

Enquiry No. B/4066/2015/1260/V3**PRE-QUALIFICATION REQUIREMENTS**

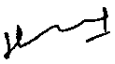
Following are the pre-qualification requirements (PQR) for supply of Thermal Insulation of TIP.

Sl No	Pre-Qualification Requirements	Vendor's confirmation Indicating page no. where documents are placed
1.	Vendor should have an experience in design, supply and application of Thermal Insulation of hot pipes (as per IS 14164:2008 or equivalent) of at least two complete SG/TG sets of 200MW or above projects and satisfying the criteria given below: a. Min. pipe size covered= Nb400 b. Temperature of operating fluid= 350°C and above.	
2.	Vendor to furnish following documents: a. Purchase order copy in support of sl. no. 1 above, along with all technical annexures like BOM, site data conditions, sample calculations used for calculating insulation thicknesses & K-values at different mean temperature (100, 150, 200, 250 and 300°C) This purchase order should not be older than 5 years as on the date of bid opening.	
3.	Vendor to confirm compliance to BHEL quality plan no. QA/BE/QP/316/SQP Rev. 00 (enclosed).	
4.	Vendor to confirm Inspection by BHEL nominated inspection agency M/s BVIL as per quality plan no. QA/BE/QP/316/SQP Rev. 00 (enclosed).	

Notes:

1. BHEL would consider the offers and open the price bids of only those bidders, who fulfill the Pre-Qualification requirements (PQRs).

दिनांक एवं हस्ताक्षर SIGN & DATE		उत्पाद मानक STEAM TURBINE ENGINEERING PRODUCT STANDARD	ST 29005	
			पृष्ठ 23 का 1 Page 1 of 23	
सामग्री सूची संख्या को अधिकृतित करता है	SUPERSEDES INVENTORY NO.	BASED ON: BHEL EXPERIENCE		
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electrical Limited. It must not be used directly or indirectly in any way detrimental to the interest of the company.		SPECIFICATION FOR THERMAL INSULATION FOR T.G.INTEGRAL PIPING SYSTEM		
स्वत्वाधिकार एवं गोपनीय इस प्रलेख की कोई भी प्रतिलिपि भारत के बिना हस्तक्षेप के सम्पत्ति है इसका प्रयोग अन्यथा रूप से किसी भी तरह प्रयोग जो कि कंपनी के हित में सम्पत्तिकारक हो न किया जाए।				
हस्ताक्षर एवं दिनांक SIGN & DATE	दिनांक एवं हस्ताक्षर SIGNATURE & DATE			
सामग्री सूची संख्या INVENTORY NO.	अनुवादक TRANSLATED BY			
P-5788	निर्माणकर्ता WORKED BY			
TSX	जांचकर्ता CHECKED BY			
सहमत विभाग AGREED DEPTT.	पर्यवेक्षणकर्ता SUPERVISED BY			
नाम NAME	स्वीकृति APPROVED : (B.K. BHALLA) AGM (STE)	ST 8.20		
दिनांक एवं हस्ताक्षर DATE & SIGNATURE	निर्माण PREPARED : STE	जारी ISSUED : STE (TL)		
REV.NO. 04 Dt. 04.02.05	जारी ISSUED : STE (TL)	दिनांक : DATE : 1-6-89		

दिनांक एवं हस्ताक्षर SIGN & DATE			उत्पाद मानक PRODUCT STANDARD STEAM TURBINE ENGINEERING		ST29005 पृष्ठ 23 का 02 Page 02 of 23	
सामग्री सूची संख्या INVENTORY NO.	SUPERSEDES INVENTORY NO.	सामग्री सूची संख्या को अधिकृतित करता है	1.0 <u>INTRODUCTION</u> In a thermal power station, thermal insulation of all piping carrying hot fluids is essential for heat economy and protection of operating personnel. In any pipe which is at a temperature higher than its surroundings will loose heat and the amount of heat lost will depend upon the temperature of the fluid conveyed and the thermal conductivity of the piping material. The heat lost through bare pipes increases with: (a) Increase in the temperature of fluid conveyed. (b) Air velocity of the surroundings. Providing proper and adequate insulation on to the facilities and equipments controls heat transfer and maintain the required skin temperature. The use of high quality insulation can return 20% or more per year on the investment.			
COPYRIGHT AND CONFIDENTIAL The information on this documents is the property of Bharat Heavy Electrical Limited. It must not be used directly or indirectly in any way detrimental to the interest of the company			2.0 <u>SCOPE</u> This specifications covers the design, technical requirements and essential particulars for the supply, application & finishing of the thermal insulation complete with all auxiliary materials for the integral piping systems for thermal power stations. Thermal insulation will be applied over integral steam piping having a rated operated temperature of above 60°C for the protection of the operating person & for energy conservation. 2.1 The scope of supply shall be defined in data sheet of the project. (a) The description of the components to be insulated. (b) Maximum continuous operating temperature of the components. (c) Design ambient temperature. (d) Type of insulation ordered. (e) Cold face temperature of the insulation above ambient. (f) Other instruction and notes concerning the design, manufacture and supply of Insulation. 2.2 Attachment, devices & accessories shall form the part of the scope of supply. 2.3 Application of the insulation shall be done at site after consultation with or at the request of the chief of the erection group of BHEL at site. 2.4 In case the requirements specified in the data sheet for a particular project are different than what is given in this specification, the data sheet requirements shall be considered as final and binding for that project. 2.5 The pipe lengths given in data of the insulation schedule are inclusive of the equivalent length of tees/stub and reducer. The vertical / near vertical runs of piping are included in the pipe length given in the data of insulation schedule. Additional supporting arrangements are required for insulation on vertical / near vertical piping. The bidder should include the charges for these supporting arrangements in the contract cost based on his experience. No breakup of vertical and horizontal runs are to be furnished to the bidder.			
स्वत्वाधिकार एवं गोपनीय इस प्रलेख में दी गई सूचना भारत हेवी इलेक्ट्रिकल्स की संपत्ति है इसका प्रसारण एवं अप्रकाश रूप से किसी भी तरह प्रयोग, जो कि कंपनी के हित में हानिकारक हो न किया जाए।						
हस्ताक्षर एवं दिनांक SIGN & DATE	11/11/03					
सामग्री सूची संख्या INVENTORY NO.	P-5788	REV. NO. 04		निर्माणकर्ता WORKED BY	S.K.G.	 12.11.03
				जांचकर्ता CHECKED BY	V.K.G.	 12.11.03

चिनांक एवं हस्ताक्षर SIGN & DATE		उत्पाद मानक STEAM TURBINE ENGINEERING PRODUCT STANDARD		ST29005	
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समीची सूची संख्या INVENTORY NO.	समीची सूची संख्या को अधिकृतित करता है	2.6 Data furnished for the items to be insulated is based on pipe erection drawings. No physical measurement of insulation work will be done. The conversion factors for the valve and fittings will be taken from IS:14164.			
COPYRIGHT AND CONFIDENTIAL The information on this documents is the property of Bharat Heavy Electrical Limited. It must not be used directly or indirectly in any way detrimental to the interest of the company		3.0 DESIGN AND PERFORMANCE REQUIREMENTS			
स्वत्वाधिकार एवं गोपनीय इस प्रलेख में कोई भी सूचना भारत भारती इंजीनियरिंग्स की संपत्ति है इसका प्रत्यक्ष एवं अप्रत्यक्ष रूप से किसी भी तरह उपयोग, जो कि कंपनी के हित में हानिकारक हो न किया जाए।		3.1 For the design of the insulation shall be assumed that the surface temperature of the equipment is taken equal to the temperature of the steam. Heat loss at the surface of insulation shall not exceed 180 Kcal / m ² h unless specified in data sheet.			
		3.2 In principal all the equipments operating above 60°C shall be insulated. However the contractor shall be guided by BHEL regarding the scope as per clause No.2.			
		3.3 If the ambient temperature is not specified in the data sheet, the same shall be assumed as 40°C.			
		3.4 Insulation thickness shall be completed based on the design parameters given in data sheet of the project. The thickness given in insulation schedule shall be reviewed by the bidder.			
		3.5 Insulation shall be supplied in thickness 25, 40, 50, 65 and 75mm. Higher thickness shall be made up in multiple layers from them. The breakup of thickness of multiple layers is given under the column insulation thickness in the insulation schedule.			
		4.0 MATERIALS			
		4.1 INSULATING MATERIALS			
		The insulating materials and protective covering shall be new and fresh, incombustible, non-hygroscopic and shall be guaranteed to withstand continuously and without deterioration the maximum temperature to which they will be subjected under the specified application. The insulation material and any component of the finished insulation job shall not react chemically by itself or in combination with water or moisture to form the substances which are more actively corrosive to the applied surfaces than water or moisture alone. The material shall not offer substance to fungus or vermin and must not pose a health hazard. The bidder shall submit with the bid the details of application of protective coatings or other methods he proposes to use for corrosion protection of insulated surface.			
चिनांक एवं हस्ताक्षर SIGN & DATE	14.8.04				
समीची सूची संख्या INVENTORY NO.	P-5738	REV. NO. 04	निर्माणकर्ता WORKED BY	S.K.G.	7/7/04
			जांचकर्ता CHECKED BY	V.K.G.	7.7.04

