

PRICE BID



**Tender Notice No.
HY/ES/NALCO#5/MECH/13**

For

**Mechanical jobs of Erection, Testing, Pre-commissioning
and commissioning of 1X19.5 MW BPTG at NALCO,
DAMANJODI, ODISHA**

**Tender Submission on or before 31-10- 2013 at 11:00Hrs
Drop Box at Vendor Complex in BHEL Admin Block**

Tender opening Date 31-10-2013 at 13:30Hrs

**Addl General Manager
External Services Department
02 Annexe, 02nd Floor,**

**Bharat Heavy Electricals Limited
Ramachandrapuram, Hyderabad – 502 032
Phone: 040-2318 3415/3416, 2318 3409**

BHARAT HEAVY ELECTRICALS LTD- HYDERABAD
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SPEC NO.201:PROJECT INFORMATION

One set of 1x19.5 MW BPTG with auxiliaries and piping etc. are to be erected, tested and commissioned at NALCO, Damanjodi.

PROJECT DATA

1. **Project Authority** : M/s National Aluminium Company Ltd.
2. **Name of the Project** : 19.5 MW BPTG, NALCO, Damanjodi.
3. **Location of Site** : Damanjodi, Odisha
4. **Nearest Railway Station** : Vizag
5. **Nearest Air Port** : Vizag

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SPEC NO. 202: SCOPE OF WORK

1. It is not the intention in this specification to specify each and every activity in the scope of work. However broadly they are brought out in this section and specification nos. 101, 102 & 103 of this Tender Schedule. Bidder may kindly note the same. For the completeness of the job, bidder to note that all activities to complete the erection, testing and commissioning shall be deemed to have been included. Any minor modifications including strengthening by additional welding etc., if required on the equipment to be erected shall be considered as part of the erection and shall not call for any extra payment. Any rectification work on parting planes, machined surfaces shall also be deemed to have been included in the scope of work.

2. The bidder shall quote "FIRM" Prices only.

The following terms of payment will be operated

- a. **80 % payment against running bills.**
- b. **5% on submission of Protocols.**
- c. **10 % up on final commissioning and material reconciliation.**
- d. **Balance 5% on completion of guarantee period of one year from commissioning or against bank guarantee.**
- e. **Security deposit will be deducted as per rules and paid on completion of guarantee period.**
- f. **Service Taxes will be paid extra as per the prevailing government rates on submission of necessary documents.**

3. For equipment erection the bidder shall quote a tonnage rate. The payment shall be on actual net weight of equipment erected. The terms of payment shall be strictly governed by specification No. 204. Any deviation to the terms of payment will be evaluated in terms of loading on the prices. The tonnage indicated is only approximate and may vary. Bidder shall agree to keep the rates valid for any variation of quantity.

4. Erection, testing, pre-commissioning and commissioning of the equipment using contractor's own tools and tackles, consumables, including electrodes, skilled and unskilled manpower etc., as per the detailed description and nature of work as enumerated in tender schedule and this specification, includes all handling and transportation of materials from storage yard and site to pre-assembly area and place of erection and other incidental works required prior to and during pre-fabrication, pre-assembly, erection, testing, pre-commissioning and commissioning of entire system. The scope shall include necessary chipping and dressing of foundations up to a minimum of 50 mm till the required accuracy are obtained for blue matching with the packer plates.

DETAILS OF THE EQUIPMENTS TO BE ERECTED ARE INDICATED IN THE PRICE SCHEDULE SL. No. 1.01.00 SPEC NO 204

Unit rates quoted for metric ton includes the following activities of the works:

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1. **ERECTION**
2. **TESTING**
3. **PRE-COMMISSIONING**
4. **HYDRAULIC TESTING OF EQUIPMENT AND PIPING**
5. **PAINTING (SUPPLY AND APPLICATION)**

5. During the erection, testing, pre-commissioning and commissioning works, some repairs, rectification and modifications etc. are likely to occur. Bidder shall note that they are part of scope of job. The bidder while quoting the rates shall take the above in consideration and no extra payment will be entertained on this account.

NOTE:

Examples for repairs, rectification, modifications etc.

1. Mismatching of exhaust hood flanges,
 2. Machine base plate hole enlarging for adjustments,
 3. Supports welding to equipment and rectification as per site condition,
 4. Matching of filter section,
 5. Additional chipping of foundation,
 6. Changing of parts when they fail during the tests etc.,
 7. Re-reaming of Coupling bolts holes etc.
 8. Any parting plane blue matching etc.,
 9. Providing of small opening on oil tanks & mounting of oil pumps. These points are only few examples, similar types of other works are also likely to come which are incidental to the nature of erection work.
6. For any extra equipment & structural the approved unit rates of erection only will be applicable, and this will not be treated as extra works for payment on man hour rates basis.
7. For piping, bidder shall quote a rate per joint / running length separately for:
- a. Fit up and welding,
 - b. Radiography

As given in the specification No. 204 (Price Tabulation). Pipe size, welding type details and no. Of joints (approximate) are given for pipe sizes above 48.3 mm Nb. Bidder shall agree to keep the rates valid for any quantity variation.

8. For piping erection, the contractor shall quote rate per meter length. The piping erection includes all types of piping hangers, supports, fittings (tapings points for instruments, vents and drains as applicable) and Hydraulic test of piping, painting etc. For pipe sizes 48.3 mm and less erection includes fit up and welding, radiography,

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Stress Relieving, etc also where ever required.(Size dia 48.3 mm and less pipes are site routed). Apart from this, the bidder is required to include the jobs of degreasing, mechanical cleaning, steam blowing, oil flushing, pickling and washing, Alkali flushing, cardboard blasting and sand blasting etc. including consumables in the Unit rates quoted and no separate payment will be considered for these jobs. All pipe sizes and corresponding lengths are indicated in tabular column of specification No. 204. Bidder should agree to keep the rates valid for any quantity variation.

The Bidder shall arrange to obtain all approval with reference to IBR and deal with IBR directorate / Local IBR authority for approval of drawings, qualification of welders field inspection of materials, joints, radiography and hydraulic test etc. The price offered by the bidder shall include the expenditure towards the above including incidentals of any kind. However the statutory fees shall be paid by BHEL.

NOTE: The rates shall be quoted only in the format enclosed. Deviation in the form of addition / deletion / omission in the format is not acceptable and may result in rejection of bid.

9. For thermal insulation (application only) bidder shall quote a unit rate per Sq. meter for equipment and per meter length for piping including pipe fittings like elbows, tees, reducers, flanges and Valves etc. The thermal insulation job shall be carried out as per the specification No. 51765, 56276 and 4-38101-01000 and includes aluminum cladding, fixing arrangements of thermal insulation etc including all consumables. Bidder shall agree for any variation of quantity without change of rate. Bidder to note that material shall be supplied by BHEL.
10. All piping will be supplied to site in commercial lengths. Fabrication and edge preparation of all piping including welding of stubs on piping for instrumentation tap off points, and providing drains, vents and any other connection points shall be included in the contractor's scope. The unit rates indicated in table 1.04.00 should include the complete scope.
11. Any changes, modifications, involving rerouting of piping, cutting, repairing and re-welding, the payment shall be on the joints basis only as per the approved rates and not at man-hour rates. No separate payments are envisaged for jobs involving cutting of already completed joints.
12. Bidder has to carry out mechanical cleaning, pickling, acid cleaning, alkali flushing, cardboard blasting, etc. as per the guidelines given in the documents enclosed. No separate payments are envisaged for these jobs. The Bidder shall include for these jobs in the unit rates quoted.

