFENERS

When the stiffeners protrudes through the insulation and are exposed to atmosphere, provide an additional 40 mm insulation over the stiffener.

DUCT DAMPER & GATE

Insulation thickness shall be s per the adjacent duct insulation. The stuffing boxes should not be insulated. A clear gap of 50 mm (minimum) should be maintained all around the stuffing boxes.

AIR HEATERS

DO NOT insulate over the axial seal, adjuster seal access covers and basket removal doors insulation should be applied in a manner to permit a free circulation of ambient air around the bearing.

INSULATION OF DUCT (CLEARING STIFFENERS)

MATERIALS:

- | | |
|--------------------------------------|-----------------------------|
| 1) FIXING PIN INSLN DIA – 6 | 7) OUTER CASING |
| 2) RETAINER TYPE – A | 8) SELF TAPPING SCREW M4X13 |
| 3) RETAINER TYPE – C | 9) WOOL MATTRESS |
| 4) CASING SUPPORT – 650 MM | 10) WELD MESH |
| 5) GI BINDING WIRE DIA – 1.22/0.914 | 11) CORNER SUPPORT |
| 6) GI SEWING WIRE DIA – 0.71 / 0.914 | 12) ANGLE 40X40X5 – 100 |

APPLICATION:

Weld the Fixing pin over the Duct.

Position the Retainer Type – C so that it will be in the same plane as that of the top surface of the stiffener.

Tack weld the Retainer – Type – C to the Fixing pin.

For the top plate of the horizontal duct, spread the Weld mesh over the Retainer Type – C.

This serves as the additional support where people walk over the insulation.

Weld the Corner support to the bottom corners of the duct.

Weld the Angle to the corner support.

This arrangement will help to achieve a sharp corner for the insulation and outer casing.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Fixing pin.

The Binding wire shall be wound across the pins diagonally underneath the Retainer Type – A.

Fix the Casing support - 650 mm long to the Retainer by using 2 numbers of Self tapping screws, fixed diagonally for each Retainer.

Fix the outer casing by using Self tapping screws.

PROCEDURE FOR CURING OF CASTABLE REFRECTORY

CURING OF REFRACTORY WORK

Curing of refractory means retaining the moisture for a minimum period in order to ensure the proper hydration of the binder. Curing of exposed castable surfaces should start after the surface has become firm. This can be tested when a finger rubbed across the surface comes away clean or when the surface feels warm to the touch. Moisture loss for the first 24 hours, after the material has been installed shall be retarded. Initial set occurs within one or two hours.

Castables should be cured for 24 hours. Moist conditions can be maintained by protection with damp sacking or plastic sheet which should not come into immediate contact with the refractory or alternatively by dry coating the castable with an impervious organic based sealing compound. In some instances, satisfactory results can be obtained by sparkling water over the surface. It should be watered for a period of 20 to 24 hours after 4 to 5 hours of construction. The rate of water applicable should be carefully controlled to prevent washing of the fines and to prevent collection of pools in low spots. Shield the surface from direct sunlight at least for about 48 hours. 8 hours after casting and pouring, remove the wooden frames which have no load bearing function in order to permit watering of the lateral parts of the structures. In case of steel frames apply water without stripping them. On completion of the curing period the application of moisture should be stopped. The exposed castable should be allowed to air dry for 24 hours. Naturally air drying of castable after curing will actually cause slight increase in strength. The castable can be all dried indefinitely without adverse effect. Optimum results can be obtained with a drying period of 48 hours.

Before lighting the boiler for drying the setting the following shall be attended.

1. All dirt and foreign objects sticking to tube surface are to be removed to ensure a thoroughly clean surface.
2. Expansion joints are to be cleaned and inspected for the proper functioning of expansion during operation.
3. Test sample of castable refractory is to be taken from entry door regions to determine the moisture content in the laboratory.

Sample of castable are to be taken for the determination of moisture content before and after drying. When the moisture content drops below 0.58 the castable is considered to be dry and the boiler is ready for commissioning. All result of measurement should be duly recorded.

