

SECTION – V
SPECIAL CONDITIONS OF CONTRACT
[SCC]
&
SECTION-VI
SCOPE OF WORK

SPECIAL CONDITIONS OF CONTRACT

JOB: ANNUAL RATE CONTRACT FOR HIRING OF SERVICES TOWARDS INSULATION REPAIRING AND MAINTENANCE WORKS FOR OVERALL BCPL LEPETKATA PLANT FOR PERIOD OF TWO YEARS

1.0 GENERAL:

- 1.1 M/s. Brahmaputra Cracker and Polymer Limited (BCPL), a Public Sector Undertaking (PSU) Company is a Petrochemical Plant located at Lepetkata, Dibrugarh, Assam. M/s GAIL (India) Limited is the main promoter having 70% of equity participation and the rest 30% is equally shared by Oil India Ltd (OIL), Numaligarh Refinery Limited (NRL) and Government of Assam.
- 1.2 The Special Conditions of Contract shall be read in conjunction with the General Conditions of Contract, Special Conditions of Contract Schedule of rates, Specifications, Drawings and any other documents forming part of the contract, wherever the context so requires.
- 1.3 The intending Contractor shall be deemed to have visited the site. Non-familiarity with site and Process Industry conditions will not be considered a reason either for extra claim or for not carrying out job in strict conformity with drawings, specifications or any other terms and conditions of the tender.
- 1.4 BCPL intends to line-up Annual Rate Contract for hiring of services towards insulation repairing and maintenance works. The contract is inclusive of all the required consumables, tools & tackles etc.
- 1.5 The work is to be carried out in “restricted area”. Contractor shall have to obtain permission in standard format for his employees assigned to the job and work strictly as per instruction of Engineer-In-Charge (EIC).
- 1.6 Insulation jobs shall be done in Gas Sweetening Unit (GSU) / Ethylene Cracker Unit (ECU) / Linear Low Density Poly Ethylene (LLDPE) / High Density Poly Ethylene (HDPE) / Poly Propylene Unit (PPU) / Captive Power Plant (CPP) / DM Plant / N2 Plants / Cooling Towers / RWTP / ETP / Offsite and Storages / Loading & Unloading area / Pipelines etc. at BCPL- Lepetkata plant, GSU of BCPL-Lakwa plant and GDU of BCPL-Duliajan unit. The contractor shall execute the Insulation jobs in BCPL-Lepetkata, Lakwa & Duliajan plant and other related facilities, auxiliaries as per SOR items and as per instructions of ENGINEER-IN-CHARGE. The scope of work shall include Hot & Cold insulation, Insulation for steam tracing, Ceramic Insulation, Refractory works etc. on rotary equipments, vessels, exchangers, piping, tanks, spheres , HRSGs, Utility Boilers, Steam Turbines, Furnaces etc. as detailed in schedule of rates
- 1.7 Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities, it is understood that that the Contractor shall do so at his own cost and the value of contract shall be deemed to have included all such costs.
- 1.8 The minimum technical details required for bidding has been incorporated in the detail Scope of Work/SOR. However, if required, the bidder may refer further technical details by visiting the site at his own expense.
- 1.9 The personnel to be deputed by the contractor shall observe all security, fire and safety rules of BCPL while at the site. His work will be supervised by BCPL engineers and contractor has to be strictly adhering to the instructions of EIC.
- 1.10 In case during the execution of contract or thereafter at any later stage, including after the completion of contract, it comes into the knowledge of BCPL or any of its employee that the information submitted by the bidder, regarding experience etc., is false, BCPL shall have the right to

terminate the contract immediately without assigning any reason thereof and get the remaining jobs executed at the risk and cost of bidder besides blacklisting it for further dealings with BCPL.

- 1.11 Notwithstanding the sub-division of the documents into these separate sections and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the contract so far as it may be practicable to do so.
- 1.12 Where any portion of the General Condition of Contract is repugnant, to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears, the provisions of the Special Conditions of Contract shall be deemed to over-ride the provisions of the General Condition of Contract and shall to the extent of such repugnancy, or variations, prevail.
- 1.13 Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities, it is understood that the contractor shall do so at his cost and the value of contract shall be deemed to have included cost of such performance and provisions, so mentioned.
- 1.14 In case of an irreconcilable conflict between Indian and other applicable standards, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings or Schedule of Rates, the decision of BCPL/EIC shall be final.
- 1.15 It will be Contractor's responsibility to bring to the notice of Engineer-In-Charge any irreconcilable conflict in the contract documents before starting the work(s) or making the supply with reference which the conflict exists.
- 1.16 In the absence of any specifications covering any, material, design of work(s) the same shall be performed/ supplied/ executed in accordance with Standard Engineering Practice as per the instructions/ directions of the Engineer-In-Charge, which will be binding on the Contractor.

2.0 CONTRACT BASIC CONDITIONS:

SN	DESCRIPTION	:	REMARKS
2.1	Work Site Locations	:	All work shall be carried out at BCPL-Lepetkata, GSU-Lakwa and GDU-Duliajan unit
2.2	Scope Of Work& Technical Specifications/Drawing	:	Scope of work & Technical Specifications/ Drawing Details are given in Scope of Work of bid document
2.3	Time Schedule & Mobilization Period	:	The initial period of the contract shall be two years i.e. 24 months from the date of Fax of Acceptance (FOA)/Letter of Acceptance whichever is earlier which is further extendable to another 06 months based upon the performance of contractor and the job requirement on same rates, terms and conditions. The decision of the "BCPL" regarding extension of the contract shall be final and binding on the contractor. Mobilization period for the contractor will be 15 days from the date of issue of Letter of Intent / Work Order whichever is earlier. The contractor has to mobilize all resources including manpower within the above period.

2.4	Special Conditions of Contract	:	Shall be in accordance with GCC and to be read in conjunction with SCC V((II)&V(III) and SOW /Technical Specification Section-VI of bid document & Preamble to SOR Section-VII of bid document In case of an irreconcilable conflict between Indian and other applicable standards, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings or Schedule of Rates, the decision of BCPL/EIC shall be final. It will be Contractor's responsibility to bring to the notice of Engineer-In-Charge any irreconcilable conflict in the contract documents before starting the work(s) or making the supply with reference which the conflict exists. In the absence of any specifications covering any, material, design of work(s) the same shall be performed/ supplied/ executed in accordance with Standard Engineering Practice as per the instructions/ directions of the Engineer-In-Charge, which will be binding on the Contractor.
2.5	Sub-letting of works	:	Not permissible
2.6	MOBILISATION ADVANCE (M.A.):	:	No Mobilization Advance will be paid. All payments shall be made as per payment terms.
2.7	QUALITY ASSURANCE SYSTEM IF ANY REQUIRED	:	The bidder shall include in his offer the Quality Assurance Program containing the overall quality management and procedures which is required to be adhered to during the execution of contract. After the award of the contract, detailed quality assurance program to be followed for the execution of contract under various divisions of works will be mutually discussed and agreed to. Quality Assurance System plans/procedure of the contractor shall cover details of the personnel responsible for the quality assurance, plans or procedure to be followed for quality control in respect of work. The BCPL or their representative shall reserve the right to inspect/witness, review any or all stages or work at site as deemed necessary for quality assurance.
2.8	ENGINEER-IN-CHARGE [EIC]	:	There shall be an "Engineer-In-Charge" nominated by HOD of Indenting Dept. for the said contract.
2.9	WRONG INFORMATION :	:	If the Bidder deliberately gives wrong information in his Bid to create circumstances for the acceptance of his Bid, BCPL reserves the right to reject his Bid without any reference to the Bidder.

2.10	WORKING HOURS	General working hours shall be 08:30 Hrs to 05:00 Hrs on all days including holiday / Sunday. However, job may continue round the clock in case of urgency which shall be solely decided by Engineer-In-Charge. No extra rate will be considered on jobs round the clock including, General Holidays, National Holidays etc.
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3.0 BID PRICES /QUOTED RATES :

- 3.1** The quoted rate shall be firm & fixed and valid during the currency of the contract. No escalation on whatsoever account shall be paid under this contract except statutory variation in GST if applicable. Statutory variation in GST if applicable shall be reimburse/ paid by BCPL at actuals against submission of documentary evidence.
- 3.2** The quoted prices shall be deemed to be inclusive of the following:
- (i) Cost of Supply Materials, Tools & Tackles, Machines & Equipment etc for execution of the job , Contractor overheads, profits & administrative charges including Indian Withholding Tax & WCT etc as applicable except service tax/GST if applicable.
 - (ii) Contractors responsibilities towards /for compliance under Labour/Industrial laws for the deployed manpower w.r.t payment of Minimum wage, Employees' Provident Fund contribution, Employees' State Insurance(ESI) contribution or Insurance policy coverage under Employee's Compensation Act,1923, Bonus, Death Gratuity, Leave Wages, as per the Factories Act as applicable, Safety Kits & Liveries in terms of Safety Provisions under Factories Act 1948, Maternity benefit to women Contract workers under Maternity Benefit Act 1961.
- 3.3** Bidders are advised in their own interest to visit BCPL plant and ascertain the conditions and quantum of work before quoting.
- 3.4** The rates quoted by the bidder shall be all inclusive for provisions of all incidental expenses necessary for proper execution and completion of work in full in accordance with the Terms & Conditions of the Bid Documents.

4.0 LOCATION:

The contractor has to execute the Insulation jobs at BCPL-Lepetkata, GSU-Lakwa and GDU-Duliajan unit and other related facilities/ auxiliaries as per SOR items and as per instructions of site in charge /unit in charge /ENGINEER-IN-CHARGE. However, for urgent requirement (if the existing contractor working in that area fails to deliver or any other emergency determined by BCPL) as per instruction of EIC, the contractor has to execute the jobs covered in / similar to items of this contract in any other area on same rates, terms and conditions.

5.0 CONTRACTOR'S SCOPE:

- a) Contractor shall make his own arrangements for transportation of his men to respective place of work, boarding, lodging and local conveyance etc. and also bear all incidental charges. The company shall have no obligation in this respect.
- b) During annual shutdown, when maximum no. of insulations works are likely to be available for maintenance, the contractor shall deploy additional resources / equipment's, as per direction of engineer-in-charge to ensure timely completion of job.
- c) The contractor shall always keep available the required tools and tackles, consumables and other material as may be considered necessary by EIC as per work exigency for timely and efficient performance of the jobs as spelt out in the scope of work.

d) The procurement and supply, in sequence and at the appropriate time of all materials and consumables required for completion of work shall be entirely the contractor's responsibility and quoted rates for work shall be inclusive of all such items. The contractor's scope of work supply shall include the following major items but not limited to the same

- Basic insulation materials as specified in technical specifications
- Spacer rings, trays, with ceramic millboard, MS/Aluminium bands, ceramic blanket and Rope, cement etc.
- Plain Aluminium/GI sheet and/or corrugated sheets for cladding as applicable, GI wire and GI wire mesh, Aluminium foils.
- Anticorrosive paints, heat transfer cement / putty, heat resistant paint, barium chromate Paint /sealant etc., if any.
- GI / S.S. stitching and lacing wires
- GI bolts, nuts, studs, self-tapping screws, washers etc.
- Moisture barrier as per specification.
- Welding equipments, consumables, gases.
- Steel scaffolding wherever required.
- Glass cloth, vapour sealing and filler materials, bituminous felt strips, and bituminous mastic.
- Safety tools and tackles for workmen.
- All other items not mentioned above, but covered in applicable standard/drawings, Schedule of rate and technical specifications.

The scope of work envisaged under this contract is insulation works as per specifications, Drawings, codes, standard practice etc. It is however explicitly understood that the scope as described in tender document is not limiting in so far as the responsibilities of the Contractor are concerned and shall include carrying out any and all works and providing any and all facilities those are required in accomplishing an operating system, complying fully with all requirements as are envisaged of it, complete in all respects and satisfying all performance and guarantee requirements stated or implied from the context of the tender document.

6. UTILITY SUPPLY BY BCPL :

- 6.1 Service air, service water shall be provided to the contractor free of cost at one point. The contractor has to make his own arrangement to use the same at work site by extending pipe line, etc. as per requirement.
- 6.2 Electric power shall be provided to the contractor free of cost at a single point. The contractor has to make his own arrangement to use the same at work site by extending cable, etc. as per requirement.
- 6.3 Space for office shall be provided by BCPL, if required and available. However, after expiry of the contract the contractors shall demolish his office & clean the area to the satisfactions of EIC, at his risk and cost.
- 6.4 Intercom telephone facility can be extended to contractor at site office, if required and available.

7.0 WORK PROCEDURES:

- 7.1 The SOR jobs have to be carried out as per standard maintenance/ engineering practices and as per instructions of Site in charge/unit in charge/Engineer in charge. Detailed job description of SOR items is given in "Job Description of SOR". In case of any discrepancies, the decision /interpretation of EIC shall be final.
- 7.2 Contractor shall start the job after getting intimation from site in charge of the respective unit. Once the job is started, it shall be continued till completion and after completion of all the jobs area must be cleaned / cleared up to the satisfaction of site in charge of respective unit. In case of any unforeseen situation Job can be stopped midway only after getting permission from EIC. Depending upon the criticality of the job EIC can ask contractor to deploy MWF or any other suitable category of manpower as per job requirement.
- 7.3 The Contractor has to generate document and maintain record of executed jobs (SOR item wise) and

take signature of the concerned site in charge of respective units for completion of the job on Daily Activity Report/ "Work Intimation slip"/ in the format introduced by BCPL time to time, failing which the same shall not be considered for billing. In normal circumstances contractor has to get certifications of all the jobs done in the previous month by first week of present month.

- 7.4 The execution of the work may continue working during all times and weather conditions and no extra rate will be considered on jobs round the clock including, General Holidays, National Holidays, May day, etc as per the requirement of BCPL to be decided by Engineer-In-Charge and contractor should take this aspect into consideration while quoting his rates. No extra claim will be paid on any account.
- 7.5 Any SOR job shall be deemed completed only after successful trial including leak testing and cleaning of the area up to the satisfaction of site in charge of respective units. Job shall be considered as incomplete if the quality of the job is not up to the satisfaction of site in charge. In case of repetition of the jobs due to poor workmanship/negligence at contractor side the same shall be carried out by the contractor without any additional cost implication to BCPL.
- 7.6 Cleaning of the area/equipment after completion of SOR jobs and shifting of scrap insulation sheet and spent insulation after proper weighment of sheet metal and insulation separately and same returned to designated place in plant premises shall be in the scope of the contractor. Job shall not be certified until unless contractor clean the area up to the satisfaction of site engineer and if contractor fails to clean the area within 7 days from the date of job execution job shall not be considered at all for certification.
- 7.7 If contractor fails to clean the area within 7 days from the date of job execution the job shall not be considered at all for certification. Site in charge of respective unit has to ensure that contractor has cleaned the area before certification of the executed job.
- 7.8 The Contractor shall ensure the quality of the jobs carried out. In case of repetition of jobs due to faulty workmanship/negligence attributable to contractor, same shall be carried out by the contractor without any additional cost implication to BCPL. If such repetitions are frequent, the site in charge of respective unit / "EIC" shall take suitable actions including deduction of cost of damages to the equipment's / plant and cost of production losses etc. in the best interest of the company.
- 7.9 All maintenance jobs are to be carried out under "Permit system". The contractor has to obtain the necessary "Safety work permit" before starting the jobs. The contractor has to comply all the safety requirements for the execution of the jobs as per instructions of Plant Safety Officer/Site in charge of respective unit. The "Safety work permit" has to be returned back to "site in charge of respective unit after completion of the jobs.
- 7.10 The materials, design and workmanship shall satisfy the relevant Indian Standards, the job specifications contained herein and codes referred to, where the job specifications stipulate requirements in addition to those contained in the standard codes and specifications. These additional requirements shall also be satisfied.
- 7.11 The quantities mentioned in SOR are indicative & may change according to the jobs requirements and as per instructions of Engineer in charge.
- 7.12 All jobs in this contract are to be carried out under proper supervision. Contractor has to ensure effective supervision of all the jobs carried in plant through experienced and adequately qualified personnel. The supervisor should be well qualified and should have adequate knowledge on safety aspects of working in petrochemical plants.
- 7.13 However, depending on job requirement esp. during breakdown / shutdown / turnaround the number of supervisors may have to be increased as per advice of EIC.
- 7.14 For over-all supervision jobs, the contractor shall deploy adequate/ sufficient no of persons as per previous practices for the contract period for effective supervision of the job.
- 7.15 The contractor shall employ such workers who are above 18 years of age.