SIGN & DATE	SIGN & DATE	SIGN & DATE		PRODUCT STANDARD STEAM TURBINE ENGINEERING	ST 29005	
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SUPERSEDES INVENTORY No.	SUPERSEDES INVENTORY No.	SUPERSEDES INVENTORY No.	The material of insulation used for mattress shall be bonded mineral (rock) as per IS8183. If Preformed pipe section are used, it shall be as per IS9842.			
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.			4.2 SHEATHING MATERIAL The sheathing material for all insulated piping & equipment shall be aluminium sheet confirming to IS 737. Unless otherwise specified in Data sheet, the thickness of aluminium sheathing to be used shall be as follows: a) Pipes of 450 mm (18 inch.) and above; over outside diameter of insulation :- 1.219 mm (18 SWG). b) Pipes of 150 mm (6 inch) and above; over outside diameter of insulation :- 0.914 mm (20 SWG). c) Pipes less than 150 mm (6 inch); over outside diameter of insulation :- 0.711 mm (22 SWG) 4.3 BINDING & LACING WIRE Binding & lacing wire shall be 20 SWG galvanized steel wire. Where interface temperature is 400°C or more, the binding wire shall be 20 SWG stainless steel wire. 4.4 STRAPS & BANDS All straps & bands shall be galvanized steel. For securing aluminium sheathing material, stainless steel or anodized aluminium bands shall be used. Bands shall be 20 mm wide & 0.6 mm thick. 4.5 SCREWS Screws shall be of self tapping type & shall be cadmium/zinc plated. 5.0 APPLICATION OF INSULATION 5.1 GENERAL The application of thermal insulation is highly skilled job contrary to the general belief. Badly fitted/laid insulation can lead to greater heat loss or surface			
INVENTORY No.	INVENTORY No.	INVENTORY No.	REV. No.	WORKED BY:—	CHECKED BY:—	
P-5788	22/6/89		04	Rizam	Shinde	

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SUPERSEDES INVENTORY No.				temperature than that estimated & also to constant maintenance. Ample provision shall be made for maximum possible thermal movement & the insulation shall be applied in a manner which will avoid breaking or telescoping due to alternate periods of expansion & contraction. A single layer of insulation shall not be more than 75 mm thick. The following are some of the points to be considered in the application of insulation		
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.				a) Surfaces must be clean, dry, & free from grease, loose scale, moisture etc. before application of insulation. b) Insulation thickness on flanges & valves should be equal to that of the adjacent/associated pipes. c) Where contamination by chemicals or oil spillage is possible, it is important that precaution be taken to avoid contamination of insulation. d) Pipe hangers & supports and any penetrations should be covered in such a way that moisture cannot penetrate. e) The bare insulation must be stored in a proper place (indoor) to avoid contamination which will lead to change in weight & thermal conductivity values. f) Rigid sections should have staggered joints where more than one layer is involved & they must be held in close contact with pipe & fitting face by means of wire or bands.		
SIGN & DATE 27/6/89				5.2 PIPING :- 5.2.1 For insulation of piping with preformed pipe sections the same shall be applied over the pipe and finally insulation shall be held in position with 15 mm wide aluminium band at not greater than 400 mm spacing. 5.2.2 For insulation of piping with mattresses having backing GI wire or SS wire netting, the required lengths & shapes are cut from the blankets & wrapped on the piping with edges pulled together tightly at the longitudinal joint and secured by lacing wire & this joint shall be at lower side. If the interface temperature is 400°C or more the wire netting shall be from 20 SWG stainless steel wire and having hexagonal opening of 25 mm size. Otherwise each layer of mattress shall have GI wire netting from 20 SWG & having hexagonal opening of 25 mm size. The ends of all wire loops shall be firmly twisted together with pliers, bent over & carefully pressed into the surface of the insulation. Preformed insulation & mattress insulation on vertical or near vertical piping must be supported in position by means of metal rings & at intervals as per enclosed sketches. GI band/Aluminium bands are to be used for tightly securing the different layers of insulation.		
INVENTORY No. P. 5788				5.2.3 Piping bends shall be insulated to the same specification as adjacent straight piping and should form a smooth external surface. Where preformed material is used, it		
REV. No. 04				WORKED BY:— <i>Rigam</i>		
				CHECKED BY:— <i>Sharma</i>		

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should be cut lobster back finish and wired or strapped into position.

5.2.4 All insulation shall be protected by an outer covering of aluminium sheathing. All insulation sheathing joints shall be sealed and made effectively weather & waterproof. All flat surfaces shall be adequately sloped to prevent pools of water collecting. The sheathing shall be protected internally with two coats of anti corrosive paint as per IS 158. The jackets shall be installed with the longitudinal lap joint at 45° below the horizontal for horizontal pipes and the joints sealed with sealing compound.

Arrangements for securing the metal finish over the insulation shall ensure that direct metal contact between the insulated surface and outer metal cladding is avoided. 4 mm thick asbestos board packing shall be used as interfaces to thermally isolate the metal covering from supporting arrangements. There shall be over lapping of 50 mm on both longitudinal & circumferential joints. The screws shall be provided at not greater than 150 mm spacing. Sealing compound is to be applied at all sheathing joints. The overlapping in outer casing should always be at the bottom for horizontal piping so that no rain water enters into the insulation through the joints & the lapping must be done so that water will have a natural drainage. In case of vertical & inclined piping, circumferential overlapping is made such that no rain water enters into the insulation through the joints by proper lapping sequence.

5.2.5 All joints in the insulation shall be staggered. For multiple layers of insulation the different layers shall be applied so that the butt joints of one layer do not coincide with those of the other layer.

6.0 VALVES & FLANGES INSULATION

The insulation on all valves & 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. A typical arrangements shown in drawing at sheet no 15.

7.0 GENERAL INSTRUCTIONS FOR ERECTION OF INSULATION

a) Persons doing the actual job can alter the method of fixing of sheet metal as and when necessary, only after consulting the concerned field engineer.

b) Care shall be taken to see that the flexible insulation mattresses are not unduly compressed.

c) The day to day insulation works are covered by sheathing or with suitable protective materials to prevent the rain water entry.

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SUPERSEDES INVENTORY No.		d) The indicated insulation thickness are minimum requirements which should be maintained, and are based on LRB mattresses. If the bidder desires to use pipe section or combination of pipe section & LRB mattresses, the same should be done after prior approval of design engineer. e) Where junctions between bodies of different diameter occur and difference of 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 smaller body. f) Once the insulation is laid walking on the insulated pipe should be avoided. Suitable scaffoldings are to be used. Similarly slinging of pipes over the insulation should be avoided. g) The layers** of wool mattresses to be adopted, to obtain the specified insulation thickness, are as per table below unless otherwise specified																																																
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SIGN & DATE	22/6/89	<table border="1"> <thead> <tr> <th>Thickness of insulation(mm)</th> <th>Ist layer</th> <th>IIInd layer</th> <th>IIIrd layer</th> <th>IVth layer</th> </tr> </thead> <tbody> <tr> <td>80</td> <td>40</td> <td>40</td> <td>--</td> <td>--</td> </tr> <tr> <td>100</td> <td>50</td> <td>50</td> <td>--</td> <td>--</td> </tr> <tr> <td>110</td> <td>65</td> <td>50</td> <td>--</td> <td>--</td> </tr> <tr> <td>120</td> <td>75</td> <td>50</td> <td>--</td> <td>--</td> </tr> <tr> <td>130</td> <td>65</td> <td>40</td> <td>25</td> <td>--</td> </tr> <tr> <td>140</td> <td>75</td> <td>65</td> <td>--</td> <td>--</td> </tr> <tr> <td>150</td> <td>75</td> <td>75</td> <td>--</td> <td>--</td> </tr> <tr> <td>200</td> <td>75</td> <td>75</td> <td>50</td> <td>--</td> </tr> </tbody> </table>				Thickness of insulation(mm)	Ist layer	IIInd layer	IIIrd layer	IVth layer	80	40	40	--	--	100	50	50	--	--	110	65	50	--	--	120	75	50	--	--	130	65	40	25	--	140	75	65	--	--	150	75	75	--	--	200	75	75	50	--
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140	75	65	--	--																																														
150	75	75	--	--																																														
200	75	75	50	--																																														
INVENTORY No.	P.5788	**If the mattress thickness combination are indicated in the insulation schedule, the above instruction is to be ignored. The necessary guide lines of fixing arrangement for pipe section & mattresses are given in the drawings at sheet nos 10 & 11. h) Insulation Fixing Arrangements:- Typical fixing arrangements for insulation of pipes & pipe fittings are shown vide drawings listed below; i) Fixing arrangement pipe section and lightly bonded mattresses/ mattresses at sheet nos. 10, 12 & 13.																																																
REV. No.	04	WORKED BY: - <i>Rigam</i> CHECKED BY: - <i>hmk</i>																																																