CARE OF THE REFRACTORY WORK

The refractory work is subjected to considerable thermal stresses during boiler operation. Sudden application of heat or cooling introduces severe stresses and endangers the refractory work. Even when the boiler is operated in the recommended regime possibilities of damage occurring to the refractories (due to severed reasons such as bad workmanship, poor quality, slag deposition, corrosive atmosphere etc) must be kept in mind. The following simple rules to be observed.

- (i) Avoid sudden cooling of the furnace after a shut down. A cooling rate of 20° to 30° per hour for the refractory lining in the initial period is recommended. This means that FD fans must be stopped after a shut down of the boiler. Ventilation of the furnace by natural draft is permissible only after six hours of shut down. Forced cooling can be started only after 16 hours.
- (ii) Avoid quick heating of the furnace. Boiler starting diagram is usually a reliable guide.
- (iii) Thoroughly examine the refractory work during shot downs for cracks, chipping off spelling etc. During operation also this can be checked periodically by visual examination through observation holes.

Whenever defects are notice arrange for their quick alimentation, by shutting down the boiler at the earliest depending on the scarceness of the defect.

- (iv) Abnormal heating of outside metal sheet covering of the boiler and hot spots are usually a good indication of damaged refractory and insulation in this area. The leakage of flue gas will spoil the property of good mattresses within a short time.
- (v) Deep the access door, observation doors, etc. properly shut. They are entry points for cold air and this cold air can damage the refractory work by localized cooling.
- (vi) Sufficient quantity of water is to be added to the castable refractory for mixing before application as per supplier's recommendations.

METHOD OF APPLICATION AND CURING
OF POURABLE INSULATION

- (i) Typical application are for insulating behind buckstays and areas such as roofs having multiplicity of hangers, rods and other penetrations.
- (ii) The application of pourable insulation can be pumping and gunning.
- (iii) Density of the pourable insulation installed and cured is around 600 to 650 Kgs/M
- (iv) Pourable insulation is a hydraulic setting insulation additive or air entrainment agents shall not be used.
- (v) (a) Empty the entire bag at a time and mix the whole material so that segregated particles get mixed.
(b) The pourable insulation should be thoroughly mixed with clean water to develop casing and pump consistencies.
© The correct quantity of water shall be placed in the mixer before adding the dry pourable insulation normally about 70 to 100 by weight. However this has to be confirmed from the supplier while purchasing this material.
(d) Mixing time shall not to be less than the minutes or more than five minutes.
(e) Dried out material shall not be remixed.
(f) Pourable insulation once mixed must be in place within half an hour.
- (vi) (a) All areas where pourable insulation will be placed must be free of scale, rust, dust or other loose materials.
(b) All porous forms used such as wood etc shall be oiled before pouring.
© All absorbent surface such as insulation brick, concrete, shall be wet down thoroughly to prevent water absorption.
(d) Waiting of wall insulation used as forms at buckstay levels is not required.
- (vii) (a) The surface of pourable insulation once in place will become firm in approximately two hours. The surfaces should be kept damp with an occasional light spray or covering with a cloth that is kept damp for the entire 24 hours curing period.
(b) For mixing and spraying the water should be clean and cold.
© Application of moisture after 24 hours should be stopped forms etc should be removed and the materials allowed to air dry for 24 hours.
- (viii) The shuttering scaffolding moulds should be removed after about 36 hours of casing.

APPLICATION OF INSULATION FOR BOILER PIPING, PIPING AND EQUIPMENTS / VESSELS AND ACCESSORIES.

Bonded mattress having standard thickness to 25, 40, 50, 60, 75 mm conforming IS 8103 having a density of 150 kg/cubic meter and light bonded mattress having a density of 150 kg/cubic meter and light bounded mattress having standard thickness of 25, 40, 50, 60, 75 mm conforming to IS 9842 having a density of 144 kg/cubic meter and pipe section in the standard thickness of 25, 40, 50, 60, 75 mm conforming IS 9842 having density of 144 kg/cubic meter will be 100 kg/cubic Mtr.