Bidder shall also carry out steam blowing in stages (approx. 4 to 5) as per the site requirements. Steam blowing is to be done by installing spool pieces,

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aluminum target plates elbows, necessary temporary supports etc. temporarily. After completion of steam blowing nozzles, orifices valves and other specialties etc. have to be (restoration work) installed by cutting / welding of pipes. The permanent supports shall be installed later. The contractor to note that the restoration of pipelines, valves & specialties, etc.(upon completion of steam blowing activity) shall form a part of the scope of work. No separate payments for these activities are earmarked. Bidder to note this aspect & accordingly bid for these B.O.Q, given in the Price Schedule.

13. The Bidder to note that they have to provide commissioning assistance as per the site requirement during commissioning. No separate payments are envisaged and the unit rates quoted for erection and commissioning are deemed to have taken care of this requirement. **Commissioning is deemed to be completed on successful run of the unit for 72 hours continuously.**
14. **PROTOCOL & DOCUMENTATION:**
Bidder shall prepare all the necessary documents/ protocol in connection to equipment erection, testing, piping erection, radiography film, joints inspection reports, as built drawings, reports and other relevant document in the format approved by BHEL and/or Client/ Consultant.
15. **PAINTING:**
The Bidder shall consider total five (5) coats (including the primer) of painting for the items to be erected i.e. equipment, piping and auxiliaries, etc for the purpose of quotation and the work is subject to inspection / approval by BHEL's client. Pipes are to be grid blasted before painting. Supply and Application of Paints are included in contractor scope. Expenditure towards this job shall be included in the unit rates quoted and no separate payments are envisaged.
16. **POWER POINT:**
Bidder to kindly note that the construction power and water will be provided at single point at site within reasonable distance for the job. The successful bidder shall have to at his own cost provide necessary distribution cabling etc by him. The Bidder has to ensure that the statutory regulations are met with while executing the work.
17. **GROUTING MATERIAL:**
The rate for equipment erection and commissioning shall include the cost of grout cement for the equipment and no separate payments are envisaged in the contract. For information of bidders the requirement of cement will be approximately 6.0 Tons for main equipment. All materials etc shall be

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arranged by the bidder at his cost. Grouting material specification is included in the annexure.

18. Bidder to Note that:

Turbine and Generator will be supplied Assembled. Contractor shall arrange required crane services with suitable capacities for placing the heavy items like Turbine, Generator on their foundations. No extra payment is allowed for this.

19. ACCEPTANCE OF THE TENDER

Acceptance of the tender will be intimated to the successful bidder through a letter of intent / Fax of intent. The bidder shall then be required to execute an agreement annexed at the end (Annexure I & II), within seven (7) days from the date of issue of the letter of Intent. In the event of failure on the part of the contractor to sign the agreement within the specified time, the earnest money deposit shall be forfeited and the acceptance of his tender shall be considered as withdrawn.

20. CONTENTS OF THE CONTRACT DOCUMENTS

The letter of submission of tender, notice inviting tender, scope of inquiry, Instruction to bidder, general conditions of contract, general and technical specifications, tender proposal forms, tender drawings, contract form between the bidder and BHEL, forms of different deeds (as applicable), amendments/ addenda / corrigenda and interpretations/ clarifications as issued by BHEL subsequent to issues of tender documents (if any), bidder's tender No. dated all correspondences, minutes of meetings, agreed variations etc., between the bidder and BHEL till issue of the letter of intent by BHEL, agreed quality assurance program and time schedule network together with the letter of intent issued by BHEL, all pertaining to this tender, agreed man power deployment together with their technical qualifications etc., shall form the contract.

21. The contract document shall be containing, the scope of inquiry, general and technical specifications and amendments / addenda / corrigenda, interpretation / clarifications issued by BHEL on technical aspects, as well as all correspondences, minutes of meetings etc., between the bidder and BHEL on technical aspects, agreed quality assurance programme, time schedules network, and the rest of documents listed in clause 20 above.

22. The Bidder shall prepare , one (1) original of Contract as described in clauses 19, 20 & 21 above within seven (7) days of signing the contract agreement and shall arrange six (6) true copies of the contract documents free of charge within 4 weeks from the date of signing the contract agreement. After retaining one copy with them for their use, the contractor shall hand over remaining 5 copies to BHEL for their use at site & headquarters including their finance department.

23. List of Documents enclosed:

- | | |
|----------------------------------|------------------------|
| 1. Site Erection notes | : 16 sheets |
| 2. Plant Standard (Welding ends) | :HY 0620599 (6 Sheets) |
| 3. Specification for insulation | : (5 Sheets) |
| 4. Standard for Grouting | :TC-9-1900 (3 Sheets) |

SAFETY:

Safety during job execution is of paramount importance to us. Bidder's representatives shall adhere to the safety norms and requirements as mentioned in tender schedule which forms an integral part of our order. Also an annexure covering, engineering standards and practices prevalent in our works, is enclosed for reference. Since the erection work shall be done close to the operating plant, necessary safety /work permits shall be taken from our authorized engineers before commencement of any job. Bidder shall appoint and inform us the name, & qualification of the person, from your team, who shall be responsible for safety during job execution. For safety related issues, he will work in close coordination with Safety Officer authorized by customer.

SAFETY REGULATIONS

Bidder shall ensure trained men attend work in safe apparel and are provided with requisite safety appliances, safe tools/tackles etc. thereby ensuring safe working conditions. The work shall be carried out under bidder's competent supervision only and duly tested tools/tackles/appliances as per statutes in force shall be used and a copy of their test certificates shall be furnished to us on demand by our engineers. Bidder be solely responsible and shall ensure that all safety requirements under relevant statutes in force are complied with. In case of failure to observe the above regulations while undertaking the job safety officer/ engineer in charge can order for stopping of work.

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SPEC NO. 203: ERECTION SCHEDULE

Schedule for Erection and Commissioning of 1X19.5 MW BPTG Auxiliaries and piping shall be tentatively as follows:

- | | | |
|--------------------------------------|----------|------------------|
| 1. Site opening | : | Dec, 2013 |
| 2. Commissioning of Turbine | : | Aug, 2014 |
| 3. Load run and stabilization | : | Sep, 2014 |

For the purpose of contract, the period shall be taken as 9 months. Completion of the work shall be as per BHEL Bar Charts revised from time to time. In order to expedite the work, the contractor has to deploy manpower on two-shift basis during erection and during pre-commissioning and commissioning period manpower should be provided round the clock basis as per site requirement **without any extra cost to BHEL.**