PRODUCT STANDARD

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REV.
NO.
04

- ii) Fixing arrangements for lightly bonded mattress at sheet nos 11,12 & 13.
- iii) Lugs at sheet no 14.
- iv) Flats at sheet no. 15.
- v) Fixing of insulation on valves at sheet no. 16.
- vi) Insulation of tee at sheet no. 17.
- vii) Insulation of elbow at sheet no. 18.
- viii) Pipe clamp carbon steel at sheet no. 19.
- ix) Pipe clamp alloy steel at sheet no. 20.

8.0 PROTECTION OF MATERIALS DURING STORAGE

The supplier shall protect the insulation materials from weather at all times from delivery to finish. Decking & covering tarpaulins alone are not adequate for any length of time & shall not be allowed except in extreme emergencies and only for short periods. Stacking of insulating materials directly on ground shall not be done.

9.0 GUARANTEES

The supplier shall guarantee that if the specified maximum surface temperatures are exceeded on actual measurement, the supplier shall either replace the insulation with a superior material or provide additional insulation thickness at the BHEL'S/ site engineers discretion at no extra cost to the BHEL.

The supplier shall also guarantee the quality of the materials used & workmanship for a period of 18 months from the date of commissioning. Any defects arising from faulty materials or workmanship during this period shall be rectified by the supplier at no extra cost to BHEL.

10.0 INSPECTION & TESTING

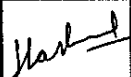
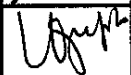
10.1 Thermal insulating material :-

Supplier shall arrange for carrying out all the tests for establishing thermal conductivity values, physical & chemical properties as required by relevant IS & or BS codes and standards. The tests shall be done on representative samples drawn from each lot of insulation material to be supplied under this specification & prior intimation shall be given so that BHEL can depute their representative to witness any or all the tests. For thermal conductivity values, test certificates from independent authorized testing agency (subject to BHEL'S approval) shall be furnished to BHEL for approval.

10.2 Other materials :-

For other materials i.e. cladding sheet, wire netting, binding wires, stitching & lacing wires etc., manufacturers correlated test certificates as per relevant codes & standards shall be furnished. In case correlating test certificates are not available, the supplier shall arrange to carry out necessary tests in presence of BHEL'S representative.

WORKED BY: - *Rigam*CHECKED BY: - *Shinde*

दिनांक एवं हस्ताक्षर SIGN & DATE			उत्पाद मानक STEAM TURBINE ENGINEERING PRODUCT STANDARD		ST29005 पृष्ठ 23 का 9 Page 9 of 23	
शीर्षक सूची संख्या को अधिकृतित करता है	SUPERSEDES INVENTORY NO.	All test certificates shall be furnished & written approval shall be taken from BHEL before commencement of the supply of material.				
COPYRIGHT AND CONFIDENTIAL. The information on this document is the property of Bharat Heavy Electrical Limited. It must not be used directly or indirectly in any way detrimental to the interest of the company.		11.0 DOCUMENTS TO BE SUBMITTED Two copies of the following pre-approval documents shall be submitted by the bidder along with the offer :- (i) Thermal conductivity values of the insulating materials at various mean temperatures not older than 2 years for densities 100, 120 & 150 Kg / m³ from government approved lab for information. (ii) Manufacturer's descriptive and illustrative literature for insulating materials offered with complete properties as per relevant standards. (iii) Quality plan duly signed on BHEL format for approval. (iv) Total bill of material of each item, giving the material specification, density / size / thickness, quantity and the wastage allowance considered shall be indicated in Data Sheet / Insulation schedule, alongwith its thickness calculation.				
स्वत्वाधिकार एवं गोपनीय इस प्रलेख में दी गई सूचना भारत हेवी इलेक्ट्रिकल्स की सम्पत्ति है इसका प्रत्यक्ष एवं अप्रत्यक्ष रूप से किसी भी तरह प्रयोग, जो कि कंपनी के हित में हानिकारक हो न किया जाए ।						
हस्ताक्षर एवं दिनांक SIGN & DATE	 11/12/05					
शीर्षक सूची संख्या INVENTORY NO.	P-5788	REV. NO. 04		निर्माणकर्ता WORKED BY	S.K.G.	 4/2/05
				जांचकर्ता CHECKED BY	V.K.G.	 04.02.05

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INSULATION SUPPORT

SPIDER (VERTICAL PIPING ONLY)

GI BAND 30X0.71

SECURED TIGHTLY ON FINAL LAYER AS PER DETAIL-A AND FASTENED WITH TWO NOS OF SELF TAPPING SCREWS

2 Nos.

SELF TAPPING SCREWS

DETAIL-A

ALU. STRAP/G.I.

REAR END

FRONT END

CLAMPS (A.S. OR C.S.) DEPENDING ON PIPE MATERIAL

BOLT & NUT FOR C.S. CLAMPS

STUD & NUT FOR A.S. CLAMPS

FLAT 3-15 THK FOR C.S. AND 6 THK FOR A.S. AS SPACED AS PER DETAIL-B

SPACED AS PER DETAIL-B

RIVET

ASBESTOS MILL BOARD

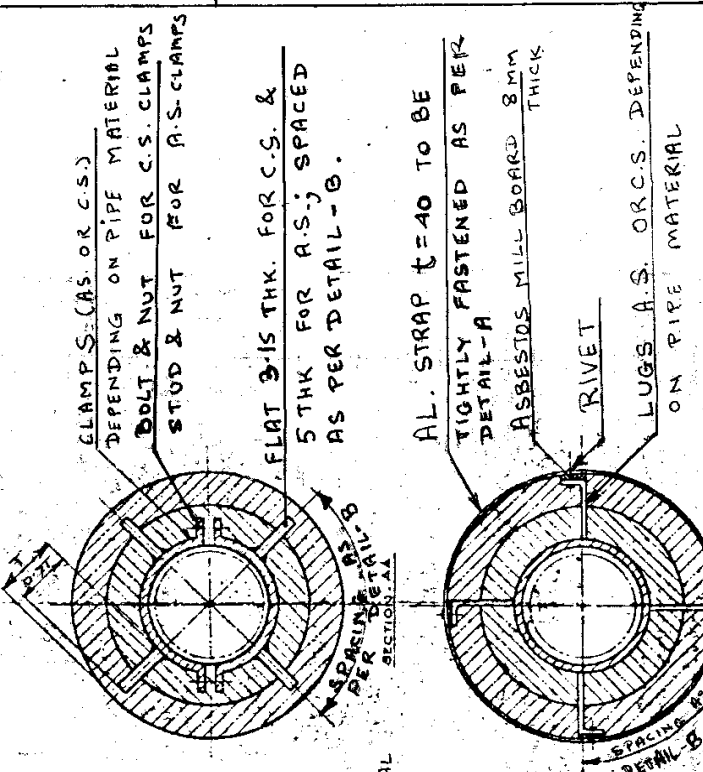
LUGS (C.S. OR A.S.) DEPENDING ON PIPE MAT.