The application of insulation will be done as per general notes/ drawings enclosed. The application commissioning shall be as per latest editions of IS 7413 code of practice for application and finishing of thermal insulation materials between 40° C to 700° C of Bs 5970 code for practice for thermal insulation of pipe work and equipment (in the temperature range – 100° C to + 870° C).

Inspection before application, during the application and after the application of insulation will be carried out by BHEL Field Quality Engineer as per BHEL Field Quality Plan. Every layer of insulation shall be got approved by BHEL Engineer / FQA Engineer.

Prior to applying insulation the surfaces to be insulated shall be made clean and dry and free from dirt and grease. Where cladding is attached to carbons steel or low alloy steels the steel shall be first prime painted with zinc chromate and then painted with Aluminum paintings. Wherever required to provide aluminum foil as protective covering for bolts and other fittings shall be arranged by contactor. The prints wherever required for preservation coating shall be supplied by contractor.

For insulation of piping with performed pipe sections the came shall be applied over pipe and finally be held in position with 15 mm wide aluminum band at greater than 300 mm spacing for mineral wool insulation.

For insulation of piping with mattresses having backing GI wire netting, the required lengths and shapes are to be cut from the blankets and wrapped on the piping and held in position with proper support by fastening the binding to be done circumferential at not greater than 300 mm spacing.

Performed insulation on vertical or near vertical piping must be supported in position by means of metal ring at interval not greater than 960 mm.

The support attachment may be welded or clamped to the pipe, subject to the approval of BHEL Site Engineer Necessary fabrication of support rings to be done as per site requirement.

Piping bends shall be insulated to the same specification as adjacent straight piping and should form a smooth external surface. Where performed material is used it should be cut lobster-back fashion and wired or strapped into position.

Pipe insulation shall be cut to fit nearly around hangers and supports. On horizontal lines which are supported directly on pipe racks the insulation and weather proofing shall be sufficiently cut away at the support to accommodate pipe movement.

Protrusions through insulations which themselves do not required insulations such as pipe clamps supports of small pipings instrument take offs etc shall be covered to the same thickness as the adjacent insulation expect for hanger rods.

At outdoor location the hanger rod protraction shall be shielded with metal flashing to deflect rain and protect the insulation from moisture while permitting the movement of the hanger rod.

Arrangement of securing the metal finish even the insulation shall ensure that direct metal contact between the insulated surface and outer meter cladding is avoided. 4mm thick asbestos board packing shall be used at interface to thermally isolate the metal covering from supporting arrangement. All cladding joints shall be vapours tight and shall be able to accommodate thermal movements. Paste type self setting vapours sealing compound shall be used.

Metal cladding on piping shall be screwed with self tapping screws. These joints should be arranged approximately 30° below horizontal centre line so as to shed water on any horizontal pipe line. The screws shall be flat or round head types of 12mm size and overlapping of 50 mm on both longitudinal and circumferential joints. The screws shall be provided at not greater than 150 mm spacing.

Insulation expansion joints shall be provided in all pipelines to allow movements and expansion of the pipe. The recommended intervals of expansion joints are.

Pipe Temperature	Spacing of Insulation Expansion joints
Below 200°C	5.5 M
201° - 300°C	3.5 M
301°C - 400°C	3.0 M
Above 400°C	2.0 M

All joints in the insulation shall be staggered. For multiple layer of insulation the different layers shall be applied so that the butt joints of one layer do not coincide with those of the other layers. At the joint of each layer of insulation loose insulation shall be packed firmly.

Equipments Insulation Application Procedure

For equipment and shells a matrix of insulation support shall be developed by:-

- (a) Welding the insulation support lugs on a frame work prepared with 20 mm x 3 mm size MS Straps where direct welding of lugs to the sheet is not permitted.
- (b) Welding the directly on shell after written permission by Site Engineer. The material of the support shall be similar to the material of the shell in this case.