7.16 Transportation of worker to the site and back shall be the responsibility of the contractor. BCPL shall have no obligation in this regard.

7.17 The personnel deployed against this contract shall not be used for any other contract except without specific clearance from the EIC of the contract.

8.0 CONTRACTOR TO ENSURE THE PAYMENT OF WAGES AND EXTEND COVERAGE UNDER SOCIAL SECURITY LEGISLATION TO CONTRACT WORKERS

Sl. No.	Wage components	Rates
8.1	Minimum wage	Minimum Rates of wages as notified by Central Government or State Government whichever is higher, on the date of floating the tender and subsequently any escalation / de-escalation/
8.2	Employees' Provident Fund contribution	The rates notified by Appropriate Government under the EPF Act, 1952 for contribution of EPF prevailing on the day and subsequent amendment if any.
8.3	Employees' State Insurance(ESI) contribution or Insurance policy coverage under Employee's Compensation Act,1923	The rates of contribution as prescribed by the Government with specific notification on the date of floating of tender and subsequent changes if any as per Government Notification. In case the work center is situated, in an ESI non-implemented area / contract workers are drawing salary beyond the prescribed ceiling under ESI, it must be ensured that the contractor/contracting firm should extend coverage to the contract workers through Employee Compensation Policy, to meet the Compensation Liability under Employee's Compensation Act, 1923 along with Medical Liability. The liability of compensation
8.4	Bonus	Contractor to ensure the minimum bonus under the Payment of Bonus Act, 1965 and Bonus (Amendment) Act, 2015 submit <u>proof of payment of bonus to BCPL.</u>
8.5	Death Gratuity	In case of Death or disablement of a Contract worker during execution of work under the CONTRACT, Contractor has to pay the GATUITY as per provision under the Payment of Gratuity Act 1972 and <u>submit proof of having paid the same.</u>
8.6	Leave with Wages as per Factories Act /Rules.	Earned leave be regulated in terms of Factories Act / Rules Framed there under. Other leaves be regulated as per Statutory Provisions applicable in the State. Contractor to maintain proper record and Register as prescribed under Statutory provisions.
8.7	Safety Kits & Liveries in terms of Safety Provisions under Factories Act , 1948 (For workers working in Factories and Construction activities)	Cost of Safety Kit & Liveries in terms of Safety provisions under Factories Act, 1948 (for workers working in factories only). The contractor to provide safety kits and liveries (i.e. shirts, trousers, socks, Helmet, safety shoes, Face Shield, Eye and Ear Protector as per safety norms of BCPL) and submit proof of purchase &
8.8	Maternity Benefit to women Contract workers under Maternity Benefit Act, 1961 where ESI Act, 1948 is not applicable.	Contract to regulate the same in line with the provisions under the Maternity Benefit Act 1961. In case replacement is provided by the Contractor in lieu of the Women workers availing Maternity leave, her name should not be struck from the Muster Roll/Attendance Register during the period of Maternity Leave.

9.0 Compliances under various Labour Laws:

9.1 *The Employees Provident Fund & Miscellaneous Provisions Act 1952:*

- a) The contractor shall have his own PF code no. with the RPFC as required under Employee PF & Miscellaneous Provisions Act, 1952 and extend benefits of Employees Provident Fund 1952, Employee Deposit Linked Insurance 1976 and Employee Pension Scheme 1995 to contract workers deployed.
- b) The contractor has to ensure compliance under EPF 1952, EPS 1995 & EDLI 1976.
- c) The contractor should submit copies of separate e-Challans / ECR, in respect of contract workers engaged through this contract only, with an e-acknowledgement from PF office, (reflecting TRRN No. of ECR and Challan Status as “Payment Confirmed”) on a monthly basis. **Common challans would not be acceptable in BCPL.**
- d) PF is mandatory irrespective of the wages paid by the Contractor to workers i.e. even workers drawing wages more than the prescribed ceiling, has to be made to the member. The exclusion be carried out as per provisions of EPF Scheme 1952.

9.2 *The Payment of Wages Act 1936:*

- a) The contractor shall be solely responsible for the payment of wages and other dues to the personnel, if any, deployed by him latest by 7th day of the subsequent month in the presence of Engineer In-Charge.
- b) After disbursement of wages the authorized representative and Engineer In-Charge have to certify the payment of wages to the contract workers and sign the **Wage Register - Form B** (under The Ease of Compliance to Maintain Registers under various Labour Laws Rules, 2017) jointly with specific seal detailing name/designation/Company.

9.3 *The Minimum Wages Act 1948 :*

Ensure the Minimum wages as prescribed in the Schedule above monthly without further bifurcation of the same. The Minimum Wages in case of revision shall be revised and paid to the Contractor workers by the Contractor ensuring the statutory compliance under EPF Act and ESIC act the revised wages. The rates of Minimum Wages declared by Central Labour Department or State Labour Department whichever is higher shall be made applicable during the tenure of contract.

9.4 *The Employees State Insurance Act 1948:* (If applicable)

- a) The contractor shall have his own ESI code No. allotted by Employee State Insurance Corporation (ESIC) as required under Employee State Insurance Act 1948.
- b) The contractors shall submit the **ECR** along with bank receipts/bank statement on monthly basis as a part of compliance and proof of depositing of ESI contribution with ESI Authorities.

9.5 *The Employees Compensation Act 1923:*

In case the WORK PLACE is out of the notified area under ESIC i.e. ESIC non-implemented area and in case of excluded employees under ESIC, the Contractor is required to take a POLICY from IREDA approved Insurance Company taking into consideration the maximum **compensation liability** (i.e. Rs. 10.86 Lakhs per employee) under Employee Compensation (i.e. **EC**) and Medical Policy towards **medical expenses liability in lieu of ESI** @ 4.75 % of wages annually extending coverage to all workers.

9.6 *The Maternity Benefit Act 1948:*

In case of any woman contract worker eligible for benefit under the Act, contractor should abide by the regulation and should not remove her name from **Employee Register (Form A)** during the period.

9.7 *The Payment of Bonus Act, 1965:*

Contractor to ensure the minimum bonus within the prescribed time frame i.e. 8 months from the closure of accounting year under the Payment of Bonus Act, 1965 and submit proof of payment of bonus to BCPL.

9.8 The Payment of Gratuity Act 1972 :

In case of Death or disablement of a Contract worker during execution of work under the contract, Contractor has to pay the GATUITY as per provision under the *Payment of Gratuity Act 1972* and submit proof of having paid the same.

9.9 Contract Labour (R&A) Act, 1970 :

- a) The contractor is required to obtain Labour license under the provisions of *Contract Labour (R&A) Act, 1970* from the office of Licensing Officer, Central Labour Authority, Ministry of Labor and Employment, Govt. of India having jurisdiction of the Region.
- b) The contractor shall discharge obligations as provided under Contract Labor (R&A) Act, 1970 rules and regulations framed under the same and enforced from time to time.
- c) The Contractor shall ensure Regular and effective supervision and control of the deployed contract workers and give suitable direction for undertaking the Contractual Obligation and meeting all statutory obligation for genuineness and non- camouflaged state of the Contract.

10.0 Additional Responsibilities of the Contractor:

- (i) The contractor shall be solely responsible and indemnify the BCPL against all charges, dues, claim etc. arising out of the disputes relating to the dues and employment of personnel, if any, deployed by him.
- (ii) The contractor shall indemnify BCPL against all losses or damages, if any, caused to it on account of acts of the personnel, if any, deployed by him.
- (iii) All personnel deployed by the contractor should be on the rolls of the contractor.
- (iv) No contract worker below the age of 18 years and above superannuation age of 58 years, as prescribed under EPS, shall be deployed on work.
- (v) The personnel to be deputed by the contractor shall observe all security, fire and safety rules of BCPL while at the site/work. His Work/Services will be supervised by the supervisors of contractor. Contractor has to be strictly adhering to guidance, instruction whenever required. A copy of the work order should be with the Security Department for facilitating the movement of men, machine and materials involved in the contract.
- (vi) Contractor has to deploy the personnel with no past criminal records. Also the contractor has to provide police verification for all the persons deployed by him.
- (vii) While confirming to any of these conditions, the contractor should ensure that no law of state regarding labor, their welfare, conduct etc is violated. The contractor shall indemnify BCPL for any action brought against him for violation, non-compliance of any act, rules & regulation of center / state / local statutory authorities.
- (viii) All existing and amended safety / fire rules of BCPL are to be followed at the work site.
- (ix) Contractor shall ensure payment of wages to the personnel employed and meet all statutory obligations of payment as per Minimum Wages act 1948 and payment of wages Act 1936.
- (x) In case of accident, injury and death caused to the contract workers while executing the Work under the contract, the contractor shall be solely responsible for payment of adequate compensation, insurance money etc. to the next kith & kin of injured / diseased. Contractor shall indemnify BCPL from such liabilities.
- (xi) The contractor shall not employ or permit to be employed any person suffering from any contagious, loathsome or infectious disease. The contractor shall get examined the deployed contract workers from a civil Govt. doctor.
- (xii) No contract workers or person of contractor (including contractor) be allowed to consume alcoholic drinks or any narcotics within the plant premises. If found under the influence of above, BCPL will terminate the contract immediately and may refer the case to police.
- (xiii) The contractor hereby agrees to indemnify owner / BCPL and harmless from all claims, demands,

actions, cost and charges etc. brought by any court, competent authority / statutory authorities against owner/BCPL.

- (xiv) The Contractor to maintain all Register and other records at an Office or the nearest convenient building within the precincts of the work place or at a place within a radius of three kilometers.
- (xv) Supervision and control for the contract for service rests on the contractor and as such contractor and its authorized representatives, duly accepted by BCPL, are only allowed to enter the premises for execution of the contract.
- (xvi) The Engineer In charges is authorized to certify the Wages Register maintained by Contractor and accordingly as and when attendance to be checked EIC can ask for such registers which must be submitted by the contractor or his representative to the EIC.
- (xvii) While engaging the contractual manpower, Contractor is required to make efforts to provide opportunity of employment to people belonging to Scheduled Castes and Weaker Sections of the Society also, in order to have a fair representation of these sections.
- (xviii) Notwithstanding anything contrary contained in the contract, the contractor shall bear any upward revision in the rate of Minimum Wages, including revisions of variable dearness allowance from time to time at its own cost throughout the contract period.

11.0 Documents to be submitted by the Agency/contractor to Engineer In- Charge at various stages during the currency of the contract:

(I) Immediately after issuance/receiving of Letter of Intent (LOI):

- i. Details as required for issuance of **FORM - VII (Notice of Commencement of Work)**
- ii. Application for issuance of **FORM –III (Form of Certificate by Principal Employer)** for obtaining Labour License from Licensing Authority for engaging 20 or more contract workers .
- iii. Copy of **FORM - VI (License)** before commencement of work if 20 or more contract workers are engaged.
- iv. Copy of Provident Fund Registration Certificate issued by concerned Regional Provident Fund Commissioner.
- v. Copy of Employee State Insurance Registration Certificate issued by concerned ESIC. Where ESI Act is not applicable, copy of Insurance Coverage under Employee Compensation Act, 1923 of appropriate value.

(II) At the time of submission of monthly bills:

- i. Copy of **Wage Register in FORM – B** (under The Ease of Compliance to Maintain Registers under various Labour Laws Rules, 2017) duly certified by authorized representative of the contractor and authorised person in BCPL.
- ii. Copy of bank statement duly certified by bank as proof of **Payment of wages**.
- iii. Copy of Separate ECR for the proof of Provident Fund contribution and ESI contribution deposit along with details of contract workers, PF account No. / ESI No., contributions of contract worker and employer etc. for the previous month, in respect of contract workers deployed by them in BCPL through this contract only.
- iv. Copy of the wage slip issued to the Contract Workers duly signed and sealed.

(III) Evaluation of Bill and Release of Payment:

Bill should be evaluated based on the actual payment released/incurred under various heads of components as stated above .The Contractor to submit a Statement duly signed to the effect and the cost actually incurred as per timeline.

(IV) At the time of closure of contract:

- i. **Indemnity Bond** of Rs. 100/- duly notarized from Notary indemnifying BCPL from all liabilities w.r.t. the persons engaged by the contractor regarding payment of wages, Provident Fund/ESI contributions, Insurance and other payments.
 - ii. Copy of the **Wage Register** in FORM - B for the last month. Copy of **Employment Card** in FORM - XII issued to the Contract workers.
 - iii. Copy of the ECR related to EPF and ESIC Compliance in respect of Contract Workers.
 - iv. Details as required for issuance of **FORM - VII (Notice of Completion of Work)**
- Before making payment of the last bill/invoice of the Contractor, the appropriate authority (i.e. Payment Making Authority etc.) in BCPL, shall verify from the EPF/ESI the detail/status of the payment made by the Contractor. In case the information furnished by the Contractor is found to be incorrect BCPL shall take appropriate action against the Contractor.

11. TERMS OF PAYMENT:

- 11.1** The bill in quadruplicate should be submitted to Engineer- In-Charge before 15th of next calendar month, enclosing therewith requisite documents for the jobs completed during the previous month and submitted to the Engineer- In-Charge for the job certification and payment. However 100% joint measurement of the executed SOR jobs in measurement sheet shall be checked and certified by site in charge of respective unit and approved by respective unit in charge before forwarding to EIC for further forwarding to F&A for payment.
- 11.2** In case contractor has not enclosed all the specified documents, it will be considered as Non-performance on the part of Contractor and Engineer-In- Charge may take suitable action.
- 11.3** All payments shall be released within 30 days. BCPL will not entertain any claim of interest on billed amount for any delay. BCPL will release the payments after offsetting all dues to the contractor under the contract. Recovery of income tax from the invoice(s)/bill(s) shall be as per the rules & regulations in force in accordance with the income tax act.
- 11.4** The contractor shall submit a certificate along with each running bill that the contractor has obtained the EPF code no. (Code number to be indicated) and EPF contribution in respect of contractual labor up to the previous bill has already been deposited with the PF commissioner. The Engineer- In-Charge while certifying the bills of the contractor shall record the same.
- 11.5** Final bill along with No claim certificate shall be submitted within 30 days of completion of contract period.
- 11.6** Payment of the bills shall not be made if the executed SOR jobs are not certified by the site in engineer and approved by respective unit in charge from time to time.
- 11.7** 10% of the billing amount shall be kept reserved with BCPL for observing the performance of insulation & workmanship, which shall be released after completion of three months from the date of job completion.

12.0 DEFECT LIABILITY PERIOD:

- 12.1** The contractor has to stand guarantee for the insulation jobs done by him against bad workmanship for a period of **twelve months**, from the date of application of the insulation job. If any defect or damages are noticed as a result of poor workmanship during the one year from date of application period, the same has to be rectified and to be made good by the contractor free of cost. Defect liability period of the contract shall be one year from date of completion of contract.
- 12.2** The contractor shall guarantee that the insulation materials used are in accordance with the

specifications contained herein/to being provided during execution of work.