ALU. SHEET 40X

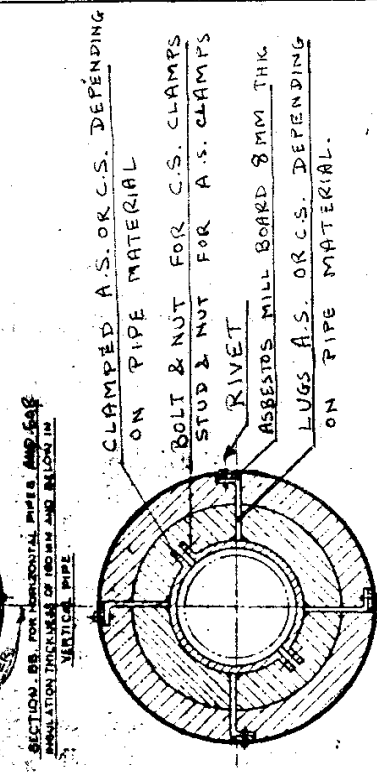
FOR HORIZONTAL PIPES (FOR FIRST LAYER PIPE SECTION AND SUBSEQUENT LAYERS LIGHTLY BONDED SLAB) MATTRESSES)

WORKED BY: - *Rigam*CHECKED BY: - *Shinder*

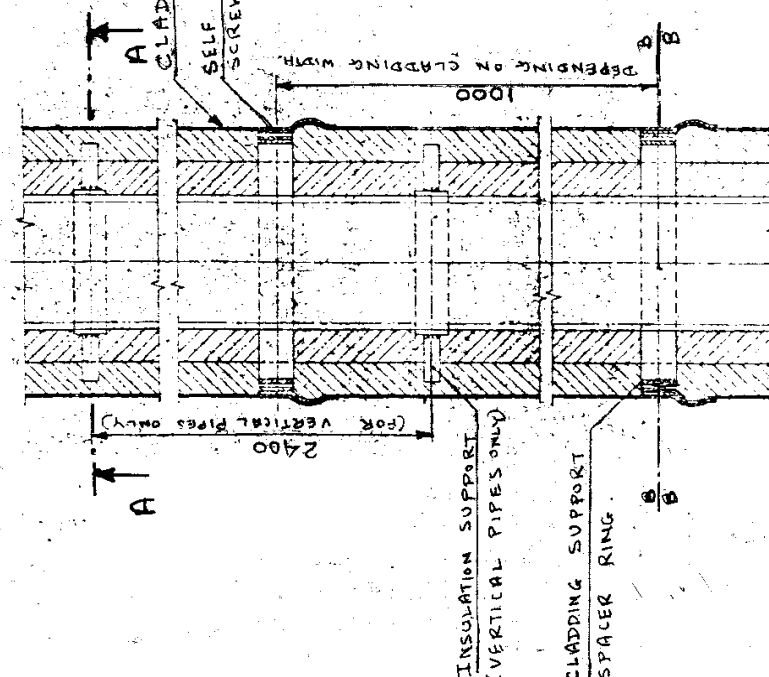
INVENTORY No. P-5788	SIGN & DATE 22/4/89	COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.	SUPERSEDES INVENTORY No.	SIGN & DATE
			PRODUCT STANDARD STEAM TURBINE ENGINEERING	
ST 29005			PAGE 11 OF 23	



SECTION-AA
WELDING DETAIL-B
PER DETAIL-B



SECTION-BB
FOR HORIZONTAL PIPES AND SLOPE
INSULATION THICKNESS OF 80MM AND BELOW IN
VERTICAL PIPE



SECTION-AA
SECTION-BB

REV. NO.
D4

WORKED BY: — *Rigan*

CHECKED BY: — *Shinde*



PRODUCT STANDARD
STEAM TURBINE ENGINEERING

ST 29005

PAGE 12 OF 23

SIGN & DATE

SUPERSEDES
INVENTORY No.

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SIGN & DATE

INVENTORY No.

P-5788

REV.
NO.
04**NOTES ON ERECTION :-****A. (ONLY PIPE SECTION)**

1. Fix support spider on vertical pipes. Bottom most spider at tangent point of bend/tee.
2. Commence insulation of all layers except last layers of insulation, from support spider level in vertical pipes.
3. Fit each layer of insulation and secure with 30 x 0.71 GI bands at spacing as shown. Secure it tightly by cutting the alu. sheet as per detail-A.
4. Secure last layer of insulation and fasten it at a GI band 30 x 0.71 (as detail-A).
5. Fix cladding sheet and apply sealant.
6. For horizontal pipes use GI bands 30 x 0.71 and secure it as per detail-A.

B. FIRST LAYER PIPE SECTION AND SUBSEQUENT LAYERS LRB**MATTRESSES OR MATTRESSES.**

1. For horizontal pipes secure tightly the first layer of pipe section using 30 x 0.71 GI bands and as per detail-A.
2. Insert lugs for horizontal pipes and secure it tightly using alu. sheet 40 x 1 as per detail-A.
3. Fit in asbestos mill board and rivet.
4. Insert the LRB mattresses or mattresses with field cut slots from edge in felt and wire netting to clear lugs.
5. Fix cladding sheet and apply sealant.
6. For fixing of insulation in vertical pipes follow the same as the one for pipe section.

C. GENERAL

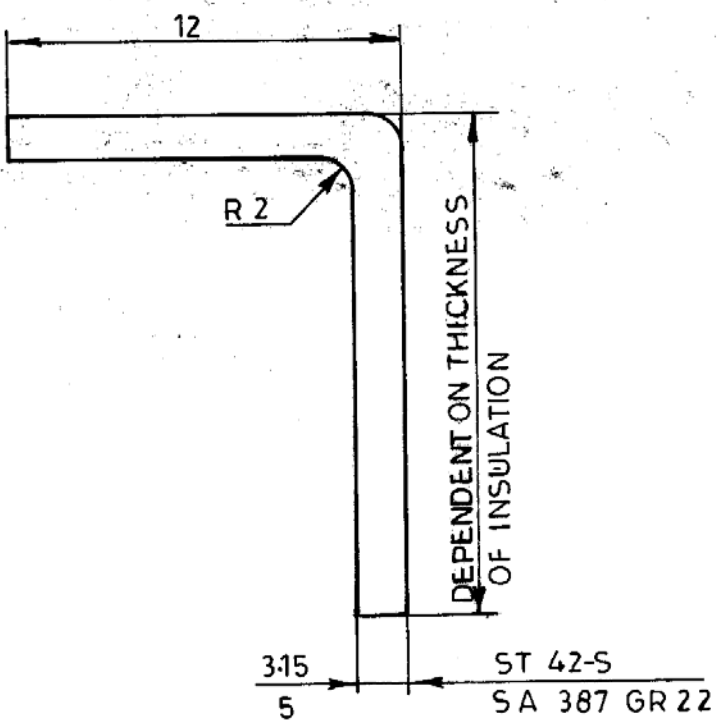
- a) After proper folding (as per detail-A) the ends are to be properly fastened by using two nos. self tapping screws per band.
- b) Lugs/flats are issued in standard length running meters. They are to be cut at site depending on insulation thickness.

D. NOTES ON APPLICATION

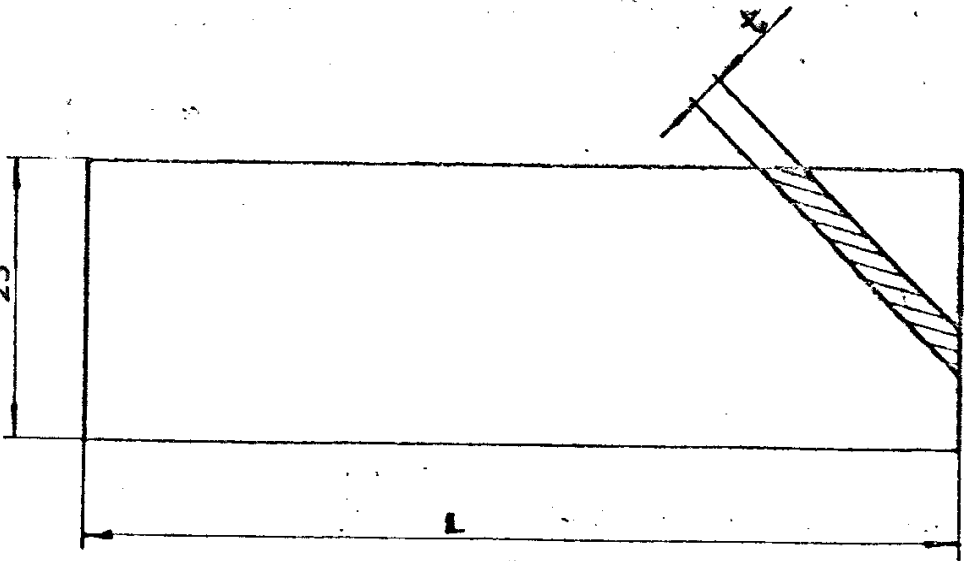
1. Fix insulation support spiders on vertical pipes. Bottom most spider at tangent point of bend/tee at bottom.
2. Fix cladding support spacer ring at specified intervals by using aluminium strap tightly (as per detail-A).
3. Commence insulation on all layers of insulation except last layer from support spider level in vertical pipes.
4. Insert insulation at support spacer rings locations with field cut slots from edge in felt and wire netting to clean lugs/projection.
5. Stitch wire netting together at all edges and field cuts.