The support shall be pitched at 300 mm for vertical and underside surfaces and 500 mm for oppressed surfaces. A support shall be located above each vessel flange at a sufficient distance above the flange bolts to allow for easy removal. The top and bottom supports shall be slotted suitably for attachments of straps and wires.

The support lugs shall be 6 mm

Insulation with back up GI wire noting, shall be cut to fit the equipments and shall be wrapped on the equipment and held in position with proper support and tie wires. All joints between course shall be staggered and tightly butter and adjacent edges laced together with lacing wire.

Insulation shall be fastened in place with MS Straps of 20 x 3 mm, on approx., 300 mm centers where contour of equipment permits. Straps shall be tightened with a banding machine and chamfered with seals.

Insulation on top of horizontal heads shall be cut to fit the curvature of the head and shall be secured in place with the help of radial straps fixed in between circumferential rings. Insulation on bottom heads shall be wired to nuts welded to head. Insulation shall also be strapped to bottom insulation support. For outdoor equipments insulation shall be arranged to be weather proof.

Metal jacketing shall be applied directly over the metal insulation and neatly fitted to place. All gaps shall be arranged so as to shed water. Suitable flashing and weather proofing shall be provided at all nozzles, manholes and other projections to prevent the entrance of water.

VALVES & FLANGES INSULATION APPLICATION

The insulation on all valves and flanged joints shall be enclosed in a removable jacketing so that it may be removed without disturbing the concerned equipment or piping. The thickness of insulation shall be same as that of the pipe line in which these valves and fittings are located.

The layout of wool mattresses to be adopted to obtain the specified insulation thickness are as per be on unless otherwise specified:

Thickness of Insulation (mm)	Layer			
	I	II	III	IV
25	25			
40	40	-	-	-
50	50	-	-	-
60	60	-	-	-
65	40	25	-	-
75	75	-	-	-
80	40	40	-	-
100	50	50	-	-
110	60	50	-	-
125	75	50	-	-
135	75	60	-	-
150	75	75	-	-
155	75	40	40	-
160	75	60	25	-
165	75	50	40	-

The material density of boned mineral wool used for pipe having outside diameter more than 355.6 mm is 150 kg/cubic meter IS 8183.

The material density of bonded mineral wool used for pipe having outside diameter less than or equal to 355.6 mm is 144 kg/cubic meter IS 9842.

Cladding material used is galvanised steel sheet as per IS 277 GRADE 375.

Cladding material gauge for pipe outside diameter less than or equal to 300 mm is 24 SWG.

Cladding material gauge for pipe outside diameter greater than 300 is 22 SWG.

For piping up to including 355.6 mm OD, first layer shall be pipe sections and subsequent layer shall be bonded. Wherever pipe sections are not supplied the first layer has to be wrapped using bonded wool material for piping 355.6 mm OD, bonded mattress shall be used on all the layers.

Description of type of insulation and the method of Application for Boiler Feed Pumps

1. Type of insulation

The pumps should be insulated with 125 mm thick flexible wire backed mineral wool mattress of 150 kg/ density.

2. Method of Application

The above insulation is to be applied to 2.0 mm thick flats aluminum sheeting (18 SWG) and secured by 19 mm wide aluminum retaining dips and 1/8 inch diameter aluminum pop rivets, all to be secured by 2 inch long X No.8 spacing to a 40 mm wide x 3 mm thick angle iron frame work of all welded construction bound by 40 mm PVC tape.

<u>SECTION</u>	<u>TITLE</u>	<u>NO. OF SHEETS</u>
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SECTION - A

THERMAL INSULATION FOR PIPING AND EQUIPMENTS

1.0 INTRODUCTION

In a thermal power station or process plant, thermal insulation or heat lagging of piping and equipment's carrying hot fluids is essential for best economy and protection of operating personnel. Any pipe which is at a temperature higher than its surroundings will lose heat and the amount of heat lost will depend upon the temperature of the fluid and the thermal conductivity of the piping material/covering.

The heat lost through bare pipe increases with

- a) Increase in the temperature of fluid conveyed
- b) Decrease in ambient temperature and
- c) Increase in wind velocity of the surroundings.