13.0 SPECIFIC INSTRUCTIONS TO CARRY OUT THE JOB

- 13.1 Contractor shall deploy staff having suitable qualification and adequate experience in application of Insulation Material over Petrochemical/Refinery/Hydrocarbon processing Units/Power plants. BCPL reserves the right to reject any of the persons deployed by the contractor found unsuitable for the work.
- 13.2 Supervisor employed by contractor should have required knowledge and experience of the job. He will assist in the application of insulation over pipelines and equipments. The supervisor will also submit the status of jobs on daily basis to Engineer-In-Charge.
- 13.3 The personnel engaged by the contractor should be well qualified and experienced to discharge the contractual obligations effectively.
- 13.4 The manpower to be deployed should be familiar to work in petrochemical /LPG/Gas Processing/ Chemical / Refinery / gas based power plant.
- 13.5 The insulation material including paint and consumables brought to site by the contractor for execution of the job should be got approved by Engineer-In-Charge and should be procured directly from manufacturer as per specification of the material to be supplied. It should be accompanied by manufacturer's test certificate.
- 13.6 All the jobs have to be carried out on top priority basis and to be completed in all respect with in the time specified by the Engineer-In-Charge.
- 13.7 In case the contractor leaves any job incomplete or fails to complete it in stipulated time or not up to the satisfaction of site in charge of respective unit / EIC then that job will be done through any other agency and deduct its cost from contractor's bill.

14.0 PENALTY CLAUSE FOR SAFETY VIOLATION

- 14.1 Guidelines for imposition of punitive fines against repetitive violation of safety rules & regulations by the contractor during execution of job shall attract penalty as per details below,
- 14.2 For first time violation of safety rules & regulation by contractor, HOD (F&S) will issue a warning letter to contractor with intimation to OIC of work center and EIC.
- 14.3 In case of second time violation of safety rules & regulations by same contractor, OIC will call contractor in person and will have a meeting to discuss reason for repetitive violation along with EIC and HOD (F&S). A warning letter will also be issued by EIC to contractor.
- 14.4 In case of further violation, punitive fines will be imposed on contractor. Amount of fine will be decided as per severity of violation of safety. However, minimum fine would be Rs.5000/- and in multiple of Rs.5000/- thereafter. This will be limited to 5% of contract value, as maximum cumulative penalty.
- 14.5 In case of consistent violation of safety rules & regulation by contractor, BCPL reserves the right to take suitable action against contractor including forfeiture of security deposit and termination of the contract and upon such termination the BCPL shall have the right to remove the contractor's materials from site.

15. PENALTY/TERMINATION CLAUSE FOR NON PERFORMANCE, IF ANY:

- 15.1 In case of failure on the part of the contractor causing safety problem or production loss or mechanical damage to the equipment, contractor shall be penalized at a flat rate of 5% of each case of bill amount in that particular month plus actual cost of equipment damaged as per the discretion of the "ENGINEER-IN- CHARGE".
- 15.2 In case of non-availability of the services by the contractor on any day, BCPL has the right to get

- the same done by any other agency at the risk and cost and responsibility of the contractor. In addition 15% of the service charges will be deducted from the contractor's dues.
- 15.3 If the contractor fails to mobilize the required resources within reasonable time as decided by ENGINEER-IN-CHARGE, BCPL may get the work done through other agency at the risk and cost of the contractor and the security deposit of the contractor may liable to be forfeited.
- 15.4 In case of delay in execution of job EIC at his discretion may impose a penalty of Rs 1000/-per distinct case of delay. The time taken by contractor for any job shall be considered as the duration from intimation received by the contractor supervisor to the completion of the job in totality. The total of the recoveries shall be limited to maximum 5% of contract value on yearly basis.
- 15.5 EIC at its discretion may also make recovery from contractor's bill, If the contractor neglects/fails to execute jobs/ his duties included in the Scope of Work up to the satisfaction of EIC during execution of the contract or fails to respond to a notice of neglect within a period of the time set in such notice. The amount of recovery shall be determined by BCPL in consideration of the nature and consequence of the contractor's neglect. The recovery shall be limited to a maximum of Rs 1000/-per distinct case of neglect. The total of the recoveries shall be limited to maximum 5% of contract value on yearly basis.
- 15.6 In case of consistent non-performance of contractual obligations and violation of terms and conditions of the contract, BCPL reserves the right to get the work done through other agency at the risk and cost of the contractor and to take suitable action against contractor including forfeiture the security deposit and termination of the contract.
- 15.7 Notwithstanding anything contained elsewhere, the BCPL may at any time its discretion terminate the contract or part of the contract after giving 07days notice in writing to the contractor without assigning any reason and upon such termination the BCPL shall have the right to remove the contractor's materials from site and the contractor shall be paid price of the work satisfactorily completed in accordance with the provisions of this contract. In no case payment of the bills shall be made if the jobs are not certified by the inspector from time to time.

16.0 MEASUREMENT:

Measurement shall be strictly in accordance with measurement of insulation as per Annexure-II enclosed along with the tender.

17.0 INSURANCE & DAMAGE TO PROPERTY:

Contractor will be responsible for insurance coverage of his personnel and BCPL will have no liability what so ever, on this account. Damage, if any caused to roads / building / structures/ machinery, equipment, property either moveable or immovable during execution of work, the same will be made good by the Contractor.

18. SCHEDULE OF RATES & QUANTUM OF JOBS :

- 18.1 The quantities shown in schedule of rates are for a period of two years only.
- 18.2 Payment shall be made only for the actual jobs carried out, duly certified by the EIC. BCPL does not give any guarantee regarding quantum of jobs. The decision of "EIC" regarding operating the schedule of quantities shall be final and binding to the contractor.
- 18.3 The rates quoted by the contractor shall remain firm throughout the period of the contract. Schedule of rates shall be deemed to include and cover all costs, expenses and liabilities of every description and all risks of every kind required to execute the work.

- 18.4 The owner reserves the right to interpolate or extrapolate the rates for any new items of work not covered in schedule of rates, from the similar items already available in schedule of rates. All the works, item wise, shall be measured upon completion and paid for, at the rates quoted and accepted in the SOR. For any activity, which is not specifically covered in the SOR description, but is covered under Special condition of contract Scope of work Specification Drawing etc., no extra claim shall be entertained, since SOR is to be read in conjunction with other documents forming part of the tender.
- 18.5 All temporary and ancillary works including enabling works connected with the works shall be the responsibility of the contractor and the price quoted in the SOR by them shall be deemed to have included the cost of such works.
- 18.6 No payment towards idle time shall be done on account of any reason viz., insufficient front, delay in issue of safety work permit, delay in providing electricity connections, water supply etc.
- 18.7 In case of any dispute in SOR etc. BCPL'S decision will be final and binding to the contractor.

19. TERMINATION OF CONTRACT:

- a) Notwithstanding anything contained elsewhere, the BCPL may, at any time, at its discretion terminate the contract of part of the contract after giving 15 days' notice in writing to the contractor without assigning any reason and upon such termination the BCPL shall have the right to remove your materials from site and the contractor shall be paid price of the work satisfactorily completed in accordance with the provisions of this contract.
- b) If BCPL considers that the performance of the contractor under the contract is unsatisfactory or not up to the expected standard, then BCPL shall notify the contractor in writing and may specify in details the cause of its dissatisfaction. The BCPL shall have requisition contained in the said written notice issued by the BCPL to the contractor within 10 days of the receipt thereof. The above clause shall be read in conjunction with termination clause in GCC- works

ANNEXURE-III

MEASUREMENT OF INSULATION WORK

The mode of measurement shall be as per IS 14164 – 2008 (latest version and amendments if any) or any other relevant standard unless otherwise mentioned in the tender document and the weight of structural steel sections shall be measured as per ISI handbook. All insulation jobs are to be carried out as per Technical specifications and instruction of BCPL. However, the measurement for insulation work is given below

Payment will be made on the basis of joint measurements, taken by contractor and 100% certified by site in charge and respective unit in charge and finally submitted to Engineer In charge for further processing. Measurement shall be based on “physical measurements /Approved for construction drawings, to the extent that the work conforms to the drawings and details are adequate shall be taken by contractor in presence of site in charge.

Measurement of weights shall be in Metric Tones/ Kilogram, metric tons correct to the nearest kilograms; linear measurements shall be in meters, correct to the nearest centimeter. Measurement shall be taken over finished surfaces for all type of insulation.

TANKS, COLUMNS, VESSELS, DRUMS, SPHERES, EXCHANGERS AND ROTARY EQUIPMENTS:

No deduction shall be made for any area required to be left un-insulated, the area of which is equivalent to a circle / projection of 300 mm in diameter or less.

All insulated nozzles/manholes shall be measured as given below:

As piping insulation, if the area of such nozzle is equivalent to a circle / projection of 300 mm in diameter or less. The area covered by such nozzle shall not be deducted from the overall area of tank/column/vessel/exchanger/equipment insulation measurements.

If any nozzle/manhole insulated is equivalent to a circle of over 300 mm in dia., the area of such nozzle/manhole to be considered for measurements shall be taken as twice the actual insulated area and paid for as vessel insulation. The areas of tank/column/vessel/exchangers/equipment, covered by such nozzle manhole shall be excluded from measurements.

The area of standard dished end of vessels, exchangers etc. shall be considered as the square of the diameter of the insulated body of shell for the purpose of measurement. For flat ends actual area shall be considered for payment. For removable boxes on exchangers, if any, no extra payment will be made. Insulated areas with different specification shall be measured separately, such as:

- 1) Roofs/tops of tanks considering them as flat surfaces.
- 2) Sides of vessels and tanks where corrugated aluminum sheets are to be used, measurements being taken over the crest of corrugated sheets.

However, the quoted rates shall be deemed to be the above consideration i.e. Roofs/Tops of tanks by using flat Aluminum sheet.

No additional payment shall be made for using corrugated Aluminum sheets as per Technical Specification and the quoted rates shall be deemed to be inclusive of it.

For boxes or stiffener rings, area over two sides of boxes perpendicular to the axis of the equipment shall be added to the area of equipment.

For any other connected structure, if insulated, the measurement shall be taken on actual area

basis. PIPING (Pipes, Valves, Flanges, Pipe Fittings, Traps, Expansion Joints, Bellows,

Hoses, etc):

Measurements of piping shall be taken/ considered along curvilinear center lines of pipe insulated and through all fittings which are insulated but excluding Valve and Flange assembly.

For all types of valves, including control valves, flange assemblies including orifice plates, flanges, and other piping fittings, measurement shall be based on actual count and then converted into equivalent length of connected piping to arrive at the total equivalent lengths of piping or ducting or various diameters as per applicable IS 14164 – 1994 (latest version) unless otherwise mentioned.

No extra payment shall be made for tees, branch connections and inspection plugs and the rates quoted shall be inclusive of all these items. Branch connections shall be measured from the outer surface of the header.

No extra payment shall be made for vents, drains and instrument connections having nozzles length up to 12". However, if the length of such connections exceeds 300 mm the same will be paid as per piping measurements in respective sizes.

For all fittings measurements along curvature centre line shall be considered.

Steam/refrigerant traced lines and untraced lines shall be normally specified and measured separately, according to the number of tracers.

For steam / refrigerant traced pipelines, which are specified and are measured separately, only the diameter of the main pipeline(s) shall be reckoned for measurement of insulation. No separate measurement shall be made for the insulation of the steam tracer line(s) which shall be deemed to have been covered under the insulation of the main pipeline.

No extra payment shall be made for all types valves of size 1-1/2" and below and these shall be considered as part of the piping insulation work.

No additional payment shall be made ,wherever wrapping with aluminum foil over stainless steel alloy piping and equipment prior to application of insulation are to be applied / provided as per technical specification and the quoted rates shall be deemed to be inclusive of it.

Any mode of measurement other than the above may also be adopted, if agreed to between the purchase and the applicators.

All provisions is respected of piping also applicable to ducting wherever the ducts are having shapes other than circular , they shall be considered equivalent to a pipe of equivalent perimeter.

Where ever Unit of Measurement is in SQM, following shall be applicable:

PIPE & PIPE FITTINGS: Length in Mtr as per measurement mentioned above, OD in Mtr taken over the finished Insulated surface and value of pie should be taken as 3.14.

Measurement of SOR item 3.16 the scaffolding shall be in M3. (L X BX H) .Payment shall be made on actual Measurement of length breadth & height of scaffolding from the base/platform where the scaffolding is actually erected.

Measurement of the SOR item 3.14 for application of ceramic fiber rope shall be made on actual length of the ceramic rope used in insulation work in pipeline. Without any addition (IS)

Measurement of SOR item 3.1

Removal of hot insulation/cladding shall be on actual area basis without any addition (IS) .However diameter shall be dia of finished insulation.

Removal of old refractory shall be measured in metric tons correct to the nearest kilograms.

Removal of old PUF insulation on M3 basis $(3.14 \times \text{Dia of finished insulation surface} \times \text{actual Length of insulation removal} \times \text{thickness of insulation without any addition (IS)})$.

For SOR # 3.11H & 3.12 1EA=1 resource for 1 Hour work

For SOR item 3.17 payments shall be made for application of Moisture barrier for hot insulation temp up to 125Deg C to be provided in SOR no 2.E.1 to 3 and 2.G.1.However for temp more than 125deg C and thickness more than 50 mm Moisture barrier is not required. Hence in insulation

DETAIL SCOPE OF WORK

Annexure – IV

The scope of work shall include Hot & Cold insulation, Acoustic Insulation, Ceramic Insulation, Refractory works etc on rotary equipments, vessels, exchangers, piping, tanks, spheres , HRSGs, Utility Boilers, Steam Turbines, Ethylene Cracking Furnaces etc. as detailed in schedule of rates.

The work in brief shall include the following but not limited to this only.

1. The jobs to be carried out as per SOR.
2. Supply of all insulation and ancillary materials like spacer rings, stays, ceramic millboard, lacing and binding wires, screws, bands, roofing felt, studs, flats, support ring clips, sealants and necessary drilling and fixing of bolts/nuts, washers etc. wherever specified and required. All insulation materials shall be new and of approved quality with complete tests certificates and in accordance with the specifications.
3. The contractor has to arrive with all necessary masonry tools and tackles required to execute the job along with mortar. All sorts of consumables like mortar, markin cloth, kerosene / diesel etc. shall be in the scope of contractor.
4. After completion of insulation job where ever required by Site in charge of respective unit /EIC, contractor has to write Date of Insulation with Black paint on Cladding Sheet. Specification like Font size, spacing etc. regarding “The writing job of Date of insulation” on insulation jobs will be specified by the Site in charge of respective unit
5. Application of insulation with weather proofing on vessels, columns, equipment like heat exchangers and piping including valves, flanges etc. as per specifications and instructions of site in charge /Engineer-in-Charge.
6. Providing besides all materials and consumables, sufficient and skilled labour and supervision required for carrying out the insulation work, all safety devices, equipment, instruments etc. necessary and incidental requirements to perform the work in workmanship and efficient manner within the stipulated time period.
7. Proper storage and protection of insulation material and consumables brought to site by the contractor at all stages of work.
8. The contractor shall shift the material from warehouse to working site for use during repairing/work.
9. Contractor shall execute the jobs as per the scope of work defined, without any damage to existing system/ equipment. If any damage found, the cost of damage will be recovered from contractor’s bill.
10. Providing inspection plugs and windows at all locations as per drawing, specifications and instructions of site in charge of respective unit.
11. Keeping the work place clean and tidy during course of execution and cleaning the work site including Vacuum cleaning (vacuum cleaner is in BCPL’s scope) after attending any inside insulation / refractory repair, if required, to full satisfaction of site in charge of respective unit .
12. Any other incidental/intermediate/ancillary or any enabling work/materials not specifically mentioned in the specifications but necessary for the execution and completion of work as envisaged in the tender document.
13. The contractor shall have to complete the job within the specified time period, as per the instruction and up to the entire satisfaction of site in charge /unit incharge/EIC.
14. If the contractor fails to execute the job in time, same shall be required to carry out by some other third party, at the cost and risk of their own.
15. If any deviation is required from the above specified conditions by the party, the same shall be submitted in writing by the party. The same may be incorporated in the scope of work and related conditions, and a suitable amendment order shall be issued to that effect, if the same is acceptable to BCPL.