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SPEC NO. 204

1.01.00 ERECTION, TESTING COMMISSIONING AND PAINTING

1.01.00 ERECTION, TESTING COMMISSIONING AND PAINTING APPLICATION				
S.NO	Description	QUANTITY		TOTAL WT
		NO OF ITEMS/DES	WT	
1.01.01	Turbine Assembly	1	27000	27000
1.01.02	Gear Box Assembly	1	11000	11000
1.01.03	Generator Assembly	1	50600	50600
1.01.04	Generator Foundation items	1 set	7000	7000
1.01.05	Generator Air Cooler Duct	1	6100	6100
1.01.06	Generator Air cooler	6	960	5760
1.01.07	Lub oil tank	1	4810	4810
1.01.08	Overhead Lube Oil tank	1	2200	2200
1.01.09	Duplex filters	1	450	450
1.01.10	Main / Aux. Lube Oil Pump Assembly	2	1150	2300
1.01.11	Emergency Oil Pump Assembly	1	610	610
1.01.12	Jacking Oil Pump Assembly	1	650	650
1.01.13	Lube Oil Accumulators	1 set	310	310
1.01.14	Oil Vapour Extn Fan	2	100	200
1.01.15	Lube Oil Centrifuge	1	1500	1500
1.01.16	Transfer Oil Pump	1	200	200
1.01.17	Drain Oil Tank	1	1130	1130
1.01.18	Gov. Oil Console	1	800	800
1.01.19	Bed Plate Under Exhaust Hood	2	850	1700
1.01.20	Stop Valve Assembly	1	300	300
1.01.21	HP Servomotor Assembly	1	300	300
1.01.22	LP Servomotor Assembly	1	300	300
1.01.23	Lube Oil Cooler	2	3300	6600
1.01.24	Valves	1 Set	6000	6000
1.01.25	Condensate Collection Tank	1	1300	1300
1.01.26	Gland Steam Condenser	1	5500	5500
1.01.27	QCNRV	2	900	1800

1.01.28	Structurals	1 Set	5000	5000
Total				151420
Rate per Kg				
1.01.00 Total Amount				

Note: The above rates are exclusive of govt. service taxes, which are to be paid extra.

Notes:

1. The Turbine and Generator will be dispatched to site in assembled conditions. Bidders to note that turbine, Gear Box, Generator erection include the placement of turbine, Gear Box and generator at site in position, with proper foundation preparation and grouting with Conbextra GP-2 Cement.

Contractor shall arrange required crane services with suitable capacities for placing the heavy items like Turbine, Generator which are being sent in assembled condition on their foundations. No extra payment is allowed for this.

2. In case of any discrepancy in above component weights, the item weights in packing list shall be taken as final.

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1.02.00 Pipe fit up and welding

S.No	PIPE SIZE	MATL.	TYPE OF WELD	No. of Joints	Rate (Rs)	AMOUNT (Rs)
IBR PIPING-Alloy Steel						
1.02.01	0.5" Sch 80	P11	TIG+SMAW	7.00		
1.02.02	1" Sch 80	P11	TIG+SMAW	277.00		
1.02.03	1.5" Sch 80	P11	TIG+SMAW	7.00		
1.02.04	2" Sch 160	P11	TIG+SMAW	26.00		
1.02.05	3" Sch 40	P11	TIG+SMAW	3.00		
1.02.06	4" Sch 40	P11	TIG+SMAW	23.00		
1.02.07	6" Sch 40	P11	TIG+SMAW	3.00		
1.02.08	8" Sch 100	P11	TIG+SMAW	17.00		
1.02.09	8" Sch 20	P11	TIG+SMAW	3.00		
1.02.10	10" Sch 80	P11	TIG+SMAW	73.00		
1.02.11	12" Sch 40	P11	TIG+SMAW	3.00		
1.02.12	20" Sch 80	P11	TIG+SMAW	23.00		
IBR PIPING-Carbon Steel						
1.02.13	0.5" Sch 80	A106GRB	TIG+SMAW	3.00		
1.02.14	1" Sch 80	A106GRB	TIG+SMAW	365.00		
1.02.15	1.5" Sch 80	A106GRB	TIG+SMAW	56.00		
1.02.16	3" Sch 160	A106GRB	TIG+SMAW	33.00		
1.02.17	4" Sch 40	A106GRB	TIG+SMAW	10.00		
1.02.18	8" Sch 20	A106GRB	TIG+SMAW	10.00		
1.02.19	10" Sch 40	A106GRB	TIG+SMAW	3.00		
1.02.20	12" Sch 20	A106GRB	TIG+SMAW	3.00		
1.02.21	12" Sch 40	A106GRB	TIG+SMAW	76.00		
1.02.22	14" Sch 30	A106GRB	TIG+SMAW	46.00		
1.02.23	16" Sch 30	A106GRB	TIG+SMAW	3.00		
1.02.24	20" Sch 10	A106GRB	TIG+SMAW	20.00		
1.02.25	24" Sch 20	A106GRB	TIG+SMAW	40.00		
NON-IBR PIPING						
1.02.26	0.25" Sch 80	A106GRB	TIG+SMAW	17.00		
1.02.27	0.5" Sch 80	A106GRB	TIG+SMAW	141.00		

1.02.28	0.75" Sch 80	A106GRB	TIG+SMAW	22.00			
1.02.29	1" Sch 80	A106GRB	TIG+SMAW	424.00			
1.02.30	1.5" Sch 80	A106GRB	TIG+SMAW	33.00			
1.02.31	2" Sch 80	A106GRB	TIG+SMAW	111.00			
1.02.32	2" Sch 40	A106GRB	TIG+SMAW	28.00			
1.02.33	3" Sch 160	A106GRB	TIG+SMAW	33.00			
1.02.34	3" Sch 40	A106GRB	TIG+SMAW	110.00			
1.02.35	4" Sch 40	A106GRB	TIG+SMAW	166.00			
1.02.36	6" Sch 40	A106GRB	TIG+SMAW	220.00			
1.02.37	8" Sch 20	A106GRB	TIG+SMAW	101.00			
1.02.38	10" Sch 20	A106GRB	TIG+SMAW	58.00			
1.02.39	12" Sch 20	A106GRB	TIG+SMAW	22.00			
1.02.40	6" Sch 10S	SS321	TIG	17.00			
1.02.41	4" Sch 10S	SS321	TIG	77.00			
1.02.42	3" Sch 10S	SS321	TIG	77.00			
1.02.43	2" Sch 20S	SS321	TIG	72.00			
1.02.44	1.5" Sch 40S	SS321	TIG	83.00			
1.02.45	1" Sch 40S	SS321	TIG	303.00			
1.02.46	0.75" Sch 40S	SS321	TIG	138.00			
1.02.47	1/2" Sch 40S	SS321	TIG	127.00			
1.02.48	0.25" Sch 40S	SS321	TIG	39.00			
1.02.00	TOTAL						

Note: The above rates are exclusive of govt. service taxes, which are to be paid extra.