WORKED BY:- *Rigam*CHECKED BY:- *Rigam*

चिह्नक एवं हस्ताक्षर SIGN & DATE		उत्पाद मानक STEAM TURBINE ENGINEERING PRODUCT STANDARD	ST29005									
			पृष्ठ 23 का 13 Page 13 of 23									
सामग्री सूची संख्या को INVENTORY NO.	6. Adjacent layers of insulation to be disposed to result in 50 mm overlap. 7. Fit last layer of insulation. 8. All gaps in insulation to be filled with cuttings & finished. 9. Provide and fix cladding with sealing compound. 10. Lugs and flats are issued for standard height. It has to be cut at site depending on insulation thickness (refer insulation schedule for the thickness of insulation). 11. This is applicable for LRB mattresses or mattresses (both for horizontal and vertical piping).											
COPYRIGHT AND CONFIDENTIAL The information on this documents is the property of Bharat Heavy Electrical Limited. It must not be used directly or indirectly in any way detrimental to the interest of the company	DETAIL-B <table border="1"> <thead> <tr> <th>OUTER DIA. OF PIPE</th> <th>NO.OFF</th> </tr> </thead> <tbody> <tr> <td>Upto 219</td> <td>4</td> </tr> <tr> <td>273 to 406</td> <td>6</td> </tr> <tr> <td>Above 406</td> <td>8</td> </tr> </tbody> </table>				OUTER DIA. OF PIPE	NO.OFF	Upto 219	4	273 to 406	6	Above 406	8
OUTER DIA. OF PIPE	NO.OFF											
Upto 219	4											
273 to 406	6											
Above 406	8											
स्वत्वाधिकार एवं गोपनीय इस दस्तावेज में की गई सूचना भारत हेवी इलेक्ट्रिकल्स की संपत्ति है इसका प्रयोग एवं अपरयोग अन्य से किसी भी तरह प्रयोग, जो कि कंपनी के हित में हानिकारक हो न किया जाए।	E. Inspection at site during and after application of insulation shall be carried out as stipulated in the enclosed field quality plan. F. CROSS REFERRED STANDARDS :- IS:737 IS:8183 IS:9842 IS:14164											
हस्ताक्षर एवं चिह्नक SIGN & DATE 14.8.04	REV. NO. 04											
सामग्री सूची संख्या INVENTORY NO. P-5788	निर्माणकर्ता WORKED BY S.K.G.		जांचकर्ता CHECKED BY V.K.G.									
		7/7/04		7.7.04								

SIGN & DATE			PRODUCT STANDARD STEAM TURBINE ENGINEERING		ST 29005
					PAGE 14 OF 23
SUPERSEDES		COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.			
INVENTORY No.					
INVENTORY No.	SIGN & DATE				
P-5788	22/6/89				
REV. NO. 04	WORKED BY: — <i>Rigam</i>				
		CHECKED BY: — <i>Shinde</i>			

LUGS

SIGN & DATE	SIGN & DATE	INVENTORY No.	INVENTORY No.	SUPERSEDES INVENTORY No.	SIGN & DATE		PRODUCT STANDARD STEAM TURBINE ENGINEERING	ST 29005	PAGE 15 OF 23
									
NOTE:- 1. 'L' = 0.7 x INSULATION THICKNESS 2. 't' = 3.15 THK FOR CARBON STEEL (VAR.01) 5 THK FOR ALLOY STEEL (VAR.02)									
FLAT									
WORKED BY:- Rigan						CHECKED BY:- [Signature]			

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02	PLATE-3mm Thk.	15 942 255							
		5A 387 6R22							1
01	PLATE-3/15mm-Thk	ST A2-S							1
VARIANT No.	DESCRIPTION	STD	MATL CODE	A/C	UNIT	UNIT WT	QTY.		
			MATL SPEC						

REV. NO.
04

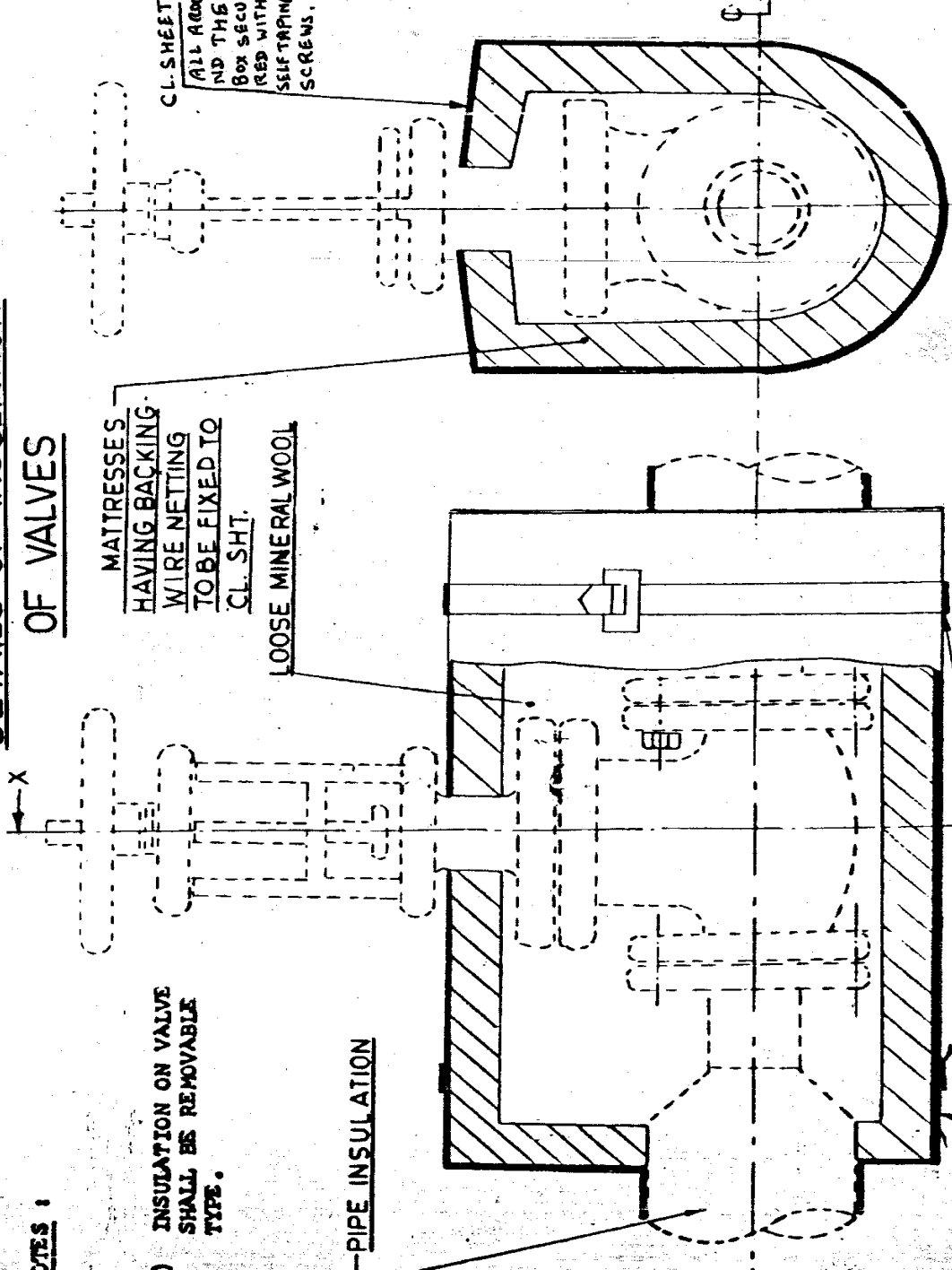
INVENTORY No. P-5788	SIGN & DATE 22/6/89	COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.	SUPERSEDES INVENTORY No.	SIGN & DATE
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PRODUCT STANDARD
STEAM TURBINE ENGINEERING