2.1 SCOPE OF SUPPLY:

2.2 BCPL’S SCOPE :

- Opening and boxing up of man way and inspection way will be done by BCPL.
- Unless specifically mentioned in the Schedule of rate, BCPL will not supply any material for this work. All material will be in the contractor’s scope of supply.

- Heavy equipment like Crane, Tractor Trailer, Hydra, Fork- lifts etc and workshop facilities shall be provided by BCPL on **chargeable basis**, if available, for execution of SOR items smoothly whenever

required as per sole discretion of EIC. However contractor has to make his own arrangement in the event of non-availability of above facilities without cost to BCPL.

2.3 CONTRACTOR'S SCOPE OF SUPPLY:

The procurement and supply, in sequence and at the appropriate time of all materials and consumables required for completion of work shall be entirely the contractor's responsibility and quoted rates for work shall be inclusive of all such items.

The contractor's scope of work supply shall include the following major items but not limited to the same:

- Basic insulation materials as specified in **Technical Specifications Nos.: 1, 2, 3 & 4 in attachment.**
- Spacer rings, trays, with ceramic millboard, MS/Aluminum bands, ceramic blanket and rope, cement etc.
- Plain Aluminum/GI sheet and/or corrugated sheets for cladding as applicable.
- GI wire and GI wire mesh.
- Aluminum foils.
- GI/S.S. stitching and lacing wires
- GI bolts, nuts, studs, self-tapping screws, washers etc.
- Moisture barrier as per specification.
- Steel scaffolding wherever required.
- Glass cloth, vapor sealing and filler materials, bituminous felt strips, and bituminous mastic.
- Safety tools and tackles for workmen.
- All other items not mentioned above, but covered in applicable standard/drawings, Schedule of rate and technical specifications.

The scope of work envisaged under this contract is insulation works as per specifications, Drawings, codes, standard practice etc. It is however explicitly understood that the scope as described in tender document is not limiting, in so far as the responsibilities of the Contractor are concerned and shall include, carrying out any and all works and providing any and all facilities those are required in accomplishing an operating system, complying fully with all requirements as are envisaged of it, complete in all respects and satisfying all performance and guarantee requirements stated or implied from the context of the tender document.

TECHNICAL SPECIFICATION NO: 1

STANDARD SPECIFICATION FOR COLD INSULATION OF VESSELS, PIPING AND EQUIPMENT

1.0 SCOPE

This specification covers technical requirements and produces for the applications of self extinguishing type insulation (rigid polyurethane foam) to vessels, equipments, heat exchangers, pump, piping and instruments.

2.0 GENERAL REQUIREMENTS

2.1 Insulation shall be provided to all vessels, equipments, heat exchangers, columns rotary equipments, piping, etc. containing fluids or vapor, for which it is necessary to:

- a) Maintain low temperature for process control.
- b) Avoid surface condensation.

2.2 Protection of Material during Storage:

Insulation material must be protected against any damage, from delivery to finish cladding; decking and covering with tarpaulins alone are not considered sufficient protection from weather for any length of time and shall not be permitted. Insulation material slabs and sections shall be stored on a flat surfaces in a horizontal position, insulation materials shall never be stocked directly on the ground. The contractor shall provide covered storage for insulation material as directed by the Engineer- in – charge.

2.3 Protection of Partially Completed Jobs:

All precautions shall be taken to ensure that each day's work is vapor sealed and cladded during erection and before being left over night to prevent seepage of water into the materials and getting trapped. The system shall be protected by tarpaulins, water shed and other protective means.

2.4 Hydrostatic Test:

Insulation shall be applied on vessels, heat exchangers, piping and other equipment only after successful completion of hydrostatic test. In case insulation work start before completion of hydrostatic test, all welded and mechanical joints shall be left exposed for testing and subsequently insulated after successful completion of the hydrostatic test.

2.5 Co- Ordination with Other Agencies:

Contractor shall work in close co- ordination with the erection contractor. Wherever temporary supports are provided the contractor shall remove these and provide the necessary insulation wood blocks.

2.6 Extent of Insulation:

2.6.1 Items Requiring Insulation are specified in the piping line schedule and equipment/vessel/heat exchanger data sheet.

2.6.1.1 All attachments and projections such as vessels supports structural steel attached to vessels, piping hanger supports, instrument connections connected directly to cold insulated piping, vessels and equipment, shall be cold insulated upto a distance of 4 times the adjoining insulation thickness.

2.6.1.2 All flanged joints, manhole covers, etc, shall be cold insulated with removable box insulation.

2.6.2 Items not Requiring Insulation

2.6.2.1 Bonnet of valves above the packing glands.

2.6.2.2 Nameplates, stamping and code inspection plates on vessels & equipments.

3.1 INSULATION MATERIAL:

3.2 General

All material used for insulation, fixing, sealing and portion shall be new and all insulation material whether dry or wet shall be non-corrosive to the surfaces insulated.

3.3 Insulation material for insulation piping, vessels and equipment in cold service shall be given below.

Operating temperature range
-180⁰ c to +80⁰ c

Insulation material
polyurethane foam.

3.4 Form of insulation shall be as follows: Preformed Pipe Section / Slabs / Radial Lags/ Cast In Situ (non preferred).

3.5 Dimensions of preformed sections for piping insulation shall be defined by the outside diameter and insulation thickness. Tolerances for preformed sections shall be as under:

Outside parameter	-0%, + 5%
Concentricity	+/-3% OD
Bore	+2mm
	-0 mm
Length width and thickness slabs.	+/-2mm

3.6 The material used shall not disintegrated, settle, change its composition, in a detrimental way, at the service conditions.

3.7 The insulating material shall be chemically inert, moisture free, rot and vermin proof.

3.8 Preformed half section and slabs shall be provided having their longitudinal and circumferential forces flat and smooth so as to make with the mating sections at the whole ends of the preformed half sections shall be flat and perpendicular to the centre lines.

3.9 Polyurethane Foam:

3.9.1 The insulation material shall be rigid preformed cellular urethane foam of self extinguishing type of accordance with ASTM C 591, Type II, Grade 2 or applicable Indian standards.

3.9.2 Composition

The insulation material shall be produced by reacting poly Isoocyanates with polyhydroxy compounds and expanded with a fluorocarbon blowing agent. The finished foam of slobs or half sections shall be uniform closed shell structure, free foam unrelated materials shrinking and deformation.

3.9.3 Density

The density of finished foam shall be within 35.0 kg/M³ TO 39.9 KG/m³ and shall be determined in accordance with ASTM C-302 or applicable Indian standards.

3.9.4 Thermal Conductivity

Thermal conductivity of the polyurethanes foam slobs and sections shall not exceed 0.019 K Cal /hr.m degC (0.16 BTU/ft² hr °F/in) at 10 deg c mean temperature after ageing. The thermal conductivity shall be tested by the method prescribed in ASTM C 335 or applicable Indian standards.

3.9.5 Closed Cell Contents

The closed cell contents shall be at least 95% by volume. Material test certificate shall be submit along with supply of material.

4.0 ANCILLARY MATERIALS:

4.1 Wire Netting, Lacing & Binding Wire:

Wire netting shall be galvanized 24 SWGx20mm to secure insulation blocks. Lacing and stitching wires shall be 22 SWG galvanized iron wire respectively.

4.2 Bands:

Bands shall be aluminum, of dimensions 20 mm width x 24 SWG, unless specified otherwise.

4.3 Adhesive:

The adhesive to be used for bonding polyurethane sections shall be of foster / Microplast / Equivalent compatible for -180°C to 80°C.

4.4 Vapour Seal

The vapour seal for polyurethane insulation shall be foster fire retardant mastic 60-30 or equivalent grade. In case of non-availability of foster's mastic, bitumen emulsion mastic inculcate grade T-12 or equivalent shall be as an alternative.

4.5 Filler Material

Polyurethane foam dust mixed with specified adhesive shall be packed tightly so as to fill irregular voids and at contraction joints.

4.6 Joint Sealer

The joint sealer to be used for sealing polyurethane insulation joints and at flashing of insulation shall be foster foam seal sealer 30-45 or equivalent.

4.7 Glass Cloth:

The glass cloth to be used for vapour barrier reinforcement shall be open weave 10 mesh glass cloth having glass fiber thickness of 5 mils.

4.8 Al sheets for cladding over the insulation:

Application

Al sheet gauge

a) For column, vessels and equipment

24SWG

b) For pipes, valves, flanges and other areas where

22 SWG

Mechanical damage is likely to occur. Slight modification may be done as per the instructions of BCPL.

4.9 Anti Corrosive Paints:

Deleted.

4.10 Bituminized Roofing Felt

Bituminized self finishing roofing felt shall confirm to IS 1322, type 3, grade 1.

5.1 APPLICATION

5.2 General

The following applies to all types of cold insulated equipments and piping.

5.2.1 Surface Preparation

The surfaces of tanks, vessels, piping and valves etc, on which cold insulation is to be applied, shall be free of duct, loose point of any other foreign matter. The surface irregularities shall be filled up with approved filler. One coat of anti corrosive primer shall be applied over the carbon / alloy steel surfaces to be insulated and allowed to dry before application of insulation. Application of Anti corrosive paint /primer is not in the scope of insulation contractor.

5.2.2 Insulation Thickness and Limit

Insulation thickness shall be in accordance with the equipment data sheet and piping line schedule.

5.2.3 Vapor Barrier

A 3.0 mm (wet) thick coating of vapour seal mastic shall be applied to the surface of the insulation as soon as possible after erection, to reduce the time the insulation is exposed to the weather to minimum. Whilst this coat is still wet glass cloth shall be laid over the surface and embedded in the mastic. Care shall be taken to ensure that the glass cloth is laid smooth and free from wrinkles, and that no pockets of air are trapped beneath the surface. At junctions in the glass cloth, the overlap shall not

be less than 75mm. a second 3mm thick coat of mastic shall be applied after approximately twelve hours. When dry, this coating shall be minimum of 1.50mm thickness. Core must be taken, however to ensure that the individual coats are not greater than 3mm (especially in corners); otherwise same cracking of dried coat may result. The total dry film thickness of vapour seal shall not be less than 2.05 mm with a tolerance of -0% to +50%. The mastic shall not be applied over wet insulation or until the adhesive is dry. During this drying time that insulation shall be protected from the weather by alkothane' film tarpaulin or similar materials approved by the engineer – in – charge.

Where joints have been left un-insulated, a complete vapour seal as specified above shall be applied to the exposed end of the insulation and flashed weather tight on to the metal.

5.1.3 Expansion/Contraction Joints :

When specified on a pipe line or vessel drawing or where deemed necessary to allow movement and contraction of the pipe or vessel without producing random cracking of the insulation, contraction joints shall be provided in the insulation. at contraction joints location , provision shall be made in GI cladding to accommodate contraction of pipe or vessel.

The following steps shall be taken:

- a) Both longitudinal and circumferential joint in insulation shall be staggered.
- b) Contraction joints shall be providing at an interval depending on a pipe or vessel material contraction / expansion coefficient and temperature. Unless otherwise specified contraction joints shall be provided at an interval of 6.0M a straight run of pipes or vessels operating at temp. - 40deg C & below.
- c) Contraction joints in horizontal vessel insulation shall be close to support point while on vertical pipes & vessels, the same shall be provide of support ring location and at interval of 4.0M straight run.
- d) A contraction joint shall consist of 12mm gap in the insulation, loosely packed with filter material, to a depth of 6mm less than the adjacent insulation thickness. 6mm gap thus left shall be filled up by approved non-setting compound (foster foam seal 30-45 sealer or equivalent) and finished smooth with the surface of insulation. Vapour barrier which shall cover the joint shall be applied only after the compound has dried. Expansion / contraction joints.

5.1.4 Stainless steel piping & equipment :

All pipes vessels and equipment of stainless steel construction shall be wrapped with 0.1 mm thick aluminum foil with an overlap of 50mm having barium chromate sealer interposed in the joint prior to application of insulation. Foil shall be secured in position by aluminum bonds, taking every precaution to avoid formation of pin

holes or cracking in the aluminum foil. Cladding shall be done after the insulation and vapour barrier exactly the same way as for other pipes and equipment.

5.1.6 For all pipes , vessels , equipment etc lying in a corrosive environment where sulphur dioxide or other corrosive media are likely to be present stainless steel bonds / clips shall be used to secure aluminum cladding in position.

5.1.7 Field Welding

Deleted.

Any type of the welding related to insulation work is not in the scope of insulation contractor.

5.2 Application Vessels & Equipment

5.2.1 General

Individual vessel and tank drawings indicate the location of insulation supports furnished by the owner. However additional supports are exchangers where ever required, to facilitate application of insulation and securing of insulation shall be provided by the contractor at his own cost. All surfaces shall be prepared before application of insulation.

5.2.2 Single Layer Insulation

Insulation radical lags / performed sections/slabs of handy sizes shall be installed on to the surfaces of vessels adhering to each other with applicable joint sealer and secured in position by G.I wire netting and aluminum bands at an interval of 225mm. There shall be no through joints and the insulation shall not be banded to the vessel.

5.2.3 Multilayer Insulation

The inner layer of insulation shall be bonded to the vessel with the applicable adhesive. Subsequently layers of insulation shall be bonded to the preceding layer, with the applicable adhesive. The joint sealer shall be applied to the ends and edges of all sections, including those in the inner most layer to seal all joints .Core shall be taken to ensure that the adhesive is evenly spread over the entire surface of application and the insulation is closely butted to each other both longitudinally and circumferentially .

All the layer except the final shall be secured in position by metallic bands at an interval of 225 mm while the final; layer shall be first secured with G.I wire net and than with metallic bands at an interval of 225 mm. Bands shall be staggered on successive layers . There shall be no through joints in the insulation.

5.2.4 Filling

All the cracks and voids in the main insulation shall be filled up with applicable fillers material.

5.3 Vertical Vessels

5.3.1 Shell (Cylindrical)

Slabs in handy sizes as given below shall be applied resting onto the supports with joints tightly butted, staggered & adhering to each other with applicable adhesive and secured in position by circumferential metallic bands at a pitch of 225mm.

For vessels upto 2.5M O.D. – radical lags of suitable width. For vessels over 2.5M O.D. – radical lags, however the procedure given below can be used as an alternative.

Flat insulation slobs of width not more than 300 mm shall be cut longitudinally to have notch (s) of suitable size spaced at suitable spacing, so as to form a radial segment suitable size spaced at suitable spacing, so as to form a radial segment suitable for the profile of the vessels shell. However extreme care shall be taken to ensure that no air pockets are formed in the finished insulation. All insulation joints shall be sealed with applicable joint sealer.

Where more than one layer is used, each layer shall be banded separately.

5.3.2 Top Heads

Shaped insulation sections shall be installed on top head, bonded and butted tightly to each other. Insulation shall be held in position by making use of galvanized iron floating ring (25mm x 0.6 mm) placed over the insulation and positioned in the centre of the head so as not to touch the nozzle at the vortex. The insulation shall be held in position by use of radial metallic bands, one end of which shall be fastened to the floating ring and the other end shall be anchored to the bond (s) place around the cylindrical section close to the head. Radial bands shall be spaced on 300 mm centre measured around the circumference of the vessel.

The final layer of insulation shall be held in position also by metallic wire net locked at the nozzle location by 2-3 loops of 10 SWG galvanized wire and to the wire net over insulation on the shell at the cylindrical section close to the head.