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1.03.00 Radiography of piping

S.No	PIPE SIZE	MATL.	TYPE OF WELD	No. of Joints	Rate (Rs)	AMOUNT (Rs)
IBR PIPING-Alloy Steel						
1.03.01	0.5" Sch 80	P11	TIG+SMAW	7.00		
1.03.02	1" Sch 80	P11	TIG+SMAW	233.00		
1.03.03	1.5" Sch 80	P11	TIG+SMAW	7.00		
1.03.04	2" Sch 160	P11	TIG+SMAW	26.00		
1.03.05	3" Sch 40	P11	TIG+SMAW	3.00		
1.03.06	4" Sch 40	P11	TIG+SMAW	23.00		
1.03.07	6" Sch 40	P11	TIG+SMAW	3.00		
1.03.08	8" Sch 100	P11	TIG+SMAW	17.00		
1.03.09	8" Sch 20	P11	TIG+SMAW	3.00		
1.03.10	10" Sch 80	P11	TIG+SMAW	73.00		
1.03.11	12" Sch 40	P11	TIG+SMAW	3.00		
1.03.12	20" Sch 80	P11	TIG+SMAW	23.00		
IBR PIPING-Carbon Steel						
1.03.13	0.5" Sch 80	A106GRB	TIG+SMAW	1.00		
1.03.14	1" Sch 80	A106GRB	TIG+SMAW	73.00		
1.03.15	1.5" Sch 80	A106GRB	TIG+SMAW	11.00		
1.03.16	3" Sch 160	A106GRB	TIG+SMAW	7.00		
1.03.17	4" Sch 40	A106GRB	TIG+SMAW	2.00		
1.03.18	8" Sch 20	A106GRB	TIG+SMAW	2.00		
1.03.19	10" Sch 40	A106GRB	TIG+SMAW	1.00		
1.03.20	12" Sch 20	A106GRB	TIG+SMAW	1.00		
1.03.21	12" Sch 40	A106GRB	TIG+SMAW	15.00		
1.03.22	14" Sch 30	A106GRB	TIG+SMAW	9.00		
1.03.23	16" Sch 30	A106GRB	TIG+SMAW	1.00		
1.03.24	20" Sch 10	A106GRB	TIG+SMAW	4.00		
1.03.25	24" Sch 20	A106GRB	TIG+SMAW	8.00		
NON-IBR PIPING						
1.03.26	0.25" Sch 80	A106GRB	TIG+SMAW	2.00		
1.03.27	0.5" Sch 80	A106GRB	TIG+SMAW	14.00		
1.03.28	0.75" Sch 80	A106GRB	TIG+SMAW	2.00		
1.03.29	1" Sch 80	A106GRB	TIG+SMAW	43.00		

1.03.30	1.5" Sch 80	A106GRB	TIG+SMAW	3.00			
1.03.31	2" Sch 80	A106GRB	TIG+SMAW	11.00			
1.03.32	2" Sch 40	A106GRB	TIG+SMAW	3.00			
1.03.33	3" Sch 160	A106GRB	TIG+SMAW	3.00			
1.03.34	3" Sch 40	A106GRB	TIG+SMAW	11.00			
1.03.35	4" Sch 40	A106GRB	TIG+SMAW	17.00			
1.03.36	6" Sch 40	A106GRB	TIG+SMAW	22.00			
1.03.37	8" Sch 20	A106GRB	TIG+SMAW	10.00			
1.03.38	10" Sch 20	A106GRB	TIG+SMAW	6.00			
1.03.39	12" Sch 20	A106GRB	TIG+SMAW	2.00			
1.03.40	6" Sch 10S	SS321	TIG	2.00			
1.03.41	4" Sch 10S	SS321	TIG	8.00			
1.03.42	3" Sch 10S	SS321	TIG	8.00			
1.03.43	2" Sch 20S	SS321	TIG	8.00			
1.03.44	1.5" Sch 40S	SS321	TIG	9.00			
1.03.45	1" Sch 40S	SS321	TIG	31.00			
1.03.46	0.75" Sch 40S	SS321	TIG	14.00			
1.03.47	1/2" Sch 40S	SS321	TIG	13.00			
1.03.48	0.25" Sch 40S	SS321	TIG	4.00			
1.03.00	TOTAL						

Note: The above rates are exclusive of govt. service taxes, which are to be paid extra.

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1.04.00 PIPING ERECTION INCLUDING SPRING HANGERS, SUPPORTS, HYDRAULIC TESTING AND PAINTING

SL.NO.	Pipe size	Matrl	Length Mtrs	Rate	Amount Rs.
IBR PIPING-Alloy Steel					
1.04.01	0.5" Sch 80	P11	13.00		
1.04.02	1" Sch 80	P11	512.00		
1.04.03	1.5" Sch 80	P11	13.00		
1.04.04	2" Sch 160	P11	52.00		
1.04.05	3" Sch 40	P11	7.00		
1.04.06	4" Sch 40	P11	46.00		
1.04.07	6" Sch 40	P11	7.00		
1.04.08	8" Sch 100	P11	33.00		
1.04.09	8" Sch 20	P11	7.00		
1.04.10	10" Sch 80	P11	145.00		
1.04.11	12" Sch 40	P11	7.00		
1.04.12	20" Sch 80	P11	46.00		
IBR PIPING-Carbon Steel					
1.04.13	0.5" Sch 80	A106GRB	7.00		
1.04.14	1" Sch 80	A106GRB	730.00		
1.04.15	1.5" Sch 80	A106GRB	112.00		
1.04.16	3" Sch 160	A106GRB	66.00		
1.04.17	4" Sch 40	A106GRB	20.00		
1.04.18	8" Sch 20	A106GRB	20.00		
1.04.19	10" Sch 40	A106GRB	7.00		
1.04.20	12" Sch 20	A106GRB	7.00		
1.04.21	12" Sch 40	A106GRB	152.00		
1.04.22	14" Sch 30	A106GRB	92.00		
1.04.23	16" Sch 30	A106GRB	7.00		
1.04.24	20" Sch 10	A106GRB	40.00		
1.04.25	24" Sch 20	A106GRB	79.00		
NON-IBR PIPING					
1.04.26	0.5" Sch 80	A106GRB	178.00		
1.04.27	0.75" Sch 80	A106GRB	13.00		
1.04.28	1" Sch 80	A106GRB	528.00		
1.04.29	2" Sch 80	A106GRB	222.00		

1.04.30	2" Sch 40	A106GRB	13.00		
1.04.31	3" Sch 160	A106GRB	66.00		
1.04.32	3" Sch 40	A106GRB	66.00		
1.04.33	4" Sch 40	A106GRB	139.00		
1.04.34	6" Sch 40	A106GRB	310.00		
1.04.35	8" Sch 20	A106GRB	125.00		
1.04.36	10" Sch 20	A106GRB	125.00		
1.04.37	12" Sch 20	A106GRB	26.00		
1.04.38	6" Sch 10S	SS321	13.00		
1.04.39	4" Sch 10S	SS321	66.00		
1.04.40	3" Sch 10S	SS321	59.00		
1.04.41	2" Sch 20S	SS321	53.00		
1.04.42	1.5" Sch 40S	SS321	92.00		
1.04.43	1" Sch 40S	SS321	185.00		
1.04.44	0.75" Sch 40S	SS321	86.00		
1.04.45	0.50" Sch 40S	SS321	99.00		
1.04.46	0.25" Sch 40S	SS321	99.00		
1.04.00 TOTAL					

Erection rates of pipes sizes dia 48.3 and below includes fit up, welding, radiography wherever applicable and welding of instrument isolation valves, flanges for thermo wells, stubs etc. on all pipes and equipment. Alloy steel pipe weld joints rate to be quoted including Stress relieving

Note: The above rates are exclusive of govt. service taxes, which are to be paid extra.