FORM
ST 29005
 PAGE 16 OF 23

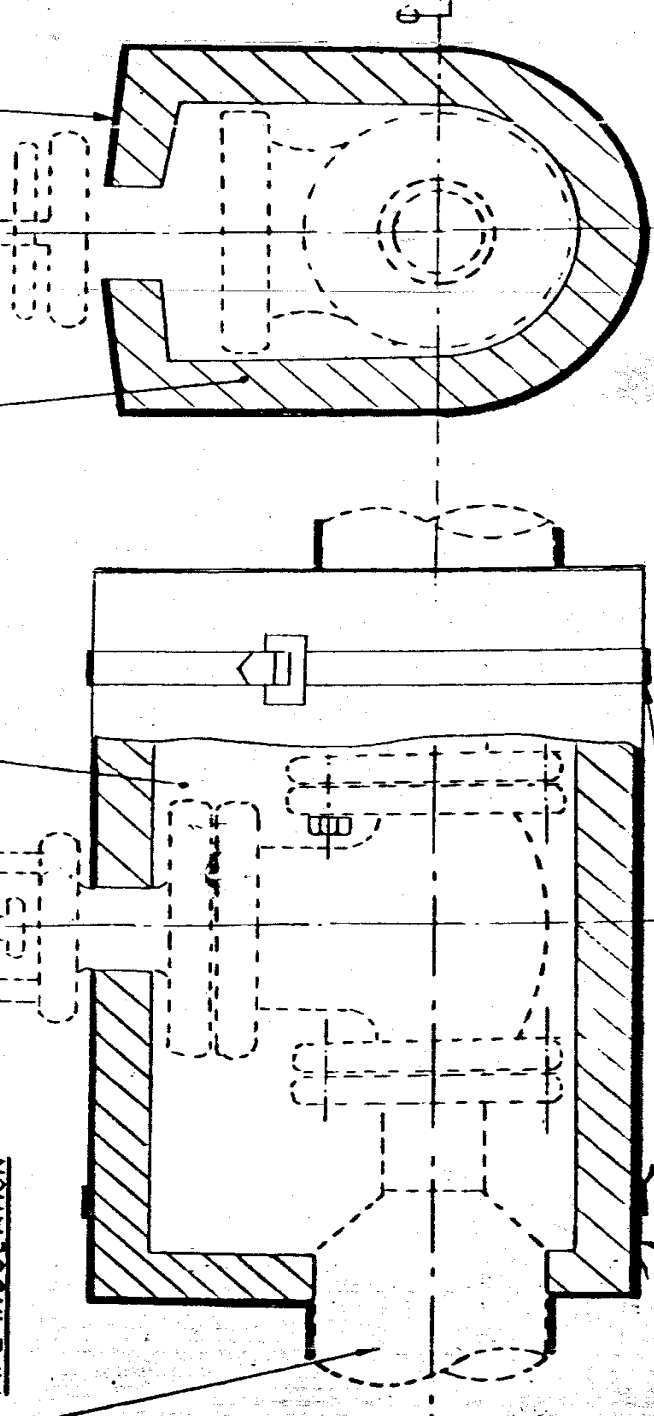
DETAILS OF INSULATION OF VALVES



NOTES :

1) INSULATION ON VALVE SHALL BE REMOVABLE TYPE.

PIPE INSULATION



CL. SHEET

ALL ABOVE AND THE BOX SECURED WITH SELF TAPPING SCREWS.

PIPE

SEC. X-X

MATTRESSES HAVING BACKING WIRE NETTING TO BE FIXED TO CL. SHT.

LOOSE MINERAL WOOL

CL. SHEET

STRAPS MADE FROM CL. SHEET

WORKED BY: *Riga*

CHECKED BY: *[Signature]*

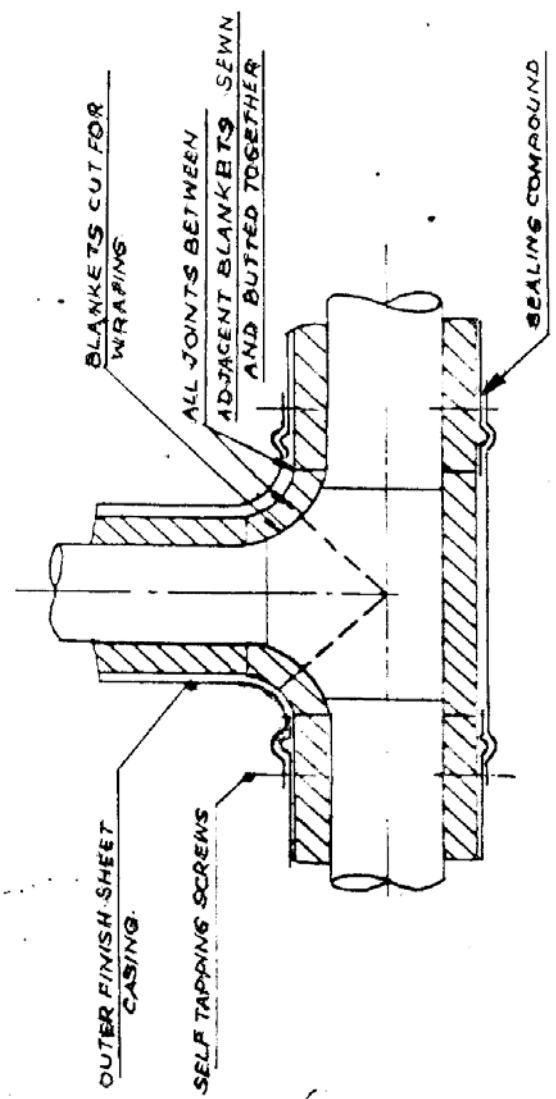
INVENTORY No.	SIGN & DATE	COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.	SUPERSEDES INVENTORY No.	SIGN & DATE
P-5788	22/6/89			



PRODUCT STANDARD
STEAM TURBINE ENGINEERING

FORM
ST 29005
PAGE 17 OF 23

FIXING OF INSULATION ON TEES



TEE INSULATION
(WITH MATTRESS INSULATION)

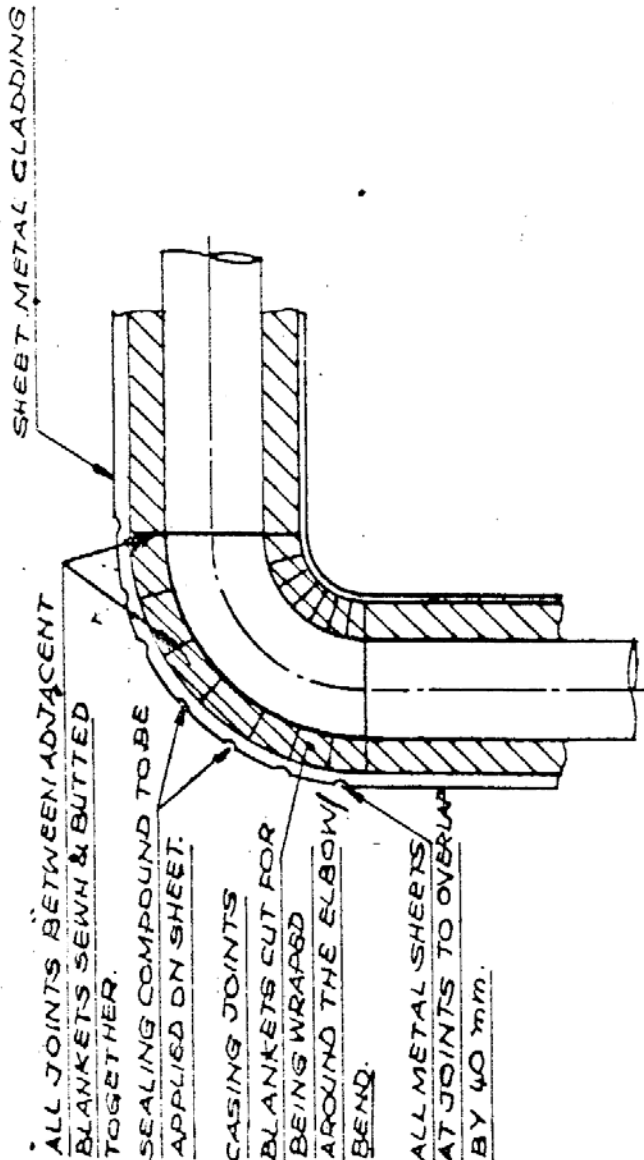
WORKED BY:- *Rigam*

CHECKED BY:- *Khuder*

REV. NO.
04

INVENTORY No. P-5708		SIGN & DATE 22-11-09		COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.		SUPERSEDES INVENTORY No.		SIGN & DATE	
REV. 20. 04		WORKED BY:- <i>Riga</i>		CHECKED BY:- <i>Shan</i>				PRODUCT STANDARD STEAM TURBINE ENGINEERING	
						FORM		ST 29005	
								PAGE 18 OF 23	

FIXING OF INSULATION ON BENDS / ELBOWS



WITH MATTRESS

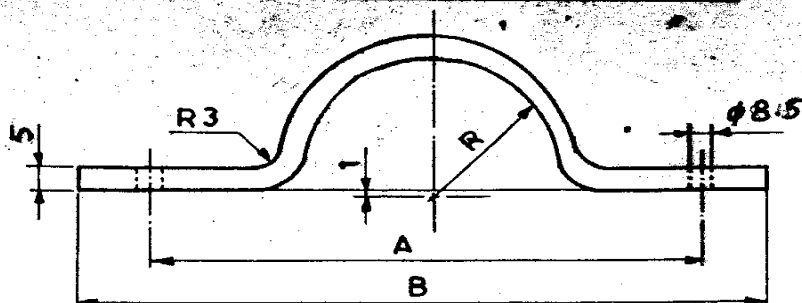
PRODUCT STANDARD

STEAM TURBINE ENGINEERING

ST 29005

PAGE 19 OF 23

PIPE CLAMPS (CARBON STEEL)

[illegible]

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SIGN & DATE

INVENTORY NO.