When there exists no nozzle at the top of the vortex, the insulation shall be held in position by wire netting and metallic bonds stretched over the head and on chord on the cylindrical section close to the head by circumferential metallic bonds (s) on the shell and near the head.

5.3.3 Bottom Heads:

In all the skirts supported vessels insulation supports are provided inside the skirt. Floating ring and wire loops around the nozzle and bonds shall be used to support downward facing of insulation. Such floating ring shall be positioned centrally around the nozzle but over the insulation by radial bonds on chord to the lagging support angle ring fixed inside the skirt at the pitch of 300 mm measured over the support angle ring.

If nozzle does not exist, metallic bonds shall be stretched across the bottom head and on chord with logging support angle ring inside the skirt. All the wire ends of wire netting shall be cut short and turned into the insulation.

5.4 Horizontal Vessels

The insulation radical logs handy sizes shall be installed in close contact with the faces to be insulated and held in position by G.I wire netting and metallic bands at a pitch of 225mm. where more than one layer is required, each layer shall be banded separately. The bands for successive layer shall not coincide with each other. Wire netting on the final layer shall be applied and ends shall be laced together by lacing wire before putting the metallic bands. Insulation sections on the vessel heads shall be secured in position by wire netting and metallic bands stretched across the heads and anchored to circumferential metallic band(s) on the shell near the heads. Anchoring of bands measured on the circumference of shall be at a pitch of 225 mm.

5.5 Tank Insulation

Material and method of application for tanks shall be the same as specified for vessels. Flat GI sheets for weather proofing shall be used exactly in the same manner as specified for other vessels.

5.6 Spherical Vessels

Before commencing the application of insulation, the contractor shall ensure that exterior surfaces have been prepared. Shaped insulation to fit curvature of sphere shall be bonded to the vessel with applicable joint sealer,. The inner layer of insulation shall be held in position by 20mm x 20SWG aluminum bands at 300 mm max. Centers at the equator. These bonds are filed up with the floating rings of 180mm dia made of 15mm dia .S.S rod at top and bottom of the sphere. The bands being staggered on successive layers and the clips of the bonds being recessed into the insulation over the outer layer, galvanized wire netting shall be spread over and laced together.

5.7 Vapour Barrier

Vapour barrier shall be applied on all the vessels as described above.

5.8 Metal Sheet Finishing

5.8.1 Horizontal Vessels

The insulation shall be covered with Aluminium sheeting with all the longitudinal and circumferential joints having on overlap of minimum 50mm. All longitudinal and circumferential joints shall be sealed with suitable approved bituminized mastic sealer. Aluminum sheeting shall be secured in position by metallic bands on the shell at a max. Pitch of 425mm. All the longitudinal joints with over lap of 50mm in the aluminum sheet shall be kept below the horizontal plane passing through the axis of the vessels to prevent water or the spillage from entering into the insulation.

Jacketing for dished heads shall be fabricated from radial segments with the radial overlap of minimum 50mm the sheeting shall be secured in position by radial tensioned metallic band stretched over the heads. One ends of each band is

anchored the circumferential band(s) on the shell while the other is fastened (pop rivetted) to 6 mm dia. Floating rod ring which can be replaced by 6mm. thick strip (G.I.) rolled in the form of a ring. Radial metallic binds, measured over the circumference of shell, shall be a pitch of 300mm. all the sheet metal joints shall be properly sealed with approved sealing mastic.

5.8.2 Vertical Vessels

The Aluminum sheeting shall be adequately rolled and installed over the insulation such that all the longitudinal joints are staggered. All the longitudinal and circumferential joints shall have an overlap of 50mm minimum and suitable sealed with approved mastic sealer. Aluminum sheeting shall be secured in position by tensioned metallic bands installed circumferentially at a max. pitch of 425mm.

5.8.2.1 Top Heads

Insulation shall be covered with flat aluminum jacket fabricated in segmental form with lapped joints properly sealed with approved mastic sealer. Over lapping of sheet metal joints shall not be less than 50mm. Aluminium jacket shall be secured in position by radial tensioned metallic band (s) of vessel on one side and fastened to 6mm dia. Floating rod ring, centralized at the vertex of head on the other side .6mm thick metallic strip rolled into a ring can be the substitute 6mm dia rod. Pitch of radial bands measured over the circumferential bands of shell be max. 300mm.

5.8.2.2 Bottom Heads

Aluminum sheeting shall be installed exactly in the same manner as indicated for the top heads.

5.8.3 Spherical Vessels

Cladding of each hemisphere of spherical vessel shall be done with GI sheets placed horizontally and a thick circumferential tensioned bond (6mm thick) shall be used at the equator to hold the radial metallic bonds.

5.8.4 Others

Opening in metal jackets for nozzles, man ways, brockets etc. shall be cut as close as possible for a snug fit.

5.9 Flashing

All opening through insulation finish shall be flashed weather tight particularly where connections are not insulated. Flashing shall be carried out. Skirt supported vessels shall have the skirt insulation inside and outside for at least 600mm below the tangent line or such that temp. of adjacent non insulated surfaces of the skirt shall not be below dew point. Proper flashing and sealing shall be done on skirt where insulation and subsequent metal finish terminate.

5.10 Exchanger Insulation

Exchanger shells except for channel and channel shall be insulated and weather proofed as specified for vessels.

Exchanger channels and channels cover including flange bolting shall be insulated with removable aluminum covers lined with insulation slabs of required thickness.

5.11 Machinery

In general, removable aluminum boxes lined with slab insulation of required thickness shall be used for insulation of machinery after giving a coat of individual pieces of equipment depending on the nature of items to be insulated to the site – in – charge at site for approval.

5.12 Application-Piping

5.12.1 General

Insulation shall be applied on after ensuring that piping to be insulated is properly installed, supported and tested.

5.12.2 Horizontal Piping

5.12.2.1 Piping surface shall be cleaned of loose rust, mill scale, grease, dust or any other foreign contamination and surfaces preparation shall be done.

5.12.2.2 The insulation shall be applied to pipes in half round sections/slabs in reasonably handy sizes. Where insulation thickness required is greater than 50mm or that the metal temp. is below -40 °C, multilayer construction shall be followed with all the joints staggered in successive layers.

5.12.2.3 The inner layer of insulation shall be bonded to the piping with applicable adhesive. Subsequently layers of the insulation shall be bonded for the preceding layers with the above adhesive. Joint sealer shall be applied to the ends and edges of all sections for sealing all longitudinal and circumferential joints. Adhesive shall be applied evenly and the half sections shall be closely butted to each other both longitudinal and circumferentially.

5.12.2.4 All the insulation layers except the final shall be secured in position by metallic band of an interval of 225 mm, while the final layer shall first be secured with GI wire netting and then metallic bands at an interval of 225mm. Bands shall be staggered on successive layers.

5.12.2.5 Insulation of piping shall be stopped short to flanges to allow for withdrawal of bolts for fitting, the insulation shall be completed by applying cut segments of the same insulation sections/slab used for pipes.

5.12.2.6 Any cracks or irregularities in the external surface of insulation sections shall be filled up by applicable fillers material.

5.12.2.7 For long run of pipes, the ends of insulation sections shall be seated of at 12M intervals and vapour barrier carried down up to the material surface.

5.12.2.8 Contraction joints shall be provided at an interval of 6.0 M.

5.12.3 Vapour Barrier

Vapour barrier shall be applied over the insulation.

5.12.4 Metal Sheet Finishing

Vapour barrier (after it has dried) shall be protected by cladding in with specified aluminum sheeting. All joints between adjacent aluminum sheets shall be staggered and grooved with a minimum overlap of 25mm, and suitable sealed with approved sealer. The longitudinal joints shall have single grooves while the circumferential joints shall have two grooves. GI bands / clips at an interval of 425mm shall be used to secure the aluminum cladding in position. self trapping screws shall not be used.

For pipes, vessels and equipments lying in a corrosive environment where sulphur dioxide is likely to be present, stainless steel bonds / clips spaced at intervals of 425mm shall be used to secure the aluminum cladding in position.

5.12.5 Vertical Piping

Insulation, vapour barrier and metal sheet finishing shall be performed as specified for horizontal piping. Contraction joints shall be provided.

Insulation support / spacer rings shall be provided at an interval of 4.0M. (If other insulation supports are not ready existing on the pipe).

5.12.6 Pipe Supports & Hangers

In all supporting arrangements of both horizontal and vertical piping, dry hard wood pipe support bearing blocks coated with fire retardant paint / mastic shall be used. Metal cradles, metal pipe supporting and hangers shall be attached to outside of the pipe support bearing blocks are not directly to bore pipe.

Provision shall be made to prevent seepage of water into the insulation from pipe hangers.

5.12.7 Flanges & Valves

Removable covers shall be provided over all flanges and valves. Loose fill mineral wool backed up by slab insulation of thickness equal to that on adjacent pipe shall be applied. Aluminum covers over the valves and flanges shall be fitted with quick release clips. This application shall be proposed for each case by the insulation contractor and approved by the BCPL.

6.0 COLD INSULATION OF PIPING LOCATED AT OR BELOW GROUND LEVEL AND WHERE THERE IS A LIKELYHOOD OF FOOT TRAFFIC.

6.1 Material of insulation shall be slab polyurethane.

6.2 Bituminized self finishing roofing felt shall be wrapped over the final layer of vapour barrier after it has fully dried, with an overlap of minimum 50mm both an longitudinal and circumferential joints.

6.2.1 The roofing felt shall be secured with the specified galvanized iron wire netting, laced with 20SWG galvanized iron wire.

6.2.2 A 3mm thick bitumen emulsion mastic shall be applied for water and weather proofing.

6.2.3 When bitumen emulsion has completely dried, the surfaces shall be painted with two coats of bitumen based aluminium paint.

7.0 SAFETY

The insulation contractor shall provided adequate protective applications like banned gloves , masks , glasses etc, to the workman carrying out the insulation work, to protective them from in holing and touching insulation dust and fibers.

8.0 GUARANTEE

8.1 The insulation contractor shall submit along with the work, authentic test certificate confirming that the insulation material offered confirm to the requirements of this specification and the standards mentioned therein. Any deviation shall be clearly stated.

8.2 The insulation contractor shall guarantee the following.

8.2.1 The insulation and ancillary material are new and unused and confirm to the standards mentioned in the specification.

8.2.2 The operating thermal conductivity shall be as specified.

8.2.3 The workman ship in execution of the insulation works shall be accordance with sound engineering practice.

NOTE: REFER EIL SPECIFICATION NO: 6-44-03 REV-1 SHT: 27 OF 44 TO SHT 44 OF 44 FOR COLD INSULATION OF VESSELS, PIPING AND EQUIPMENT (EIL SPECIFICATION NO: 6-44-03 REV-1) FOR DRAWINGS / SKETCHES AND TABLES AND ANY OTHER CLARIFICATION IF ANY.

STANDARD SPECIFICATION FOR HOT INSULATION OF VESSELS, PIPING AND EQUIPMENTS

TECHNICAL SPECIFICATION NO:2

STANDARD SPECIFICATION FOR HOT INSULATION OF VESSELS, PIPING AND EQUIPMENT

1.1 General

1.2 Scope

1.2.1 This specification covers design and material requirements for above ground , external insulation of piping and equipment operating between ambient temperature and 550⁰c for the purpose of heat conservation , process stabilization , temperature maintenance , personnel protection and fire protection . Where necessary this specification indicates the basis for selecting a criterion.

1.2.2 This specification is suitable for use in outdoor services with normal process plant atmosphere. Alternative designs and materials would be specified by owner if necessary for corrosive atmosphere or potential leaks and spills of chemicals.

1.13 All the codes /standards mentioned in this specification shall be latest issue.

2.1 Design Basis

2.2 Criteria :

2.1.1 Heat conservation insulation is designed for economic thickness and to limit cold surface temperatures below 65⁰c with 20⁰c ambient temperature in still air conditions.

2.1.2 Insulation is not desired for piping and equipment for which heat loss is desired – excepting for personnel protection or to avoid thermal stress problems.

2.1.3 Insulation is required for any of the following purpose ,

Heat conservation

Process stabilization to assist process control

Steam tracing

Electric tracing

Hot water or solvent tracing (liquid) Hot

oil tracing

Steam jacketing Hot

oil jacketing

Fire hazard protection to prevent fast boil off the liquid.

2.1.3 Personnel protection applicable where exposed surface temperatures exceed 65 °C in normal or short term operating conditions. Over internally insulated piping and equipment, provide open mesh metal guards and for surfaces which are not internally insulated provide insulation on that part of surfaces with which operating and maintenance personnel may come in contact while performing routine duties. The actual extent of insulation shall be determined by field construction Personnel and / or operating Personnel using the following criteria: exposed surfaces operating above 65 °C and located within 600 mm horizontally or 2100mm vertically of a normal access, walkway or work area.

2.1.4 Instruments and associated piping subject to operating flow and / or temperature conditions prevailing in the connected piping or equipment shall be insulated to the same requirements as that of piping equipment.

2.2 Extent of Insulation on Piping Systems.:

2.2.1 Insulated piping systems shall have straight pipe, bends, tees and pipe fittings completely insulated.

2.2.2 All valves and flanged joints shall be completely insulated only in steam, condensate service. Hot oil lines and in lines which are trace heated or jacketed to maintain temperatures.

2.2.3 For bucket and float type traps the inlet piping trap shall be insulated.

2.2.4 Insulation on inlet piping to thermostatic and thermodynamic steam trap shall terminate at approximately 500mm before the trap.

2.2.5 Steam trap outlet piping other than closed condensate recovery system shall not be insulated except for personnel protection reasons.

2.2.6 Instrumentation to be insulated, such as a level gages, level controllers, level switches, dip cells, shall have their fluid containing sections and the associated piping completely insulated, including pipes, valves and fittings.

2.2.7 Insulation shall be designed to provide an absolute minimum clearance of 25mm between the outside surface of any insulation finishing material and adjacent surfaces.

2.2.8 Where insulated horizontal piping is supported on steel shoes, the height of the shoe shall be such that the underside of the insulation finishing material is clear of the supporting structures upon which the shoe rests by 25mm minimum.

2.3 Extent of Insulation on Equipment's:

2.3.1 Support skirts of insulation vertical vessels greater than 1200mm diameter shall be insulated both internally and externally for a minimum distance of 600mm below the bottom tangent line. The insulation shall terminate not less than 300mm above the support concrete or steel work.

2.3.2 Support skirt of insulated vertical vessels of 1200 mm and less shall be insulated externally only.

2.3.3 Bottom heads of insulated vertical vessels enclosed by a support skirt shall be insulated only when the vessel outside diameter is greater than 1200mm.

2.3.4 Turbines and steam ends of reciprocating pump shall be insulated for heat conservation.

2.3.5 Liquid ends of pump shall be insulated when heat traced or jacketed.

3.0 Materials :

3.1 General

3.1.1 All material shall be of high quality and good appearance. This specification covers materials – mineral wool, glass wool, rock wool, calcium silicate, ceramic fibre, etc.

3.1.2 Insulations materials shall be of low chloride content , chemically inert , non- sulphurous , rot proof , vermin proof, impervious to hot water and steam , non – injurious to health and non corrosive to steel and aluminum (even if soaked in water at ambient temperatures for extended periods).

3.1.3 The use of insulation or finishing materials containing ASBESTOS in any form is not permitted.

3.1.4 Insulation and jacketing material backed with paper or other flammable material is not acceptable.

3.1.5 Many common flammable liquids such as oil butanol, diethanolamine and hexonal will react and start fires when they leak into inorganic absorbent insulations. Such absorbent insulations can store large quantities of combustible liquids should a leak occur.