BHARAT HEAVY ELECTRICALS LTD- HYDERABAD
External Services Department

1.05.00 THERMAL INSULATION (APPLICATION) INCLUDING CLADDING, FIXING ARRANGEMENTS ETC.

Sl. No.	Pipe OD in mm	Insulation th.in mm	Length - Mtrs	Unit Rate/mtr	Amount Rs.
1.05.01	609.6	115	73.00		
1.05.02	508	200	33.00		
1.05.03	508	100	40.00		
1.05.04	323.8	150	99.00		
1.05.05	323.8	115	7.00		
1.05.06	273.1	175	106.00		
1.05.07	219.1	175	26.00		
1.05.08	219.1	125	7.00		
1.05.09	219.1	100	13.00		
1.05.10	219.1	75	114.00		
1.05.11	168.3	175	7.00		
1.05.12	168.3	75	22.00		
1.05.13	114.3	150	7.00		
1.05.14	114.3	125	45.00		
1.05.15	88.9	50	33.00		
1.05.16	60.3	150	20.00		
1.05.17	60.3	50	112.00		
1.05.18	33.4	115	92.00		
1.05.19	33.4	100	7.00		
1.05.20	33.4	90	40.00		
1.05.21	33.4	60	74.00		
1.05.22	21.3	50	12.00		
Sl. No.	EQUIPMENT		Area in Sq Mts	Unit Rate/Sq Mtr	
1.05.23	HE Equipment (75 MM THICKNESS)		17.00		
1.05.00 Total					

Note: The above rates are exclusive of govt. service taxes, which are to be paid extra.

Note: Thermal insulation for valves elbows, Tees & fittings are already included in the length indicated The unit rate quoted for insulation of piping shall include for valves, Elbows, Tees & other fittings also and no separate payment shall be payable for these items. The bidders shall provide the insulation thickness as per IS specification.

BHARAT HEAVY ELECTRICALS LTD- HYDERABAD
External Services Department

1.06.00 MATERIAL UNLOADING AND STACKING

Sl no	Description	Weight (Tons)	Rate Rs/Ton	Amount Rs
1.06.01	Mechanical Items	389.19		
1.06.02	Instrumentation and electrical, panel, cable drums etc.	206.25		
1.06.00 Total				

Note: The above rates are exclusive of govt. service taxes, which are to be paid extra.

SUMMARY

EQUIPMENT ERECTION INCLUDING COST OF GROUTING (1.01.01 TO 1.01.28)	
PIPE FIT UP AND WELDING (1.02.01 TO 1.02.48)	
RADIOGRAPHY OF PIPING JOINTS (1.03.01 TO 1.03.48)	
PIPING ERECTION INCLUDING SPRING HANGERS SUPPORTS & PAINTING (1.04.01 TO 1.04.46)	
THERMAL INSULATION (APPL) INCLUDING CLADDING, FIXING ARRANGEMENTS ETC (1.05.01 TO 1.05.23)	
MATERTIAL HANDLING AND STAKING (1.06.01 TO 1.06.02)	
Grand Total	

Note: The above rates are exclusive of govt. service taxes, which are to be paid extra.

BHARAT HEAVY ELECTRICALS LTD- HYDERABAD
External Services Department

SPEC NO. 205 A

MAN HOUR RATES:

Bidder shall consider the following single man-hour rate including cost of supervision and consumables for all categories of extra works that may arise during the course of contract. Bidder to note that these rates shall not be applicable for modification / rectification of works executed defectively contrary to the instruction of engineers and drawing. Bidder to note that same man hour rate shall be applicable for overtime working also.

SI.No.	DESCRIPTION	MAN HOUR RATE
1.	SKILLED / UNSKILLED WORKMEN	Rs 25/-

Note: The above rates are exclusive of govt. service taxes, which are to be paid extra.



AMENDMENT - NOTIFICATION

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WELDING ENDS

Under clause 1.4, read 'ANSI B16.25

as ANSI B16.25-1986

REF:	AMD. NO.	APPROVED:	ISSUED:	DATE:	CUM. SR. NO.
	01	AGM(E&CC)	SR.M(STDS)	JULY, 93	0035



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WELDING ENDS

1. SCOPE

1.1 This standard covers the preparation of butt welding ends of pipes, welding neck flanges and pipe fittings but is equally applicable to other piping components which are connected into the piping system by butt welding.

1.2 Materials of piping components for which these welding ends are primarily intended are carbon and alloy steels. They may also be used for non-ferrous materials, upon satisfactory qualification of the welding procedures for the particular material.

1.3 This standard covers welding and preparation for one general type of joint only, i.e. without backing ring but does not prescribe specific types of welding processes and procedures. The other 3 general types of joints are (i) with split or noncontinuous backing ring (ii) with solid or continuous backing ring (iii) with consumable insert ring.

1.4 This standard is based on ANSI:B16.25

2. WELDING BEVEL DESIGN

2.1 Components having nominal wall thicknesses of 3 mm and less may have ends cut square or slightly chamfered ends (see Table 1, type I).

2.2 Components having nominal wall thicknesses over 3 mm to 22 mm inclusive shall have single angle bevels (See Table 1, type II).

2.3 Components having nominal wall thicknesses greater than 22 mm shall have compound angle bevels (See table 1, type III).

2.4 Dimensions of welding ends are given in table 2.

3. TOLERANCES

3.1 Dimensions A, B and t

3.1.1 All components other than pipes: As specified in applicable ANSI/Corporate/Plant/Product Standard for the particular component.

3.1.2 Pipes: As specified in plant standards HY 104 10 55, HY 106 10 32, HY 106 10 30.

Revision :

Issued

STANDARDS SECTION

TECHNICAL SERVICES DIVISION

Date :

Prepared :

MAR
PDP

Approved :

Henish k khanijo
Sr. M (Stds)

Date :

DECEMBER, 83.

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WELDING DETAILS FOR PIPES AND PIPING COMPONENTS

TABLE-1

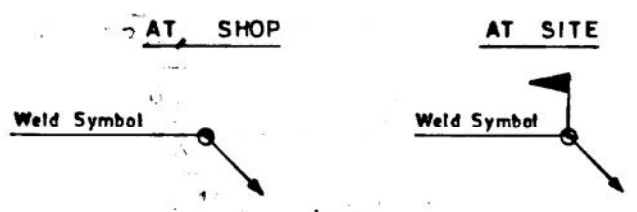
12.5 ✓

TYPE	WELD END THICKNESS-t (mm)	WELDING END DETAIL FOR JOINT WITHOUT BACKING RING	GAP BETWEEN TWO COMPONENTS TO BE BUTT WELDED
	WELD SYMBOL		
I	$t \leq 3$		
II	$22 \geq t > 3$		
III	$t > 22$		

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NOTE:

- INTERNAL SURFACE MAY BE CHAMFERED FOR MAINTAINING DIMENSION ØB AT THE WELD END, IF REQUIRED.
- INTER SECTIONS SHOULD BE SLIGHTLY ROUNDED.
- REPRESENTATION OF SHOP/SITE WELDS ON DRAWINGS SHALL BE AS MENTIONED BELOW.