68122

P-5788

REV.
NO.
04

WORKED BY:— Rizwan

CHECKED By: Shind

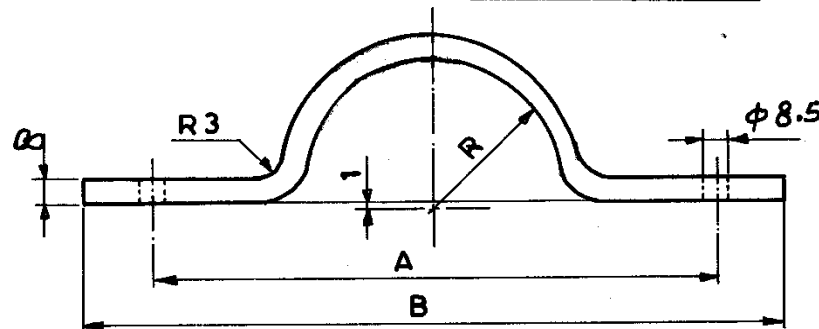


PRODUCT STANDARD
STEAM TURBINE ENGINEERING

ST 29005

PAGE 20 OF 23

PIPE CLAMPS (ALLOY STEEL)



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VAR	A	B	R	NB	DESCRIPTION	MATL.SPCN.	UNIT WT.
01	76	91	30	50	PL. 8X50X125	13 Cr Mo 44	0.400
02	88	103	37	65	PL. 8X50X150	↑	0.480
03	183	198	84	150	PL. 8X50X295		0.920
04	234	249	110	200	PL. 8X50X380		1.200
05	288	303	137	250	PL. 8X50X460		1.450
06	371	306	178	350	PL. 8X50X590		1.850
07	421	436	203	400	PL. 8X50X670		2.100
08	473	488	229	450	PL. 8X50X752		2.400
09	523	538	254	500	PL. 8X50X824		2.600
10	626	644	305	600	PL. 8X50X990		3.000
11	123	138	54	100	PL. 8X50X200		0.630
12	129	144	57	100	PL. 8X50X210		0.660
13	174	189	80	150	PL. 8X50X282		0.900
14	339	354	162	300	PL. 8X50X540		1.700
15	365	380	175	350	PL. 8X50X580		1.820
16	569	584	280	550	PL. 8X50X910		2.860
17	104	119	44	80	PL. 8X50X166		0.520
18	156	171	70	125	PL. 8X50X248	↓	0.78
19	730	745	356	700	PL. 8X50X1150	13 Cr Mo 44	3.310

SIGN & DATE

INVENTORY NO.

22/6/09

P-5788

REV. NO. 04

WORKED BY:- *Rizwan*CHECKED BY:- *Kundan*



PRODUCT STANDARD
STEAM TURBINE ENGINEERING

ST 29005

PAGE 22 OF 23

SIGN & DATE

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INVENTORY No.

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SIGN & DATE

INVENTORY No.

22/6/89

P-5788

FIELD QUALITY PLAN :-

SL NO	COMPONENT/ OPERATION	CHARACTERISTIC CHECKED	CAT	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
02	APPLICATION	Surface cleanliness	MA	Visual	Random	Specification	Specification	Log Sheet	Surface shall be free from dirt, rust, scale, oil etc. and dried.
		Insulation material appearance.	MA	-do-	-do-	-do-	-do-	-do-	Material shall be uniform and free from cracks, voids etc.
		Binding wires/ Bands spacing	MA	-do-	-do-	Appd. drg & specif.	Appd. drg & specif.	-do-	
		Wire netting dimensions and location.	MA	-do-	-do-	-do-	-do-	-do-	
		Wire ends	MA	-do-	-do-	-do-	-do-	-do-	Wire ends shall be twisted and bent inside.
		Supports arrangements & spacing	MA	-do-	-do-	-do-	-do-	-do-	
		Expansion joints spacing.	MA	-do-	-do-	-do-	-do-	-do-	
		Insulation thickness test	MA	Physical	10%	IS 7413 & Specf.	IS 7413 & Specf.	-do-	
		Uniformity of thickness	MA	-do-	-do-	-do-	-do-	-do-	
		Bulk density test	MA	-do-	-do-	-do-	-do-	-do-	

Contd. on page 23

WORKED BY :- *Prigam*REV. NO.
04CHECKED BY :- *[Signature]*



DRG.NO.412114D4000
REV.NO. 00
DATE: 11.06.2015

THERMAL INSULATION SCHEDULE FOR TG INTEGRAL PIPING

PROJECT: 270 MW

PROJECT STAGE: CONTRACT

SPEC.NO. ST29005 REV 04

DESIGN PARAMETERS:

COLD FACE TEMPERATURE: 60 DEG C

AMBIENT TEMPERATURE: 40 DEG C

EMISSIVITY OF AL. SHEET: 0.2

WIND VELOCITY: 1 M/S

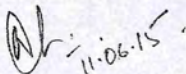
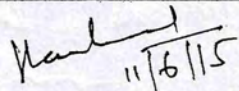
MATERIALS:

INSULATION MATERIAL: LIGHTLY RESIN BONDED ROCKWOOL
AS PER IS: 8183

DENSITY: 1. 100 KG/M³ FOR HOT FACE TEMP. UPTO 400°C
2. 150 KG/M³ FOR HOT FACE TEMP. ABOVE 400°C

CLADDING MATERIAL: ALUMINIUM SHEET

DESIGN HEAT LOSS AT
CLADDING SURFACE: 180 KCAL/SQM hr

Prepared by	Approved by
 11.06.15	 11/6/15
Navneet Chakrapani Engr- PED	S K Gupta SDGM/PED

DATA OF THERMAL INSULATION FOR TURBINE INTEGRAL PIPING

DOC.NO. 41211450001

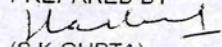
REV.00

DATE: 27/01/05

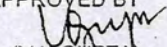
250 MW STEAM TURBINE PIPING

SL. NO.	SYSTEM DESCRIPTION	O.D. OF PIPE (MM)	HOT FACE TEMP. (DEG.C)	APPROX. LENGTH (M)	VALVES IN LINE		PIPE FITTINGS		
					NOS	SIZE NB (MM)	FLANGES (NOS)	BENDS (NOS)	ELBOWS (NOS)
SEAL STEAM									
01		21.3	200	12	-	-	-	2	-
02		26.9	470	88	-	-	-	22	-
03		33.4	200	30	-	-	1	7	-
04		33.4	470	85	-	-	-	21	-
05		60.3	470	16	-	-	-	-	4
06		73	330	30	3	65	-	-	2
07		88.9	330	35	-	-	2	-	17
08		88.9	460	5	-	-	-	-	2
09		114.3	100	42	3	-	3	-	16
10		114.3	330	49	-	-	-	-	24
11		114.3	500	15	-	-	-	-	3
12		141	330	25	3	125	-	-	12
13		168.3	200	20	7	150	-	-	12
14		168.3	330	13	1	150	1	-	14
15		168.3	460	16	-	-	-	-	6
16		219.1	200	2	-	-	-	-	-
17		219.1	330	20	1	200	2	-	3
18		219.1	460	5	-	-	2	-	3
19		273	200	60	-	-	-	-	-
20		273	330	18	1	250	-	-	7
21		323.9	330	11	2	300	-	-	6
22		508	330	3	1	400	-	-	-
TURBINE DRAINAGE SYSTEM.									
01		33.4	400	170	-	-	-	28	-
02		33.4	535	100	18	25	-	16	-

PREPARED BY


(S.K.GUPTA)

APPROVED BY


(V.K.GUPTA)

DATA OF THERMAL INSULATION FOR TURBINE INTEGRAL PIPING

250 MW STEAM TURBINE PIPING

DOC.NO. 41211450001

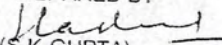
REV.00

DATE: 27/01/05

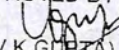
SL. NO.	SYSTEM DESCRIPTION	O.D. OF PIPE (MM)	HOT FACE TEMP. (DEG.C)	APPROX. LENGTH (M)	VALVES IN LINE		PIPE FITTINGS		
					NOS	SIZE NB (MM)	FLANGES (NOS)	BENDS (NOS)	ELBOWS (NOS)
03		48.3	535	85	6	40	-	14	-
04		60.3	535	90	10	50	-	14	-
05		73	345	32	-	-	-	6	-
06		168.3	500	2	-	-	-	-	-
07		323.9	200	4	-	-	-	-	-
08		323.9	500	4	-	-	-	-	1
09		610	450	15	-	-	-	-	2

THIS BOM MAY VARY BY +/- 5%.