3.1.6 Insulation materials have been classified into two categories – water absorbing and non water absorbing. Non water absorbing insulants like polyisocyanurate and cellular glass are recommended for services up to 125⁰c. Water absorbing insulants like ferrous insulants and calcium silicate can be used for all temperatures except for electrically traced pipe. But for low temperature (i.e. upto 125⁰c) services a suitable moisture barrier shall be used since the service is too low temperature evaporate moisture, rain or hose water absorbed.

3.17 No inflammable material shall be attached to the insulation.

3.18 Dimensions and Dimensional tolerances for pipe sections, mattresses & slab shall be generally be as per respective codes unless otherwise mentioned .The number of pieces to be used shall be as less as possible .When installed the insulation shall fit snugly and shall have a tight joint.

3.19 For low operating temperature (up to 125 deg C) services a suitable moisture barrier shall be used.

3.20 For electrically heated application polyurethane foam (PUR) or Polyisocynurate (PIR) blocks shall be used in combination, with Rockwool as inner layer.

3.2 **Insulation Material:**

3.2.1 **Fibrous Material (Rockwool & Glass Wool)**

3.2.1.1 Shall be a performed insulation and shall be of long fibred rock or glass material processed from a molten state into fibrous from bonded with a binder and suitable for the intend operational temperature range from ambient to 550⁰c . Slag wool is not acceptable.

3.2.1.2 Unless otherwise specified herein, insulation material shall strictly conform to all the requirement of quantity standards listed below.

Performed pipe insulations	: IS: 9842: latest issue/ASTM C547 TYPE II or TYPE III.
Metal mesh covered bonded	: IS :8183/ ASTM C592 CLASSII for piping & equipment
Mineral fiber blanket & Blanket type pipe insulation	: Blanket shall be faced on one side with 20mm galvanized no.22 SWG. Wire mesh, stitched through with 22 SWG . galvanized lacing wire Mattress for lined covers shall be faced on one side with 20mm galvanized 22SWG wire mesh stitched through with 22SWG galvanized lacing wire. Blanket (mattress)

Bonded Mineral fibre slab insulation : IS: 8183 latest issue
Mineral fiber blocks & board thermal insulation. : ASTM C612 TYPE IV/ TYPE V.

3.2.1.3 Insulation shall confirm to following requirement and shall tested and test certificate on representative samples furnished to GIL.as per IS : 8183/IS: 9842 (latest issue) for conformance to each of the following requirements.

Density	140 to 150kg/m3 (density shall be with in this range and density test shall be as per IS: 5688/ IS 3144(latest issue)
Shot content 3144)	Shot shall not be more than 5mm in any dimension: shot content, (IS when sieved as follows, shall not exceed as per below: IS sieve: shot content, percent (IS: 460 by mass (max.) latest issue) 500 micron 5 250 micron 15
Moisture content) &Moisture absorption)	not more than 2%.

IS : 3144)

Incombustibility : 3144 Incombustible loss in weight IS
not more than 3%

Thermal conductivity (IS : 3346)K

* Mean Temperature $^{\circ}\text{C}$

Thermal Conductivity mw/ $\text{Cm}^{\circ}\text{C}$

50	0.43
100	0.52
150	0.62
200	0.68
250	0.80
300	0.90

* mean temperature is hot face temp. + Cold face temp.

Sulphur content not more than 0.6 percent (IS: 3144)

Linear shrinkage 3144) not more than 2 % when subjected to soaking conditions (IS: of soaking heat at the started maximum temperature of use (550°C) for 24 hours

Heat resistance 3144) When heated to max .temp. (550°C), sample shall (IS: maintain its general form and shall not surface visible deformation of the fibrous structure.

Compressive Strength (average) minimum at 10% deformation 120 kg/m³ for LRB blanket (mattresses)

Recovery after compression (IS: 8184- Appendix 'A' IS: 9842- Appendix 'A') after compression to 75% of the original thickness, recovery shall not be less than 90% of the original thickness.

Alkalinity (IS: 8183 Appendix 'B' 9842 Appendix 'B') pH of the solution of the material shall be IS: between 7.0 and 10.0

Chloride content (IS : 3144) not to exceed 20 ppm.

Dimension pipe section

Hollow cylinder , split length wise on one or both sides of the cylindrical axis. Tolerance in length & thickness : +-3mm

When insulated on the pipe of the specified size, sections shall fit snugly and shall have tight longitudinal and circumferential joint .

Blanket (Mattress)

Unless otherwise specifically required, standard width shall be 600 to 1200mm standard length 1500 to 2400mm.

Tolerance in length & thickness : +/- 3mm

Block and boards (IS: 8183) Lengths

: 1000 to 1400mm Widths : 500 to

1000mm

Tolerance : width , length & thickness : +/- 3mm

3.2.2 RIGID MATERIAL (CALCIUM SILICATE)

3.2.2.1 Calcium Silicate :

Calcium silicate block and pipe thermal insulation shall be composed principally of hydrous calcium silicate reinforced with mineral fibers (except stag wool) in shall be asbestos free , it is suitable for all temperatures . Insulation shall confirm to following requirements and shall tested and test certificates on representative samples furnished to GIL as per IS : 8154 (latest issue) for conformance to each of the following requirements:

Bulk density	200 to 280 kg/m ³ to be tested as per IS: 5688
Compressive strength for flat surfaces only . test is waived for curved sections)	Reduction in thickness shall not exceed 10% when (tested per IS : 5688 dry under load of 415 kN/m ² this and wet (after 18 hrs immersion in water) under a load of 170 kN/m ² Even though CL.1.6.3.4 of IS: 5688 indicates 5% deformation, test should be conduct for 10% Deformation
Flexural strength	Average min. shall be 240 kN/m ² when tested per IS : 5688
Heat resistance	when tested per IS : 5724, under conditions of soaking at for 24 hrs at 650 ⁰ C. max. linear shrinkage : 2% max. loss in weight : 15% compressive strength : reduction in thickness under a load of 345 kN/m ² : 10% max.
Thermal conductivity	when tested as per IS : 3346 , shall be: mean temp. ⁰ C Thermal conductivity max. mw/cm deg.

	100	0.65
	150	0.75
	200	0.80
Moisture content	Not to exceed 7.5% by mass ,when tested as per Annex.A IS 8154	
Alkalinity	pH of the solution of the material shall be between 7.0 and 10.0 when tested for appendix B, IS : 8154	
Chloride content	not to exceed 20PPM when tested as per IS: 3134 . For stainless steels special quality, with inhibitors, with less than 10PPM	
Dimensions	Flat Blocks : shall be free from wrap . all mating faces shall be plane and edge shall be square to the surfaces and to one another Length: 500, 6000 or 900mm Width: 150,300 or 600mm, Thickness : 25 , 30,40,50,60& 75 mm Beveled lag : Length: 500, to 900mm width: 150mm Thickness : 25 , 30,40,50,60& 75 mm Curved segment (radius & beveled lags) Length: 500, to 1000 mm Thickness : 25 , 30,40,50,60& 75 mm For curved surface having external radius grater than 110mm Pipe sections : hollow cylindrical shapes slit in half lengthwise (in a plane including the cylindrical axis) or as curved segements . upto 14” pipe size,only hallow cylindrical shapes silt in half lengthwise shall be used. Length: 500, to 1000mm Diameter : to fit standard size of pipe. Thickness : 25 , 30,40,50,60& 75 mm	
Dimensional Tolerance	flat block, beveled & curved segments	pipe sections
Length:	+ -3mm	+ -3mm
width:	+ -3mm	-
Thickness	+ -3mm	+ -3mm

3.2.3 High Temperature Insulation Materials (Above 550°C)

Following types of insulations may be used for high temp insulation applications.

Ceramic Fibre :

Ceramic Fibre shall be composed principally of Alumina silica fibre blanket. It should be used in the temperature range of 551°C to 760°C. Ceramic fibre blankets shall be made out of fibres having fibre length of about 10 cm or more. It shall normally be of 610 mm width, 13mm or 25mm thickness. Unless otherwise specified insulation shall conform to the requirements of ASTM C892 Type III, Grade 8 or to the specifications described in the table below. Insulation shall be tested and test certificates on representative samples furnished. Ceramic fibre blankets shall be sampled for the purpose of test in accordance with ASTM C390.

Chemical & Physical characteristics of Ceramic Fibre Blankets		Test Method
• Chemical composition (By volume%)		
Al ₂ O ₃ (Min)	43	IS 1335
ZrO ₂ (Min) -		IS-10085
Fe ₂ O ₂ (Max)	0.1	IS-1527
TiO ₂ (Max)	0.3	IS1527
SiO ₂ (Max)	57 -	
• Mean Fibre Dia (Microns)	2.5-3.5	BS-2972
(Upto 3% Standard deviation)		
• Dimensional Tolerance Thickness		
(-) 0% to (+)40% -		
Width	(-) 2% (Excess is permitted) -	
Length	(-)0% (Excess is permitted) –	
• Shot Content(% Max)	20	ASTM C-892
• Bulk Density(Kg/m ³ Min)	128	ASTM C-167
• *Bulk Density Tolerance	(+) 30% & (-)0%	
-		
• Thermal Conductivity (Kcal/M/Hr/°C)**Max (Mean Temp)	0.11(600°C)	ASTM C-177/IS-3346
Maxim. Thermal conductivity m W / cm °C at 100oC mean temp. **	0.76 at 200°C for reference	
• Linear Shrinkage (%) (at max temp) for 24hrs	3(1200°C)	ASTM C-356
• Tensile Strength (Kg/cm ² g(min) Longitudinal	0.6	BS 1902 part 6

Transverse 0.5

* The density shall be calculated on the basis of actual dimensions and actual weight only, as offered by the manufacturer.

**In case of thermal conductivity Please also refer Thermal Conductivity Values at different mean Temperatures

3.2.4 Insulation material for Impulse lines and small dia pipe below 1 ½ Inch

Ceramic Fiber Rope for Insulation of Impulse / Small dia pipelines (1 ½ inch & below) as per IS: 15402 .For impulse lines insulation material shall be Ceramic fiber rope insulation unless otherwise mentioned. Ceramic Fibre rope shall be made up of Ceramic Fiber insulation of min density 250 Kg/m³. It shall comprise of ceramic fibers laid parallel and finally wrapped with stainless steel wire to reinforce the fibers and holding it in position. Other properties of ceramic fibre shall conform to the specifications as described in clause 3.2.3(1).

For Small dia pipes of 1½ inch & below Ceramic Fiber rope may also be used (approximate size of rope 19 mm size rope) and covered with Aluminum tape wherever exposed to open atmosphere.

Note: Ceramic fiber rope insulation for Impulse line:

Size layer (Impulse line)	Temp	No. of Ins layers	approx. indicative thickness of each
½”- 1 ½”	up to 250degC	1	19mm

Measurement shall be made in running meter of the actual ceramic fiber ropes use in insulating the pipeline or impulse line and payment for the same shall be done accordingly.

3.2.3 General:

Periodical checks for density, thickness, shape and size as per above requirements shall be repeated at site, as per norms and frequency decided at site, as per the direction of BCPL site- in-charge for the job at different section of the unit. Special attention is required for fibrous material as its installed thickness could be reduced due to compaction affecting performance.

All the codes mentioned shall be the latest issue.

BCPL shall have right to inspect any or all the tests conducted on insulation material by manufacturer at his shop or any laboratory.

3.3 **Weather protection jacket:**

3.3.1 Unless otherwise mentioned, Aluminium jacketing shall be used as weather protection over insulation unless otherwise specified except Fire hazardous area /above 550 degC where it should be stainless steel or Aluminized steel. For grade piping in off sites jacket material shall be galvanized steel. Aluminum shall be ASTM B209 alloy 3003 H16 or IS : 737 designation 31000 (old NS3) condition H3 for flat sheets and designated 31500/51300 condition H4 for corrugated sheets. (or applicable Indian standards shall be followed) . For stainless steel cladding the material shall be in accordance with ASTM A167 or A240 type 304. For aluminized steel cladding, the material shall be in accordance with ASTM A463, type 2, coating designated T2-100. GI shall be as per IS 277 Cladding shall be coated on the side in contact with the insulation with the bitumen anti- corrosive paint. Cladding (other than galvanized steel) shall be coated on the side in contact with the insulation with a polycraft moisture barrier consisting of one layer of one mil high density polyethylene film with a protective layer of 40-pound minimum virgin kraft paper. Polycraft moisture barrier shall be heat laminated and applied in factory. Thickness of the jacketing shall be as follows:

3.3.1.1 Fibrous Material (Mineral wool-Rock & Glass Wool)

For shell of vertical storage tank and vessel, : 22SWG or 0.71 mm corrugated ,The profile of corrugated sheet shall be 32mm,5mm and whereas in Stainless steel/Aluminized steel cladding 0.56 mm (24SWG) corrugated the profile shall be 32mm,5mm

Tank Roof: 1.22mm (18SWG) Flat, and whereas in Stainless steel/Aluminized steel cladding 0.91mm (20 SWG) Flat.

Horizontal vessel shell and heads, vertical vessel heads, exchanger etc. : 22SWG or 0.71 mm Flat Stainless steel/Aluminized steel cladding 0.56 mm (24 SWG) Flat.

For removable covers Thickness for Aluminum cladding (other than grade piping in off sites 1.22mm (18 SWG) Flat Thickness for Stainless steel /Aluminized steel cladding 1.22mm (18 SWG) Flat.

For all pipelines, equipment's ,including valves and flanges steam traps etc : Aluminum cladding 0.71mm (22 SWG) Flat and for Stainless steel/Aluminized steel cladding .56 mm (24 SWG) Flat .

Note for grade pipelines in offsite including valves, flanges etc: Al .71mm (22 SWG) however if required 0.56mm (24 SWG) Galvanized steel (as per discretion of site in charge).

3.3.1.2 Rigid material (calcium silicate)

For pipelines, equipment's, vessels, tanks, spheres, columns, valve, Flanges, exchangers: AL (22 SWG) Flat. for Stainless steel/Aluminized steel cladding .46 mm (26 SWG) Flat .

Vertical vessel shell & vertical portion of storage tank: 0.56 mm (24SWG) corrugated; the circular profile of corrugated sheet shall be 32mm, 5mm. for Stainless steel/Aluminized steel cladding .46 mm (24 SWG) corrugated .

Thickness for Aluminum jacket / cladding Removable covers 1.22mm (18 SWG) Flat **Thickness for Stainless steel / Aluminized steel jacket/cladding** 1.22mm (18 SWG) Flat

3.4 Ancillary Materials

3.4.1 Aluminium Foil to Protect Stainless Steel Surfaces Shall be 0.19mm (36 SWG) thick per ASTM B209 alloy 3003 H16 or IS : 737 designation 31000 (old NS3) condition H3.

3.4.2 Securement Bands / Wires

3.4.2.1 If material is aluminum, then specification shall be ASTM B209 alloy 3003 H16 or IS : 737 designation 31000 (old NS3) condition H3. if stainless steel, it shall be 18/8.

3.4.2.2 For securing aluminum foil on stainless steel surfaces band, 24SWG thick x20mm wide, aluminium.

3.4.2.3 For Securing Fibrous Insulation

On piping: Band 24SWG thick x 12 (min) wide, stainless steel On

equipment's: Band 24SWG thick x 20 wide, stainless steel.

On vertical storage tanks: Band, stainless steel 25mm wide Intax 24SWG thick. Horton

sphere: Band, stainless steel, 25mm wide x 0.8mm (min) thk.

3.4.2.4 For Securing Rigid Insulation

On piping up to 16" OD, wire, stainless steel , 16SWG

On piping 18" OD and larger vertical and horizontal equipment's Band , stainless steel , 20 wide x 24SWG thick

3.4.2.5 For Securing Cladding On Insulation (Both Fibrous And Rigid) For

piping: Band, stainless steel , 12mm (min) wide x24SWG thick ,

On equipment: Band, stainless steel , 20mm (min) wide x24SWG thick ,

On vertical storage tanks: Band, stainless steel, 25mm wide x 24SWG thick. On

spheres : Band, stainless steel, 25mm wide x 24SWG thick.