4. THE WELDING SYMBOLS GIVEN ABOVE ARE AS PER ISO:2553 EXCEPT THAT GIVEN FOR TYPE III.



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TABLE-2 DIMENSIONS OF WELDING ENDS

ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

OD x t	NOM. DIA. In	SCH. NO.	OD AT WELDING END Ø A	Ø B	t
21.3 X 3.73	1/2	80	21.3	13.84	3.73
21.3 X 4.78	1/2	160	21.3	11.74	4.78
21.3 X 7.47	1/2	XXS	21.3	6.36	7.47
25.0 X 3.6	-	-	25.0	17.8	3.6
25.0 X 5.0	-	-	25.0	15.0	5.0
26.7 X 3.91	3/4	80	26.7	18.88	3.91
26.7 X 5.56	3/4	160	26.7	15.58	5.56
26.7 X 7.82	3/4	XXS	26.7	11.06	7.82
33.4 X 3.38	1	40	33.4	26.64	3.38
33.4 X 4.55	1	80	33.4	24.3	4.55
33.4 X 6.35	1	160	33.4	20.7	6.35
33.4 X 9.09	1	XXS	33.4	15.22	9.09
48.3 X 3.68	1 1/2	40	48.3	40.94	3.68
48.3 X 5.08	1 1/2	80	48.3	38.14	5.08
48.3 X 7.14	1 1/2	160	48.3	34.02	7.14
48.3 X 10.15	1 1/2	XXS	48.3	28.0	10.15
60.3 X 3.91	2	40	60.3	52.48	3.91
60.3 X 5.54	2	80	60.3	49.22	5.54
60.3 X 8.74	2	160	60.3	42.82	8.74
60.3 X 11.07	2	XXS	60.3	38.16	11.07
60.3 X 12.5	2	-	60.3	35.3	12.5
73.0 X 5.16	2 1/2	40	73.0	62.68	5.16
73.0 X 7.01	2 1/2	80	73.0	58.98	7.01
73.0 X 9.53	2 1/2	160	73.0	53.94	9.53
73.0 X 14.02	2 1/2	XXS	73.0	44.96	14.02
76.1 X 3.2	-	-	76.1	69.7	3.2
76.1 X 4.0	-	-	76.1	68.1	4.0
76.1 X 5.0	-	-	76.1	66.1	5.0

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OD x t	NOM. DIA. In	SCH. NO.	OD AT WELDING END Ø A	Ø B	t
76.1 X 10.0	-	-	76.1	56.1	10.0
76.1 X 12.5	-	-	76.1	51.1	12.5
88.9 X 4.0	3	-	88.9	80.9	4.0
88.9 X 5.49	3	40	88.9	77.92	5.49
88.9 X 7.62	3	80	88.9	73.66	7.62
88.9 X 11.13	3	160	88.9	66.64	11.13
88.9 X 15.24	3	XXS	88.9	58.42	15.24
108.0 X 16.0	-	-	108.0	76.0	16.0
108.0 X 20.0	-	-	108.0	68.0	20.0
114.3 X 4.5	4	-	114.3	105.3	4.5
114.3 X 6.02	4	40	114.3	102.26	6.02
114.3 X 8.56	4	80	114.3	97.18	8.56
114.3 X 11.13	4	120	114.3	92.04	11.13
114.3 X 13.49	4	160	114.3	87.32	13.49
114.3 X 17.10	4	XXS	114.3	80.1	17.10
114.3 X 32.0	4	-	114.3	50.3	32.0
114.3 X 40.0	4	-	114.3	34.3	40.0
139.7 X 5.0	-	-	139.7	129.7	5.0
139.7 X 10.0	-	-	139.7	119.7	10.0
139.7 X 16.0	-	-	139.7	107.7	16.0
139.7 X 22.2	-	-	139.7	95.3	22.2
139.7 X 25.0	-	-	139.7	89.7	25.0
152.4 X 17.5	-	-	152.4	117.4	17.5
159.0 X 30.0	-	-	159.0	99.0	30.0
168.3 X 4.5	6	-	168.3	159.3	4.5
168.3 X 7.11	6	40	168.3	154.08	7.11
168.3 X 10.97	6	80	168.3	146.36	10.97
168.3 X 14.3	6	120	168.3	139.7	14.3
168.3 X 18.3	6	160	168.3	131.7	18.3
168.3 X 21.95	6	XXS	168.3	124.4	21.95



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OD x t	NOM. DIA. In	SCH. NO.	OD AT WELDING END ϕ A	ϕ B	t
193.7 X 32.0	-	-	193.7	129.7	32.0
219.1 X 6.35	8	20	219.1	206.4	6.35
219.1 X 7.04	8	30	219.1	205.02	7.04
219.1 X 8.18	8	40	219.1	202.74	8.18
219.1 X 10.31	8	60	219.1	198.48	10.31
219.1 X 12.7	8	80	219.1	193.7	12.7
219.1 X 18.3	8	120	219.1	182.5	18.3
219.1 X 27.1	8	-	219.1	164.9	27.1
219.1 X 32.0	8	-	219.1	155.1	32.0
219.1 X 36.0	8	-	219.1	147.1	36.0
244.5 X 32.0	-	-	244.5	180.5	32.0
273.0 X 6.35	10	20	273.0	260.3	6.35
273.0 X 7.8	10	30	273.0	257.4	7.8
273.0 X 9.27	10	40	273.0	254.46	9.27
273.0 X 12.7	10	60	273.0	247.6	12.7
273.0 X 15.1	10	80	273.0	242.8	15.1
273.0 X 21.4	10	120	273.0	230.2	21.4
273.0 X 28.58	10	160	273.0	215.84	28.58
273.0 X 33.5	10	-	273.0	206.0	33.5
273.0 X 45.0	10	-	273.0	183.0	45.0
273.0 X 50.0	10	-	273.0	173.0	50.0
323.9 X 6.35	12	20	323.9	311.2	6.35
323.9 X 8.38	12	30	323.9	307.14	8.38
323.9 X 10.31	12	40	323.9	303.28	10.31
323.9 X 12.7	12	XS	323.9	298.5	12.7
323.9 X 17.48	12	80	323.9	288.94	17.48
323.9 X 28.0	12	-	323.9	267.9	28.0
323.9 X 28.58	12	140	323.9	266.74	28.58
355.6 X 9.53	14	30	355.6	336.54	9.53
355.6 X 15.09	14	60	355.6	325.42	15.09



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OD x t	NOM. DIA. In	SCH. NO.	OD AT WELDING END ϕ A	ϕ B	t
355.6 X 12.7	14	XS	355.6	330.2	12.7
355.6 X 19.05	14	80	355.6	317.5	19.05
377.0 X 9.0	-	-	377.0	359.0	9.0
406.4 X 7.5	16	-	406.4	391.4	7.5
406.4 X 9.53	16	30	406.4	387.34	9.53
406.4 X 12.7	16	40	406.4	381.0	12.7
406.4 X 16.0	16	-	406.4	374.4	16.0
406.4 X 21.4	16	80	406.4	363.6	21.4
406.4 X 22.23	16	-	406.4	361.94	22.23
406.4 X 25.0	16	-	406.4	356.4	25.0
457.0 X 12.7	18	XS	457.0	431.6	12.7
457.0 X 14.27	18	40	457.0	428.46	14.27
457.0 X 23.8	18	80	457.0	409.4	23.8
457.2 X 25.0	18	-	457.2	407.2	25.0
457.2 X 32.0	18	-	457.2	393.2	32.0
508.0 X 12.7	20	30	508.0	482.6	12.7
508.0 X 15.11	20	40	508.0	477.78	15.11
508.0 X 28.0	20	-	508.0	452.0	28.0
508.0 X 45.0	20	-	508.0	418.0	45.0
559.0 X 22.2	22	60	559.0	514.6	22.2
559.0 X 32.0	22	-	559.0	495.0	32.0
610.0 X 12.7	24	XS	610.0	584.6	12.7
610.0 X 20.0	24	-	610.0	570.0	20.0

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Hyderabad

GENERAL SPECIFICATION PIPING INSULATION

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1.0 INTENT OF SPECIFICATION

This specification is intended to cover design, manufacture, fabrication, testing at manufacturer's shop, complete supply including all accessories and jacketing, delivery F.O.R. site duly packed for transportation of hot thermal insulation for piping, valves, fittings & specialities as specified in insulation data sheet and insulation schedule documents and as required.