PREPARED BY


(S.K.GUPTA)

APPROVED BY


(V.K.GUPTA)

MANUFACTURER'S NAME AND ADDRESS		STANDARD QUALITY PLAN				TO BE FILLED BY BHEL		TO BE FILLED BY BHEL	
BHEL		VENDOR'S NAME AND ADDRESS		THERMAL INSULATION FOR TURBINE INTEGRAL PIPING		QP. NO.:	QA/BE/QP/316/SQP	REMARKS	
		ITEM		AS PER DRWAING		REV. NO.:	00		
		DRG. NO.:		AS PER DRWAING					
		REV. NO.:		AS PER DRWAING					
		SPEC. NO.:		ST 29005					
REV. NO.:		04		Page 1 of 2					
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY
1	2	3	4	5	6	7	8	9	10
1									
1.1									
1.1.1									
1.1.2									
1.1.3									
1.1.4									
1.1.5									
1.1.6									
1.1.7									
1.1.8									
1.1.9									
1.1.10									
1.1.11									
1.1.12									
1.1.13									
1.1.14									
2.0	Sheathing Material-Aluminium Sheet (Gr.19000)								
2.1									
2.2									
2.3									
2.4									
3.0	Galvanised Steel / Stainless Steel Wire for Netting, Binding, Stitching & Lacing								
3.1									

1.0	Bonded mineral / Rockwell mattresses									
1.1	Routine tests									
1.1.1	Chemical Composition	Major	Chemical	1 Sample/lot	Vendor's Std	TC	Vendor's Std	TC	P	
1.1.2	Bulk Density	Major	Physical	As Per IS 8183	IS 3144	TC	IS 8183	TC	P	
1.1.3	Recovery After Compression	Major	Physical	-do-	IS 8183	TC	IS 8183	TC	P	
1.1.4	Shot Content	Major	Chemical	-do-	IS 3144	TC	IS 8183	TC	P	
1.1.5	Moisture Content and Moisture Absorption	Major	Physical	-do-	IS 3144	TC	IS 8183	TC	P	
1.1.6	Incombustibility	Major	Thermal	-do-	IS 3144	TC	IS 8183	TC	P	
1.1.7	Thermal Conductivity or K Value	Major	Thermal	As Per IS 3144	IS 3346	TC	IS 8183	TC	P	Refer Note:1
1.1.8	Sulphur Content	Major	Chemical	As Per IS 8183	IS 3144	TC	IS 8183	TC	P	
1.1.9	Dimensional check	Major	Measurement	-do-	IS 3144	IR	IS 8183	IR	P	
1.1.10	Fibre Diameter	Major	Measurement	-do-	IS 3144	IR	IS 8183	IR	P	
1.1.11	Resistance to Vibration	Major	Physical	-do-	IS 3144	TC	IS 8183	TC	P	
1.1.12	Heat Resistance	Major	Physical	-do-	IS 3144	TC	IS 8183	TC	P	
1.1.13	Alkalinity	Major	Chemical	-do-	IS 3144	TC	IS 8183	TC	P	
1.1.14	Corrosive Attack / Chloride Content	Major	Chemical	-do-	IS 3144	TC	IS 8183	TC	P	
2.0	Sheathing Material-Aluminium Sheet (Gr.19000)									
2.1	Chemical Composition	Major	Analysis	As Per IS 737	IS 737	TC	IS 737	TC	P	
2.2	Tensile Test & Elongation	Major	Physical	-do-	IS 737	TC	IS 737	TC	P	
2.3	Bend test	Major	Physical	-do-	IS 737	TC	IS 737	TC	P	
2.4	Gauging / Thickness	Major	Measurement	-do-	ST 29005	IR	ST 29005 / Appd BOM	IR	P	
3.0	Galvanised Steel / Stainless Steel Wire for Netting, Binding, Stitching & Lacing									
3.1	Chemical Composition	Major	Analysis	As Per IS 6528	IS 6528/IS 280	TC	IS 6528 / IS 280	TC	P	

MANUFACTURER/SUBCONTRACTOR		FOR CUSTOMER USE		APPROVED BY	
		LEGEND: D:RECORDS IDENTIFIED WITH (✓) 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER / SUBCONTRACTOR B: BHEL; / NOM. INSPECTION AGENCY N: CUSTOMER TC: TEST CERTIFICATE IR: INSPECTION REPORT COC: CERTIFICATE OF CONFORMANCE INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER		16.06.15	

MANUFACTURER'S NAME AND ADDRESS			STANDARD QUALITY PLAN					TO BE FILLED BY BHEL		TO BE FILLED BY BHEL	
BHEL	VENDOR'S NAME AND ADDRESS	ITEM	THERMAL INSULATION FOR TURBINE INTEGRAL PIPING		QP. NO.:	QA/BE/QP/316/SQP		ACCEPTANCE NORMS	FORMAT OF RECORDS		REMARKS
					REV. NO.:	00					
		DRG. NO.:		AS PER DRWAING							
		REV. NO.:		AS PER DRWAING							
		SPEC. NO.:		ST 29005							
		REV. NO.:		04							
				Page 2 of 2							
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	M B N	10	11

						/ IS 280											
3.2			Dimensions (Size of netting & Dia / Gauge of Wire)	Major	Measurement	-do-	ST 29005	ST 29005 / Appd BOM	IR	V	P	V					
3.3			Tensile Test & Elongation	Major	Physical	-do-	IS 6528/ IS 280	IS 6528 / IS 280	TC	V	P	V					
3.4			Wrapping Test	Major	Physical	-do-	IS 6528/ IS 280	IS 6528 / IS 280	TC	V	P	V					
3.5			Bend Test	Major	Physical	-do-	IS 6528 / IS 280	IS 6528 / IS 280	TC	V	P	V					
3.6			Mass of Coating for GI Wire	Major	Measurement	-do-	IS 280	IS 280	TC	V	P	V					
4.0	Straps, Bands & Screws																
4.1			Dimensional	Major	Measurement	--	ST 29005	ST 29005	COC	-	P	-					
4.2			Visual	Major	Physical	--	ST 29005	ST 29005	COC	-	P	-					
5.0	Packing / Marking & Storage																
5.1			Identification (Batch no., Thickness, Density) & Marking	Major	Visual	100%	ST 29005	ST 29005	IR	-	p	-					
5.2			Packing & Despatch	Major	Visual	100%	ST 29005	ST 29005	IR	-	p	-					

NOTE: 1. Thermal Conductivity or 'K' Value test report on the samples identified and tested in last one year shall be reviewed by BHEL / BHEL nominated inspection agency. However samples for Thermal Conductivity or 'K' Value test shall be identified by BHEL / BHEL nominated inspection agency from **each lot** and test shall be conducted at CBRI Roorkee / IIT Chennai / PIBCO, NEW DELHI / M/s ISOLLOYD ENGINEERING TECHNOLOGIES LIMITED, BADDI . The test report of the same shall be submitted to BHEL for review and acceptance.

			FOR CUSTOMER USE		APPROVED BY <i>[Signature]</i> 16.06.15 Aarti Meena
MANUFACTURER/S UBCONTRACTOR		LEGEND: D: RECORDS IDENTIFIED WITH (✓) 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER / SUBCONTRACTOR B: BHEL / NOM. INSPECTION AGENCY N: CUSTOMER TC: TEST CERTIFICATE IR: INSPECTION REPORT COC: CERTIFICATE OF CONFORMANCE INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER			

Duvvuri
 16.06.15
 Aarti Meena
 Engineer (QA-B)