Rivets required for metal jacket securement shall be the expanding aluminium “pop” blind eye type , 9.5mm long x 5mm diameter.

Screws required for metal jacket securement shall be stainless steel/cadmium plate steel self- tapping type A No. 8 dia x 12mm long to BS 4176 complete with neoprene washer under the head .

3.4.5 ‘S’ and ‘J’ clips formed from 25mm side stainless steel banding.

3.4.6 To ensure perfect water proofing all the cladding joints shall be packed with sealing materials which may either be in the form of an elastomeric sealing compound or fiber based bituminous felt strips.

4.1 Application

4.2 General

4.2.1 The applications methods, given in this standard is general in nature. The contractor is responsible for applying an insulation system that will give a satisfactory operational performance and the requirements given herein shall be regarded as the acceptable minimum. The contractor shall carryout the work in accordance with the best practices of insulation application with the minimum of waste and derbies and the final job shall have a neat efficient and work like appearance.

4.2.2 All hydrostatic testes on piping and equipment, including steam tracing systems, shall be carried out before insulating material is applied.

The insulation contractor shall only insulated those sections of the plant that has been specifically released for such work by the engineer – in – charge. If insulation must be installed before pressure test, then all welds and flanged joints in the pipe shall be left uncovered till successful competition of pressure test. Then insulation shall be completed

4.2.3 Surface to be insulated shall be thoroughly cleaned, dried and made free from lose scale, oil or grease. It shall be the contractor responsibility to remove loosely adhering scale and dirt before applying insulation.

4.2.4 Corrosion Prevention

4.2.4.1 Carbon steel and alloy piping and equipment with normal operating temperature of 125⁰ C and below shall be protected against corrosion by painting with a 20 microns (min) dry film thickness of heat resistant aluminum paint suitable for the above temperature . While for equipments (vessels, exchangers, tanks and spheres), this coating shall be provided by equipment fabricator, Piping /equipment paint and its application painting is not in the scope of insulation contractor.

4.2.4.2 Insulation cement shall not be used on stainless steel piping or equipment.

4.2.4.3 All insulated austenitic stainless steel piping and equipment insulated with calcium silicate, rock or glass wool shall be protected against chloride attack as follows for operating temperatures upto 450⁰c the surfaces shall be wrapped with 0.19 mm thick aluminium foil with 50mm overlap at longitudinal and circumferential joints before application of insulation . All joints of the aluminum foil shall have barium chromate primer interposed. Aluminum foil shall be firmly secured on the stainless steel surface by aluminum bands at a pitch of 500mm. Care shall be taken while applying aluminum foil ensure that the foil is not punctured at any place during wrapping and clamping with aluminum bands. For operating temperature above 450⁰c the stainless steel surfaces shall be painted with two coats of heat resistant silicon aluminum paint as follows

Type	: single
Composition	: silicon resin based with aluminum flakes as pigment Dry
film thickness	: 20 microns / coat (min)
Other requirements	: it should be suitable to with stand temperatures up to 600 ⁰ c when the paint becomes dry the painted surfaces shall show no discontinuity.

4.1.5 The insulation contractor shall not carry out any welding or drilling on plant equipment and piping.

4.1.6 Insulation shall be finished, beveled and weather proofed at all terminal points where it is required to remove bolts etc. with out damage to the insulation.

4.1.7 Equipment name plates shall remain visible after insulation has been applied by beveling back the insulating material and carefully sealing the exposed edge to prevent ingress of moisture.

4.1.8 All projections, such as lifting lugs, trunions and stiffeners on piping and equipment (i.e. vacuum rings) shall be insulated with the same thickness of insulation as specified for the equipment item or pipeline.

4.1.9 The removal bosses, pressure tapping and weep hole nipples shall not be insulated in but left accessible.

4.1.10 Double layer insulation shall be required when the insulation thickness is greater than 75mm. insulation installed in two or more layers shall be staggered joint construction and each layer shall be secured in place and details of securement shall be the same for each layer.

4.1.11 Wet or damaged insulation shall not be used under any circumstances. Insulation material to be applied shall not be kept over bare ground to avoid water absorption. Installed material awaiting its protective cover shall be adequately protected from damage, rain and contamination and shall be covered with cladding at a minimum loss of time.

4.1.12 A minimum clearance of 25mm between outside surface of any insulation finish and adjacent equipment, pip or structural members shall be mentioned.

4.1.13 Insulation supports shall not project out of the insulation outer surface and shall be given sufficient coverage of insulating material to avoid hot spots on the metallic cover at support positions.

4.1.14 The insulation shall be so designed/applied such that ingress of water is prevented, leaked product can drain off and vapors can escape.

4.2 **Piping**

4.2.1 Material

4.2.1.1 Fibrous material (rock or glass wool)

Can be used for all piping other than electrical traced pipes up to 125⁰c

Can be used for all temperatures. Shall be in performed pipe section / blankets (mattress) are acceptable.

4.2.1.2 Calcium Silicate

Can be used for all piping other than electrical traced pipes upto 1250c Can

be used for all temperatures.

Ceramic Fiber

Shall be supplied in blanket strips in sizes as mentioned in the material spec in clause 3.2.3.

Pieces of insulation with cursed and damaged ends shall not be used.

Pipe sections bored / machined out of blocks shall not be used as skin effect is lost.

4.2.1.3 Corrosion protection before applying insulation :

All (insulation materials) for operating temp. up to 125⁰c, on carbon and alloy steel piping, provide painting. For stainless steel piping, provide a aluminum barrier. Painting shall not be in the scope of the insulation contractor. However aluminum barrier for stainless steel shall be done by insulation contractor.

4.2.3 **Application**

4.2.3.1 Horizontal Pipe

4.2.3.1.1 General

Insulation material shall be applied to fit snugly against the contours and shaped only where necessary to achieve this requirement. This insulation shall be carried out with the least number of material pieces as possible and all unavoidable gaps, cavities, and voids suitable filled with compatible loose fill material.

4.2.3.1.2 If Pipe Section / Moulded Blocks /Segments

End joints of adjacent blocks shall be staggered one half of the block.

Included angle between segments shall not be less than 30 deg for both single and double layer insulation.

Further, minimum are length of segments should meet following staggering requirements.

When double layer is applied, both longitudinal and circumferential joints shall be staggered. The arc between the longitudinal seam lines of the inside and outside layer of insulation shall have an angle of over 15 deg or the longitudinal joints staggered at least by one layer thickness, whichever is more stringent. Circumferential seams of the inside and outside layers shall be at least 100mm apart.

4.2.3.1.3 If Mattress/Blankets (Fibrous Insulation – Rock or Glass Wool)

Shall be applied over the surface with joints tightly butted and laced together with 1mm dia galvanized lacing wire.

4.2.3.1.4 Insulation Securement (All Insulation Materials)

Each layer of insulation shall be secured firmly in place with at least 3 loops of binding wire / band , one loop to be placed not more than 75 from each and at least one loop be equally spaced between and loops for each section . Binding wire shall be drawn about the insulation with ends tightly twisted together, bent under & pressed into the surface of insulation. Bands or wires in no case be spaced more than 200mm apart.

For calcium silicate, all joints shall be sealed with insulating cement of same composition as the molded block.

Each layer of insulation shall be secured by the same method as below.

4.2.3.1.5 Frame work for supporting cladding: fibrous insulation

This is not necessary for rigid materials. This is required only for horizontal pipe runs provided with fibrous insulation in blanket (mattress) form. Vertical piping provided with fibrous materials need not be provided with this. Piping provided with fibrous resin bonded pipe sections also need not be provided with this framework.

Spacer rings shall be fabricated out of 25x3 M.S. flats. The outside diameter of the insulation spacer rings shall be riveted to 'Z' shaped stays fabricated from the same sized M.S. flats. These rings shall be suitable painted for corrosion protection. Stays shall be provided at intervals of the insulation, subject to a minimum of 3 stays. Spacer rings shall be provided at every approx. 900. To minimize direct heat conduction through the stays, a packing of 2 sheets of 3 thick asbestos mill boards shall be provided at the joints of the stays and pipes. Joint between M.S spacer ring and stays shall be riveted by 6 dia M.S. rivets with 2 sheets of 3 thick asbestos mill board interposed.

4.2.3.2 Vertical pipe (all insulation materials)

Insulation on vertical or near vertical piping (i.e. greater than 45 angle from horizontal) shall be supported by bolted on metal collar shall be 6 thick M.S or alloy bar (to suit piping material)

Outside diameter of collar shall be around 12 less than O.D. of insulation. where multilayer insulation is used , support collar shall be extended to provide for each layer.

Support positions shall be at no greater distance apart than the following:

Pipe operating temp.	Support spacing
Upto 400 ⁰ c	4500mm
400 to 500 ⁰ c	4300mm
500 to 550 ⁰ c	2500mm
551 to 650 ⁰ c	2000mm
651 to 760 ⁰ c	1500mm

4.2.3.3 Expansion joints (both vertical and horizontal piping . all insulation materials)

Expansion joint shall be provided at regulation interval as bellows:

Temp. 0c	spacing (M)
upto 200	not required
200to 300	10
300to 350	8
350 to 400	6
400 to 550	5
551 to 650 ⁰ c	4
651 to 760 ⁰ c	3

Expansion joint shall be formed by a 25mm space between the pipe insulation sections and the space shall be filled by compressed mineral rock fibers. Expansion joints in each layer shall be offset at least 150 each other in case of multilayer insulation. Expansion joint for vertical pipe shall preferably just below insulation support collars.

4.2.3.4 Elbows and bends (all insulation materials)

Insulation material shall be mitred and shall be same as that of pipe. Insulation securement bands / wire shall be same as that for equivalent dia pipe. Each mitred section shall be secured with minimum 2 wires / bands. For bands /elbows of nom. Pipe size 6” & below , due to lack of space , for all insulation materials insulation shall be secured by spirally wound 16SWG galvanized steel wire for hard material & 10 SWG galvanized steel wire for soft material. Insulation joints of block material shall be suitable sealed with adhesive for isocyanurate / cellular glass and by insulating cement for calcium silicate. Fittings below 50mm nom. dia, if insulated of calcium silicate shall be insulated with insulating cement build up in 6mm layers to the thickness of insulation of the adjacent piping. Each layer of insulating cement shall be reinforced with 25mm no. 20 SWG wire netting.

4.2.3.5 Tee (all insulation materials)

Performed pipe sections or segments shall be carefully cut and shaped around 'tee' junctions and the insulation material of the tangential pipe shall be carefully and neatly cut to make up to the material applied to the parent pipe without the creation of voids or gaps, at the junction. Insulation shall be adequately secured by wire / band of same specification as that of same size pipe.

4.2.3.6 Flanged joints or valves (all insulation material)

Flanged joints or valve, if to be insulated, shall be insulated with prefabricated removable aluminum covers, lined with pipe sections / lags/slabs. Welded valve, if insulated, shall be insulated with oversized pipe sections or lags, cut and shaped to fit around the body of the valve. Insulated valves shall be completely covered, but the insulation shall be cut and shaped around the valve stem and kept clear of the stuffing box gland.

4.2.3.7 Insulation flashing (all insulation materials)

Insulation shall be stopped short of flanged joints and unions by a sufficient distance to permit easy removal of the flange nuts and bolts or breaking of the unions to take without disturbance or damage to the insulating material. At these positions the insulation shall be beveled and sealed with a metal closure which in turn shall be sealed with water proof sealing material.

4.2.3.8 Pipe supports: (all insulation materials)

Insulation at solid welded or clamped supports shall be cut and shaped to fit around the support and banded securely to enable the insulation to be carried with the pipe movement. When the pipe hangers pass through insulation on piping outdoors, metal hoods packed with a waterproof sealing material shall be furnished and installed. Upper bolts of the hanger clamps are not to be covered with insulation.

4.2.3.9 Steam traced piping: (all insulation materials)

Steam traced piping and fitting shall be installed with oversized sections to allow accommodation of both parent pipe and tracer without damage or deformation of the insulation. Traced instrument line and fittings shall be totally enclosed by the insulation in a similar manner and the designed warm air annulus maintained throughout the tracer pipe length. Insulation supports for vertical pipe shall have suitable clearances for tracer pipe. Composite box type insulation may be provided on the steam supply lead lines, in case they are routed together similarly this may be provided for the return lines to manifold after the run of tracers..

4.3 **Horizontal Equipment**

4.3.1 Material

4.3.1.1 Fibrous material (Rock or glass wool)

Can be used for all temperatures.

Shells: Preferably preformed pipe or multi pipe segments or slabs cut and shaped to fit. Alternately, Blanket (mattress) may be accepted.

Heads: Preformed blocks and slab cut and shaped to fit ,blankets may be accepted.

4.3.1.2 Calcium silicate. Can be used on all surfaces.

Temperature limitations for each shall be as mentioned above. Curved segments / blocks, mitre cut and shaped to fit.

4.3.1.2 Ceramic Fibre
Shall be supplied in blanket strips in sizes as mentioned in the material spec in clause 3.2.3.

4.3.2 Corrosion protection before applying insulation:

All insulation materials: For stainless steel surfaces, provide same protection as for piping.

4.3.3 Application (All Materials)

4.3.3.1 Following, provided by the vessel fabricators for insulator / cladding support / securement, as indicated in enclosed sketch no 7-12-033, shall be verified for their presence by the insulation contractor, before commencing insulation work:

- . For vessels of diameter 2000 mm and above are provided insulation support at horizontal centre line as also vertically at tangent lines. Ring support at tangent lines are provided with 6mm dia meter holes. These are to be used for insulation securement.

- . At vessel heads above 600mm outside dia meter are provided flats having 6mm dia holes . The flats are for insulation support and holes provided in them are to be used for insulation securement. Also provided on either head is a central ring made of 10 dia galvanized steel rod. For vessel fabricator, for such vessels insulations contractor shall provide these rings

- . Boot of vessels, if any is provided with circular support ring with holes with holes .

4.3.3.2 Blanket (mattress) shall be applied over the surface with joints tightly butted and laced together with 1mm dia galvanized lacing wire.

Other block insulation shall be applied with the longer dimension parallel to the axis of the vessel or equipment. When blocks are applied in multiple layers, all joints in successive layers shall be parallel to the long axis , shall be staggered and sealed with insulating cement for calcium silicate or suitable adhesive for others . In all cases , the insulation is to fit the contour of the vessels or equipment , so that the use of a leveling coat of insulating cement should not be normally necessary to get an acceptable smooth exterior .

4.3.3.3 Special considerations for insulation high temperature vessels (required only if provided with calcium silicate insulation)

This provision is required to take care of the effects of equipment circumferential thermal expansion on insulation.

This provision is required only for vessels and exchangers provided with calcium silicate insulation.

Calcium silicate insulation should be installed in beveled or curved segments only, to avoid voids and provide an efficient insulation system.

For equipment upto 3000mm in diameter and 200⁰c to take care of equipment circumferential expansion, the circumferential block is cut and fitted to be 13mm grater in circumferential than the equipment and secured so that tension of the bands produces compression on the butt edges rather than on the surface towards the vessels. The little annular space and the compressiveness of the blocks would suffice to take care of circumferential expansion of equipment.

If the vessel is above 3000mm in diameter or if the temperature is above 200⁰c or both, 25mm thick rock wool fiber blanket (mattress) insulation shall be applied around the equipment prior to the application of calcium silicate. This acts as an expansion area around the equipment to act as mechanical and some time thermal cushions. The calcium silicate block must be cut and fitted to the outside radius of the equipment plus the thickness of the rockwool spacer insulation. The insulation, when installed, should not compress the fiber blanket.

Above provision to take care of circumferential expansion is required both for shell and head.