The heat so lost has potential for work and rapidly increasing cost of fuel in the recent past has promoted to find all possible means to conserve energy. Providing proper and adequate insulation on to the piping and equipments controls heat transfer and maintains the required service temperature.

2.0 METHOD OF APPLICATION

The method of application is highly skilled job. Badly fitted/laid insulation can lead to greater heat loss, higher cold surface temperature than that estimated and frequent maintenance. Following are the important points to be considered in the application of the insulation.

- 2.1 Before applying insulation, it should be ensured that all instrument tappings, clamps, lugs and other connections on the surface to be insulated have been properly installed as per relevant drawings.
- 2.2 All surfaces to be insulated shall be cleaned of all foreign materials such as dirt, grease, loose scale, moisture etc.
- 2.3 Welding of lugs, attachments, clips etc. on the surface to be insulated for supporting insulation shall not be carried out without the permission of the authorized person.
- 2.4 All flanged joints shall be insulated only after final tightening and testing.
- 2.5 The insulation shall be applied to all surfaces when they are at ambient temperature.
- 2.6 Where more than one layer of insulation is involved, mattresses should have staggered joints (at 60 deg) and they must be held in close contact with face of

pipes/fittings by means of binding wires / Aluminum bands / seals. Circumferential joints of multilayer insulation should also be staggered by at least 150 mm.

(Refer Drg. No. PE-4-999-169-01).

- 2.7 For the first layer of insulation and in case of multi layer of insulation, mattresses with hexagonal wire netting will be facing on outer side.
- 2.8 Insulation mattresses shall be held in place by fastening over with binding wire. Care should be taken to see that the flexible insulation mattresses are not unduly compressed. The ends of binding wire shall be lightly twisted together, bent over and pressed into the insulation. For mattresses, binding wire shall be used at intervals of 300mm.

In the addition Aluminium bands shall also be provided at 300 mm intervals for diameters greater than 500mm. (Refer Drg No. PE-4-99-169-01.)

- 2.9 Where junctions between bodies of different diameters occur and difference in insulation thickness is specified, the greater thickness is to be continued for a length equal to one diameter of the smaller body and then smoothly tapered to the required smaller thickness over a length equal to two diameters of the small body.
- 2.10 The indicated thickness of insulation are minimum requirement which should be maintained. Any change in the thickness of the insulation should be done only after prior approval of the design engineer.
- 2.11 The day-to-day insulation work should be covered with suitable protective materials to prevent the rain water entry, if same is expected.
- 2.12 The insulation shall be cut to fit the piping O.D / equipment and shall be wrapped on the piping / equipments and held in position with proper support and wires. All the joints should be properly staggered and tightly butted and adjacent edges laced (Refer Drg No. PE-4-999/169/01)
- 2.13 The insulation of valves and flange joints shall be enclosed in a removable jacketing so that it may be removed without disturbing the concerned equipment or piping. The thickness of insulating shall be same as that of the pip line in which these valves and fittings are located. (Refer Drg No. PE-4-999-169-07.)
- 2.14 Steam / Air / Gas leakages in and around the pipes to be insulated with be attended before applying insulation.
- 2.15 In order to provide support to Aluminium cladding, support rings made out of 20 x 3 mm M.S. flats shall be fixed at equal intervals of approximately 850 mm spacing and at every circumferential joints. These rings shall be fixed with 'L'

type lugs and shall be fabricated from 20 x 3 mm M.S flats. To reduce that conductivity through these lugs 20 mm x 3 mm size Ceramic mill board shall be used between rings and lugs (Refer Drg No. PE-4-999-169-04 and PE-4-999-169-13).