Application of insulation will be in the scope of erection contractor(outside purview of this specification).

2.0 GENERAL INFORMATION

- 2.1 The thermal insulation shall be applied on the outer surface of piping, valves, fittings, equipment etc., to conserve the heat energy and also to maintain the outside surface temperature of the insulation below or at 60⁰ C for the safety of operating personnel.
- 2.2 Insulation thickness shall be computed on the basis of the following data unless otherwise specified:
- a) Design ambient temperature : 45⁰ C.
 - b) Outside surface temperature of insulation jacket : 60⁰ C
 - c) Emissivity of Aluminium sheet : 0.11
 - d) Thermal conductivity of insulating material at different temperatures shall be as stipulated in IS:8183 & IS:9842 as applicable.
 - e) Wind velocity : 1 metre/sec.
- 2.3 Insulation shall be supplied in thicknesses of 25, 40, 50 and 75 mm and higher thickness shall be made up in multiple layers from them.
- 2.4 Minimum Recommended Insulation thickness have been shown in Insulation schedule. Bidder, however, shall check the adequacy of the specified thickness and confirm the same. In case the specified thickness is not available from the manufacturer's standard sections, nearest higher section shall be selected where available, or thickness may be built up in layers over the section with the nearest thickness as has been specified. Wherever insulation thickness have not been indicated. Same is to be furnished by the Bidder indicating the corresponding type, class/density, thickness, design values of

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conductivity of thermal insulation, and other design data considered (for items listed under 2.2 above).

- 2.5 All covering necessary to protect insulation from the weather shall be supplied. Also all temporary covering as required during application of insulation to protect the environment/surrounding from insulating materials shall have to be provided.

3.0 CODES AND STANDARDS

All item and work covered under this specification shall conform to the latest edition of the following codes and standards :-

- IS : 280 : Mild Steel Wire for general engineering purpose.
- IS : 737 : Wrought aluminum and aluminum alloys, sheet and strip.
- IS : 3144 : Methods of test for mineral wool thermal insulation materials.
- IS : 3346 : Methods of determination of thermal conductivity of thermal insulating materials.
- IS : 7413 : Codes of practice for application and finishing of thermal insulating materials at temperatures between 40⁰ C & 700⁰ C.
- IS : 8183 : Specification for bonded mineral wool.
- IS : 9842 : Specification for preformed fibrous pipe insulation.

4.0 SCOPE OF WORK

4.1 Scope of Supply

Required amount of insulating material and all other materials e.g. binding wires, stitching wires, coversheets/jacketing, expansion joints, bonding compound, adhesives, insulation supports, fastening materials, bands etc. as specified and as required for all items to be insulated as per Specification.

5.0 MATERIALS TO BE USED

- 5.1 The insulation material to be supplied under this Specification shall be of preformed bonded mineral wool sections as per IS:9842 or bonded mineral wool mat as per IS:8183

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or approved equivalent, to meet the conductivity values as furnished for group 4 density class of the said Indian Standards.

- 5.2 The insulation shall be of preformed bonded mineral wool sections of 150 Kg./Cu.m density as per IS:9842/approved equivalent.
- 5.3 Wherever, preformed bonded mineral wool sections can not be used, factory finished, machine made, machine stitched bonded mineral wool mat of 150 Kg./Cu.m density as per IS:8183 approved equivalent shall be provided.
- 5.4 Insulating material shall be suitable for the temperature of the pipe / equipment. For bonded mineral wool insulation, the bonding substance shall retain its property upto 600 °C.
- 5.5 The insulating material whether dry or wet shall be non-corrosive and shall be incombustible as per relevant standard and free from asbestos.
- 5.6 Depending upon the application procedure, loose insulating materials as per IS:3677 if unavoidable, may be used (partly) on such items as valves etc., subject to Purchaser's approval.
- 5.7 Preformed sections shall be secured by means of aluminium bands of 20 mm x 22 SWG (as per IS-737 or equivalent) atleast at every 500 mm spacing.
- The bonded mineral wool shall be secured by means of galvanized steel wire (as per IS:280 or equivalent) of at least 0.7 mm dia in the form of hexagonal netting of 10 mm to 13 mm aperture.
- 5.8 Binding wire to be used for the application of the insulation shall be galvanized steel wire conforming to IS:280 (latest revision) and of thickness 1.0 to 1.6 mm. For above 400^o C, binding wire shall be of S.S of suitable grade.
- 5.9 The stitching wire shall be 0.7 mm diameter copper wire conforming to IS:4412 (latest revision). For above 400^o C., stitching wire shall be of S.S. of suitable grade.
- 5.10 Jacketing Material (Cladding)

The metallic jacket over the insulation shall be of Aluminium sheet conforming to IS:737 (latest revision) and thickness not less than 20 SWG., except for small bore piping (pipes less than 80 NB) where 22 SWG. May be used subject to purchaser's approval.

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5.11 All other materials, c.g., insulation supports, expansion joints, washers, etc. shall be of standard design.

6.0 THERMAL INSULATION APPLICATION PROCEDURE

Bidder shall furnish the insulation application procedure for carrying out application At site by erection contractor. All materials as required for application of application shall be in the scope of vendor.

7.0 INSPECTION & TESTING

7.1 The Contractor shall furnish test certificates from any one of the independent authorities listed below or any other reputed body subject to Purchaser's/Consultant's prior approval for all the tests as mentioned later.

- a) National Test House, Calcutta / Bombay.
- b) Central Glass & Ceramic Research Institute, Calcutta.
- c) National Metallurgical Laboratory, Jamshedpur.
- d) Central Mechanical Engineering Research Institute, Durgapur.
- e) National Physical Laboratory, Delhi.
- f) Central Building Research Institute, Roorke, UP.

7.2 The Bidder shall carry out all the tests according to IS:8183/3144 or according to any internationally accepted standard. The tests shall be done on representative samples drawn from the insulating material supplied under this specification. Thermal conductivity tests for the offered insulating material at various mean temperatures and tests to ensure bonding property of bonded mineral wool (if offered) upto 600 Deg.C shall be conducted in presence of Purchaser's representative.

7.3 All the tests mentioned in IS:3144 shall be carried out for establishing various chemical and physical properties in accordance with the procedure laid down therein.