4.3.4 Insulation securement (for all insulation materials)

Each layer of insulation on shells of equipment shall be secured by bands at every 225 centers. Each band shall be machine stretched and tensioned to remove slack only.

Each layer of insulation on vessel heads shall be secured as follows:

Band shall be in radial direction connecting the head central floating ring and shell girth ring. The radial bands shall be placed at not more than 150 centres for rigid and 300 for fibrous than 150 centres for rigid and 300 for fibrous insulation, measured at the girth ring. These bands shall be machine stretched and sealed. Outermost layer of insulation shall also be supported by drawing and securing 16SWG annealed steel wire through the 6 diameter holes provided in the shell girth ring as also the flats provided on heads. The wire shall be drawn through every hole and it shall be secured to the ring with a knot.

4.4 Vertical equipment

4.4.1 Material

4.4.1.1 Fibrous material shall be same as specified for horizontal equipment.

4.4.1.2 Calcium silicate shall be same as for horizontal equipment.

4.4.2 Corrosion protection before applying insulation (for all insulation material)

Corrosion prevention before applying insulation for stainless steel surfaces shall be same as specified for horizontal equipment.

4.4.3 Application (all insulation materials)

Application details on shell, top and bottom heads shall be similar to that of horizontal equipment. Insulation shall be similar to that of horizontal equipment. Insulation shall be laid on insulation support ring provided by the fabricator.

4.4.4 Insulation securement (all insulation materials)

Bottom and top head insulation shall be supported by 16 SWG annealed galvanized steel wire drawn through holes in the insulation supports provided by the fabricator.

Top head insulation shall be secured by floating ring / bands provided by vessel fabricator similar to head of horizontal vessels.

Shell insulation shall be supported by bands at every 225 centres on the cylindrical portion and the bands shall be kept horizontal.

Insulation securement for bottom head vessel supported on legs shall be identical to that of top head.

For insulation securement of bottom heads inside skirt n floating rings/ bands need be provided; firm securement should be ensured just by 16 SWG annealed wire drawn over insulation tightly and through the holes on support rings provided by the fabricator.

4.4.5 Expansion joints (all insulation materials)

Expansion joints shall be provided every 4000mm(max.) the joint shall be provided at insulation support rings. It shall be a 25mm space between the top of the insulation and the bottom of the support ring. The space shall be filled up by compressed rockwool fiber.

4.5 Flange, nozzle, channel cover, manway and handhole flanged cover (all insulation Materials)

Where insulation is required, these shall be insulated with lined removable prefabricated covers secured with bands or quick release toggle clips.

Otherwise, insulation shall be stooped short of uninsulated flanges and nozzles etc, a sufficient distance to permit withdrawn of bolts without disturbing the remaining of the insulation. Insulation shall be weather proofed and sealed at these locations.

4.6 Irregular surfaces such as pumps, compressors turbine etc.

4.6.1 Corrosion Protection

For S.S. surfaces at all temperatures, provide same protection as indicated for piping.

4.6.2 Application

4.6.2.1 Fibrous material: material, application and insulation securement

This shall be prefabricated removable aluminium covers, lined with mineral rock / glass wool pipe sections. Lags/ slabs / mattresses.

4.6.2.2 Calcium Silicate

Insulation material shall be insulating cement / block insulation cut and fitted.

Insulation shall be applied in max 25mm thick layers until the scheduled thickness is obtained.

Each layer shall be covered with a layer of 25 mm hex. 20 SWG galvanized iron wire mesh. The final layers shall be trowelled to a smooth finish with 6mm thick finishing cement.

Insulation shall be beveled back at 45⁰ from all casing flanges, shaft seal caps and bearing boxes.

4.7 Vertical Storage Tank: (Carbon Steel)

4.7.1 Material

4.7.1.1 Fibrous material (Rock / Glass wool) shall be in the blanket (mattress) form.

4.7.2 Application

4.7.2.1 Supporting rings / spikes (rods) for supporting insulation / cladding

4.7.2.1.1 Shell

Following insulation provided by tank fabricator.

Water Shed

At the junction of shell and roof , a water shed is provided to act as top covering for the shell insulation .

Insulation support will consist of 5mm dia diamond pitch. Length of these lugs is 3 mm less than insulation thickness.

Cladding support from tank top, horizontal rings shall be provided at every 1175 mm on tank shell.

4.7.2.1.2 Tank Roof

4.7.2.2 Insulation Laying and Securement.

4.7.2.2.1 Shell

Application of fibrous insulation

Insulation shall be applied between rings in horizontal mode. Mattress insulation shall be applied with joints tightly butted and laced together with 1 mm dia galvanized lacing wire. Mats shall be impaled to the 5mm rod and speed washers fixed and pressed home for intimate contact of the insulation. In the case of multiple layers, speed washers are necessary only over the final layers (upto and including 150mm). Rod and speed washer of spring steel should be selected to suit each other. While rods are provided by tank fabricator, speed washer shall be furnished by insulation contractor. Insulation shall be further secured by bands spaced centrally between insulation supports.

4.7.2.2.2 Roof (for all materials)

Application of both fibrous shall be similar to that as for shell. Insulation support from 5mm dia M.S. lugs shall be exactly same as in shell.

4.8 Horton Spheres:

4.8.1 Material

Shall be only mineral rock / glass wool blanket.(mattress)

4.8.2 Application

4.8.2.1 Structural members provided by sphere fabricator for insulation / cladding securement.

4.8.2.2 Insulation laying and securement

Insulation shall be applied between rings. Mattress insulation shall be applied with joints tightly butted and laced together with 1mm dia galvanized lacing wire.

Insulation shall be secured by drawing and securing tightly 16SWG stainless steel wire through the 6 dia holes, provided every 200 centres, in the horizontal leg of the insulation support angle ring. The wire shall be tightly drawn over the insulation and the insulation firmly secured. The wire shall be drawn through every single individual hole and it shall be secured with angle with a knot at every fourth hole.

5.0 **Insulation finish**

5.1 General

5.1.1 Moisture barrier

On all surfaces except Horton sphere, provided fibrous materials and calcium silicate.

For surfaces upto 125 °C, apply a breathing type moisture barrier as below. A 3 mm thick coating of mastic shall be applied to the surface of the insulation as soon as possible, after erection, to reduce the time of the insulation is exposed to the weather, to a minimum. Whilst this coat is still wet, glass cloth shall be laid over the surface and embedded in the mastic. Care shall be taken to ensure that the glass cloth is laid smooth and free from wrinkles and that no pockets of air are trapped beneath the surface. At junctions in the glass cloth, the overlap shall not be less than 75mm. a second 8mm thick coat of mastic shall be applied after

approximately 12 hrs. When dry this coating shall be a minimum of 1.50mm thick. Care must be taken, however, to ensure that the individual coats are not greater than 3mm (especially corners) otherwise some cracking of dried coat may result. The mastic shall not be applied over the wet insulation or until the adhesive is dry. During the drying time, the insulation shall be protected from the weather by "alkathene" film type tarpaulin or similar materials approved by Engineer-in-charge.

5.1.2 Insulation finish

The insulation finish shall provide a weatherproofed, mechanically damage resistant covering over the whole of the insulated areas and be applied and fitted in such a manner as to provide a close fitting assembly without gaps.

5.2 Piping (for all materials)

5.2.1 Straight pipe shall have metal jacketing cut a machine rolled. (Approx. 1 meter long) wrapped around, with 50 mm minimum overlaps on both longitudinal and circumferential overlaps. All laps shall be arranged to shed water.

5.2.2 A single bead shall be made on overlaps to ensure tight metal to metal water tight arrangement. Self-trapping screws, at every 150, shall be provided at all longitudinal overlaps for both horizontal & vertical piping.

5.2.3 At all operating temperatures the seams at overlap positions shall be rendered watertight per clause 3.4.6 to ensure that insulation remains dry and unwetted, whether the possible water impingement is from rain, hose or fire sprinklers.

5.2.4 The metal coverings shall be secured tightly around the insulated pipe and held in place with bands on a maximum of 300mm centres. One band shall be located on each circumferential lap and the distance between laps divided at equal band spacing. The band securing seals shall be kept neatly in line and positioned away from viewing angles as much as possible.

5.2.5 Vertical overlaps on vertical or near vertical piping shall be staggered in provided overlaps at 'north' and 'south' positions in alternative sections of covering.

5.2.6 Each section of metal covering on vertical piping with insulation larger than 250mm shall be supported from the next lower section with two 'S' clips fabricated from banding material. The 'S' clip shall be of sufficient length to allow the minimum overlap of 50mm.

5.2.7 On vertical piping with O.D.'s of 600mm and larger, the securing bands shall be supported by 'J' clips, fabricated from banding material. The 'J' clip spacing shall be minimum of two per band. All 'J' clips shall be screwed into position and secured.

5.2.8 Insulated bands and elbows in piping 80mm and larger, shall be metalled with 'lobster back' segments using 10mm minimum ball swage to assist shaping. The metal bands shall be screwed with tapping screws and metal sealants are to be provided to get a completely waterproofed arrangement.

5.2.9 Insulated bends and elbows in piping smaller than 80mm may use complete pressed humped back flat metal elbows or fabricated ‘ stove pipe’ elbows.

5.2.10 The practice of locating all joints in the top portion of elevated horizontal pipes for the sake of good –appearance when looking up from grade shall be located to shed water.

5.3 Equipment (for all materials)

5.3.1 The metal jacket over vertical vessel shells shall be constructed of sheet metal panels with the weight of the panel taken on the equipment insulation support rings , via angle brackets bolted to the panel.

5.3.2 The panel shall be applied commencing at the bottom of the vessel. Each circumferential ring of panel shall be tensioned by means of tensioning bands until the final joint is screwed tight . ‘S’ clips shall be used as sheeting support at unscrewed circumferential overlaps.

5.3.3 The panels shall be held tight over the vessels insulation by means of circumferential Bands and sealed per 3.4.6, the bands shall be positioned on all horizontal overlaps and at 450mm centres . bands shall be held in their relative positions with ‘J’ clips and be machine stretched and sealed to remove slack only . those bands which are not supported by ‘j’ clips, shall be held in position on cladding by providing pop rivets at every 2 M centres.

5.3.4 The panels shall have minimum overlap of one corrugation on vertical joints and 80mm on horizontal joints. The overlaps shall be arranged to shed water at all times.

5.3.5 The vertical and horizontal overlaps shall be secured with self trapping screws at 150 mm pitch except the horizontal overlaps pre selected. To act as expansion joints , these shall be constructed with a 150mm overlaps and shall remain unscrewed and left free to permit expansion. All overlaps shall be rendered watertight .

5.3.6 All equipment projections such as nozzles, shall have the jacketing sealed using a metal flashing cut to fit the projection and extending above the jacket at least 80mm. The seal between the flashing and jacket shall be made water tight by use of self tapping screws and sealing mastic.

5.3.7 Horizontal cylindrical equipment shall be furnished with flat metal jacket arranged in circumferential bands with the edge of the sheets , with a longer dimensions applied around the circumferential of the equipment insulation .

5.3.8 The panel shall have a minimum of 80mm overlap on both longitudinal and circumferential edges, both overlaps being finished with a simple ball swage and rendered watertight .

5.3.9 Horizontal overlaps shall be secured with no. 8x12mm long self trapping screws set in the overlap at 150mm intervals , and shall be staggered bands of paneling encircle the equipment . Vertical overlaps shall not be screwed for horizontal equipment.

5.3.10 The metal finish shall be banded and sealed at 450mm centres.

5.3.11 the insulated heads of vertical and horizontal equipment shall be fabricated from flat metal , in an “ orange peel “ construction with all radial seams overlapping a minimum of 50mm and secured with self tapping screws at 150mm centres. All overlaps shall be ball swaged and be rendered water tight per 3.4.6.

5.3.12 Projections from the heads shall be sealed using metal flashings, neatly cut to fit around the projections and extending above the jacket for a minimum of 80mm. The seal between flashing and jacket shall be waterproofed with a self tapping screws and mastics.

5.3.13 Insulation at bottom heads of fully skirts equipment does not require weatherproofing.

5.3.14 Heads of equipments 25” O.D and smaller shall be finished and waterproofed with square ended fabricated covers.

5.4 Vertical storage tanks.

5.4.1 Cladding applications and securement

5.4.1.1 Shell

Cladding is applied over the system of horizontal rings as follows: Overlaps

in the vertical joints will be one corrugation .

Overlaps in the horizontal joints shall be 50mm (min.)

Cladding to cladding fastening , at both horizontal and vertical overlaps shall be alternately by “POP” rivets : self tapping screws at 150mm pitch.

Cladding shall be secured to support ring by bolting . Bolts are provided by tank fabricators at 300mm centres on angles provided at every 1175 centres vertically. Felt washer , aluminium washer and nut shall be supplied by insulation contractor for all bolted connections at shell , roof and curb angle.

Insulation shall be tucked into the skirt position of the curb angle . Shell cladding and extended roof cladding shall be secured to curb angle by bolting .

Horizontal stainless steel bands over cladding to be provided every 800 mm and also to coincide at every horizontal cladding overlaps . Bands shall be tightened , locked and lock fastened featuring stainless steel fastening systems. In order to prevent sliding of the bands downwards , the bands shall be secured to the cladding using pop rivets at horizontal pitch not over 2 meters.

5.4.1.2 Roof

All cladding joints shall be sealed by elastomeric metal sealants. Min. 75mm overlap shall be ensured at all joints.

At all joints , cladding to cladding securement shall be provided by self-tapping screws and pop rivets alternately , every 150 centers.

Cladding shall be secured by bolting at every 300 provided by tank fabricator.

5.5 Horton sphere

5.5.1 Cladding support

Insulation contractor shall provided 25mm x 0.8 mm S.S bands over insulation and install them longitudinal from top to bottom of the sphere in such numbers so as afford a minimum spacing of 1175mm at numbers so as to afford a maximum spacing of 1175 mm at the equator. The S.S bands are spanned between four flatting rings, the one at the top and bottom of the sphere are provided after insulation is applied prior to application of cladding . Flotings rings will be constructed of 10mm diameter rods of S.S diameter of ring at the top and bottom , to be around 1.2m. Cladding support bands shall be tightened using mechanical tighteners and fastened to MS/AS angles using two S.S . Rivets or four nos. of aluminium POP rivets per angle cleat.

5.5.2 Cladding Application

While applying cladding , following shall be ensured : Min. overlaps both horizontal and vertical shall be 50mm.

5.5.3 Cladding securement and sealing of joints

All joints to be sealed using elastomeric metal sealant.

Cladding to cladding securement of vertical and horizontal overlaps shall be alternative by POP rivets and self-tapping screws, at every 150mm spacing.

Cladding shall be secured to the insulations angle support by bolting the cladding on the bolts provided at every 300pitch at every angle support . Asbestos mill board washer , aluminium washer and nut shall be supplied by insulation contractor .

Further cladding shall be secured by 25mmx 0.5 mm S.S. bands , applied identical to those for insulation securement . The bands shall be provided between two floating rings , one at the top and one at the bottom and arrangement and details shall be identical to that of insulation securement. Bands shall be secured to cladding every 2M by one S.S. or two aluminium POP rivets .While providing floating rings., for both insulation and cladding securement , following points shall be taken care of :

Floating rings shall clear nozzles / manholes etc.

Exercise extreme care while installing floating rings regarding cut outs in cladding around projections.

Cladding at interface between leg and the body of the sphere to be provided with care and suitably sealed to prevent water ingress.

PLEASE NOTE FOR FURTHER CLARITY ABOUT HOT INSULATION PL REFER EIL STANDARD SPECIFICATION FOR HOT INSULATION OF VESSELS, PIPING AND EQUIPMENT (EIL SPECIFICATION NO: 6-44-02 REV-5) FOR DRAWINGS AND SKETCHES & OTHER DETAILS.