- 2.16 Spacing between supporting rings for vertical piping shall be 3 mtrs. Support rings are to be provided only when the vertical height exceeds 3 mtrs. (Refer Drg No. PE-4-999-169-03-and PE-4-999-169-05).
- 2.17 For vertical pipes since support rings is provided ate every 3 mtrs interval, only two spacer rings shall be provided in between support rings.
- 2.18 Spacer rings shall be provided at both ends of elbows/bends, valves and flanges pipe having dia more than 89mm.
- 2.19 Wherever the end of hanger clamp assembly protrudes out of the insulation at the bottom suitable box structure are to be provided. Pipe hangers and supports should be covered in such a way that the moisture cannot penetrate into the insulation.
- 2.20 It is very important that sheet metal cladding should be done by a well experienced and competent fabricator. Person doing the job can alter the method of fixing of cladding sheet after consulting the concerned design engineer.
- 2.21 The longitudinal joint in the outer cladding sheet should always be at the lower half of the circumference for horizontal piping so that no rain water enters the insulation through the joints. (Refer Drg No. PE-4-999-169-01).
- 2.22 The joints of outer cladding should be staggered axially.
- 2.23 Inside surface of all Aluminium sheet will have two coats of Bituminous paint applied uniformly.
- 2.24 Aluminium sheets covering on outdoor horizontal pipes will be provided with 3 mm drain hole at the bottom center line at 6 mtr intervals.
- 2.25 The cladding sheet shall provides directly over the insulation/finishing cement (1F APPLICABLE). Suitable flashing and weather proofing shall be provided at all nozzles, manholes and other projections to prevent the entrance of water.
- 2.26 Loose wool can be taken from wool mattresses. Wherever gaps and voids have to be filled.
- 2.27 Sealing compound to be applied on Aluminum cladding sheet joints.

- 2.28 Support rings/spacer rings shall be provided if the insulation thickness > 40mm and pipe diameter > 89mm.
- 2.29 Equipment's name plates shall not be insulated.
- 2.30 Clips made out of sheet be riveted inside the box for insulation of valves and flanges to hold the insulation in box. (Refer Drg No. PE-4-999-169-06).
- 2.31 The insulation local to the inspection points of the critical piping shall be removable.
- 3.00 For Thermal Insulation Material Specification related to the project refer Annexure – 1.

IMPORTANT POINTS TO BE TAKEN CARE DURING APPLICATION

- i) Binding wires for all layers of insulation will be at distance of 300mm.
- ii) In addition Aluminum bands/seals also to be provided at distance of 300 mm for sizes above 500mm.
- iii) Aluminum bands/seals to be provided over aluminum sheets at distance of 500mm.
- iv) Ceramic mill boards to be used between all 'L' type lugs and the support rings.
- v) Inside surface of Aluminum sheets to have 2 coats of bituminous paint applied uniformly.
- vi) Gaps to be properly filled with loose wool taken from mattresses.
- vii) End of hanger clamp assembly protruding out of insulation at the bottom should be suitably boxed with Aluminum sheets.
- viii) Valves to be insulated properly in box structure as given in enclosed drawings.
- ix) Multilayer longitudinal and circumferential joints should be staggered.

ANNEXURE – 1

- 1.0 **Thermal insulating materials shall be per the details given below:-**
- 1.1 **Lightly Bonded Mineral (Rock) wool Mattresses** of density 150 Kg / Cub. Mt with S.S. wire netting will be applied for the first layer of insulation where hot face temperature greater than 400 degree centigrade. For subsequent layers matters of density 150 Kg / Cub. Mtr with G.S. wire netting will be applied.
- 1.2 **Lightly Bonded Mineral (Rock) wool Mattresses** of density 100 Kg/Cub. Mt with G.S. wire netting will be applied for all layers of insulation for host face temperature less than and equal to 400 degree centigrade.
- 2.0 **Binding and lacing wires:** For insulation matters shall be of stainless steel for all insulation interface temperatures.
- 3.0 **Aluminum cladding sheet** shall be provided over the Mattresses ad per details given below.

18 SWG (1.22 mm thk.)	For pipes with dia over insulation above 450 MM.
20 SWG (0.91 mm thk.)	For pipes with dia over insulation above 150 MM and less than equal to 450MM.
22 SEG (0.71 mm thk.)	For pipes with dia over insulation less than equal to 150mm.

SECTION – B