7.4 The Bidder shall furnish the following test reports along with the offer :-

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- a) Thermal conductivity, in mW/cm Deg. C., of the offered insulating material at various mean temperatures.
- b) Bonding property of bonded mineral wool insulation (if offered) upto 600 Deg. C.
- c) A complete chemical analysis report indicating the composition of insulation.
- d) All other tests as per IS:3144.

8.0 PERFORMANCE GUARANTEE

The bidder shall have to meet the specified surface temperature and the conductivity values of the thermal insulation shall not be more than that specified for group 4 of IS 9842 and IS 8183.

9.0 DRAWINGS, DATA AND INFORMATION REQUIRED

- 9.1 The Bidder shall enclose with his offer the following drawings and information as minimum requirement.
 - 9.1.1 A schedule indicating various types of insulation to be furnished, material specification, code and insulation thickness for each equipment, vessel and piping covered under this specification.
 - 9.1.2 Drawings and write up illustrating the application procedure for the insulation materials offered.
 - 9.1.3 Test Certificates for all the tests as applicable for each type of insulating material offered.
 - 9.1.4 A comprehensive experience list giving the name of the projects, customers, order valves, year of execution etc.
- 9.2 The Bidder shall furnish the following data and information after award of contract.
 - 9.2.1 Final versions of all drawings and data as detailed in clause No. 9.1
 - 9.2.2 Application procedure along with write-up and drawings.
 - 9.2.3 All test certificates of insulating materials.

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TECHNICAL SPECIFICATION FOR NON SHRINK FREE FLOW GROUT MIX

1. **SCOPE:** This specification is valid for Non-shrink free flow grout mix to be cast below the base-plates, bedplates and bearing-housings/pedestals for supporting the turbine generator sets. This specification applies for manufacture, working (processing) and quality control of non-shrink free-flow grout mix of cement base.
2. **GUIDELINES:** The latest version of the following standards may be referred.
 - DIN 1164:
 - DIN 18555: Mortar from mineral binding agent. (Testing)
 - DIN 50014: Climate and its technical application.
 - DIN 1048: Testing Methods for concrete.
 - DIN 50100: Material testing – Fatigue testing.
3. **REQUIREMENTS OF NON-SHRINK FREE-FLOW GROUT MIX:**
 - 3.1 The non-shrink free-flow grout mix must be made from cement base and shall be a permanently controlled and unchanging compound, to which only water shall be added at site before use.
 - 3.2 A good flowing capability of non-shrink free-flow grout mix must be demonstrated to BHEL through a trail pouring with a large base plate. In this pouring, the grout mix is filled in from one side, flows gradually below the base plate and equalizing itself fills all the hollow pockets. The base plate is taken out after 24 hours and the surface is inspected and judged.
The casting-in of base plates/bed plates with non-shrink free-flow grout mix is made for improvisation of supporting techniques. By this process, a uniform transmission of the mass forces and vibrations of turbo generator to the foundation is achieved.
Usually the cast height measures 50mm with a tolerance of ± 20 mm.
 - 3.3 The non-shrinking property of the grout mix shall be guaranteed. The expansion shall be proportional with in the stabilizing period of approximately 24 hours in order to guarantee a force transmission between foundation and the machine. After 24 hours no more expansion shall take place.
 - 3.4 The non-shrink free-flow grout mix shall have the following properties.
 - Chloride free
 - Non metallic
 - Non corrosive
 - Oil and water resistant
 - Resistance for moisture & Temperature variations.
 - High bonding strength.
 - 3.5 Properties after casting.
 - a) Compressive strength: Minimum 35 N/mm² - after 24 hours
Minimum 60 N/mm² final strength - after 28 days
 - b) Expansion coefficient:
The expansion coefficient of the cast mass shall be same as that of the foundation.
 - c) Impact and Vibration:
Should possess resistance to impact & should withstand vibration with out fracture.
4. **SUPPLIERS AND TYPE OF SUPPLY:**
This is to be purchased only from reputed manufacturers of non-shrink free-flow grout mix. They have to get all the tests done, enumerated below, at a national material-testing laboratory and furnish all the test certificates, which are subject to the acceptance by the design department.

The shrink-free pouring grout is to be packed in packets in the weight range of 25 to 50 kg and supplied. The packing shall be so made that the shrink free pouring grout is well protected from moisture and dirt.

The packing must be stamped with date of manufacturing and expiry. Each consignment of shrink-free pouring grout mix must be accompanied by detailed, valid processing (working) instructions (leaflet).

Prepared	Checked	Approved	Date
B.N.Patel	G.P. Rao	G.P. Rao	19.06.1988
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5. TESTS OF NON-SHRINK FREE-FLOW GROUT MIX:

(AT NATIONAL MATERIAL TESTING LABORATORY)

- 5.1 Determination of spreading (Slumping dimension) as per DIN 18555, in relation to compound (mixing) ratio of dry non shrink grout: water.
- 5.2 Determination of workability after 10, 20, 30, 50, 70, 90 and 110 minutes at a temperature of 5°C and 20°C.
- 5.3 Determination of beginning and end of solidification.
- 5.4 Determination of bending and compressive strength in accordance with DIN 1164. The tests are to be carried out on test grout mix prism of 4cm x 4cm x 16cm after 8 hours, 1 day, 3 days, 7days, and 28days. The preparation and testing of test pieces is to be done at controlled temperature of 5°C and 20°C.
- 5.5 Determination of change in volume of non-shrink free-flow grout after 1 day, 3 days, 7days, and 28days. Pouring grout mix is to be mixed with a water/powder ratio of 1:5.55 i.e., 0.180, and to be poured into commercial size 1 kg container (Ø 99 mm height 120mm) up to 20mm under the lip. The container is to be set up with a rubber lining and to be covered with a weight 250g until compact.
This is to be kept at 5°C and ambient temperatures and tested after 24 hours, 3days, 7days and 28 days for change in volume. The water contact at the top of the grout is to be measured with the aid of a volumetric measuring method (refer simplified measuring method to measure the change in volume of a compressed mortar, by Hermann Schmid, in concrete or steel concrete buildings 54th volume, book7, July 1959 Ed. Page 177).
The results are to be tabulated.
- 5.6 Experiments on compression – Swelling zones on non-shrinking pouring grout. Mortar prisms of 4cm x 4cm x 6.5cm of 28 days or more old (Compression face 4x6.5cm²).
- a) Determination of test sample height in the loading direction and determination of consequent upset under a load of 20.4 N/mm². The shape changes are measured with strain gauges, which are mounted respectively on two opposite faces of the test specimen.
- b) Carrying out fatigue tests in accordance with DIN 50100 under the following conditions:
- Loading (Stresses) in the compression: Swelling zones.
 - Under stress : $\sigma_4 = 0.981 \text{ N/mm}^2$
 - Fluctuation of stress : $2 \sigma_A = 20.4 \text{ N/mm}^2$
 - Loading cycle frequency : n 30 Hz.
 - Limiting number of load cycles: 10^7
- c) Determination of test specimen's upset, when the test piece has not failed till the limiting number of loading cycles during the fatigue test.
- d) Determination of compression strength of loaded test specimens and comparison with compression strength of test specimen, which is not loaded.

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