Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Revision No.	
Serial No.	Document Title	Page/ Folder No.	No. of Pages

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……

Supplier / Contractor

EIL / TPIA

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आपूर्तिकर्ताओं से प्रलेखन अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
3	29-09-2025	General Revision	QMS Standards Committee	QMS Standards Committee	AK	MN
2	01-06-2020	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12-03-2015	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04-06-2009	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

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Abbreviations:

DCI	Document Control Index
EIL	Engineers India Limited
EPS	Electronic Procurement System
FOA	Fax of Acceptance
IC	Inspection Certificate
IRN	Inspection Release Note
ITP	Inspection and Test Plan
LOA	Letter of Acceptance
LR	Lorry Receipt
MR	Material Requisition
ODC	Over Dimension Consignment
PO	Purchase Order
PR	Purchase Requisition
PVC	Polyvinyl Chloride
QAP	Quality Assurance Plan
QMS	Quality Management System
RPO	Regional Procurement Office
TPIA	Third Party Inspection Agency
URL	Universal Resource Locator
V-Portal	Vendor Portal

QMS Standards Committee

Convener: Mr. Anil Kumar

Members:
Mr. Himangshu Pal (SCM-Inspection)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)
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S. No.	Title	Doc. No.
1.	Format for completeness of Final Documentation	Format No. 3-78-0004

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1.0 SCOPE

This specification establishes the Documentation Requirements from Suppliers.

All documents/data against the PO / PR / MR shall be developed and submitted to EIL/Owner by the suppliers for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Supplier

For the purpose of this specification, the word "SUPPLIER" means the person(s), firm, company or organization who has entered into a contract with EIL / Owner for delivery of some products and/orservices.The word is considered synonymous to bidder, contractor or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

- Specification for Quality Management System Requirements from Bidders (Doc. No. 6-78-0001)

4.0 DOCUMENTATION REQUIREMENTS

4.1 Order Acknowledgement and Assigning Project Manager

After placement of order, Supplier shall acknowledge order through V-Portal within 7 days of receipt of FOA/PO. Supplier shall assign a Project Manager for that order though online portal and provide requisite details. Project Manager details shall include e-mail address, mailing address, mobile/telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.2 Documents/Data to be submitted by the Supplier

4.2.1 The Supplier shall submit the documents and data against the PO/PR/MR as per the list given in respectivePO/PR/MR.

4.2.2 Review of the supplier drawings/ documents by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the supplier of his responsibility/contractual obligation to comply with PR requirements, applicable codes, specifications and statutory rules/regulations.Any error/deficiency noticed during any stage of manufacturing/execution/inspection/ installation shall be promptly corrected by the supplier without any time and cost implications, irrespective ofcomments on the same were received from EIL during the drawing review stage or not.

4.2.3 Unless otherwise specified, submission of documents for Review/Records shall commence as follows from the date of Fax of Intent /Letter of Intent/ Fax of Acceptance (FOA)/ Letter of Acceptance (LOA):

QMS	-	1week
Document Control Index	-	2weeks
Other Documents/Drawings	-	As per approved Document Control Index

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4.2.4 Documents as specified in PO/PR/MR are minimum requirements.Supplier shall submit any other document/data required for completion of the job as per EIL/Owner instructions.

4.3 Style and Formatting

4.3.1 All Documents shall be in ENGLISH language and in M.K.S(Meter-Kilogram-Second) System of units.

4.3.2 Before forwarding the drawings and documents, contractor shallobtain the title block from EIL and ensure that the following information are properly mentioned in each drawing:

- Purchase Requisition Number
- Name of Equipment / Package
- Equipment / Package Tag No.
- Name of Project
- Client
- Drawing / Document Title
- Drawing / Document No.
- Drawing / Document Revision No. and Date

4.4 Review and Approval of Documents by Supplier

4.4.1 All, the Drawing/Documents shall be reviewed, checked, approved and duly signed/stamped by supplier before submission.Revision number shall be changed during submission of the revised supplier documents and all revisions shall be highlighted by clouds. Whenever the supplierrequires any sub-supplier drawings to be reviewed by EIL, the same shall be submitted by the supplier duly reviewed, approved and stamped by the supplier.Direct submission of sub-supplier's drawings without contractor's / suppliers' approval shall not be entertained.

4.5 Document Category

Following review codes shall be used for review of supplier Drawings/Documents:

Code 1 - No comments. Proceed with Manufacture / Fabrication / Construction as per the document.

Code 2 - Proceed with Manufacture / Fabrication / Construction as per commented document. Revised document required.

Code 3 - Document does not conform to basic requirements as marked.Resubmitfor review.

Code R - Document is retained for Records. Proceed with Manufacturing / fabrication as per Tender/ ContractRequirement.

Code V - Void, Document is returned as invalid.

Document is marked as Void under following conditions:

a) Wrong item drawing uploaded.
b) Superseded or obsolete submission.
c) Duplicate submission.
d) Out of sequence submission.
e) Mismatch in document name and title under which document uploaded.
f) Document not legible.
g) For PMC projects, document not signed and stamped by contractor and DEC

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4.6 Methodology for Submission of Documents to EIL/Owner

4.6.1 Document Control Index (DCI)

Supplier shall create and submit Document Control Index (DCI) forreview based on PO/PR/MR along with schedule date of submission of each drawing/document on EIL Vendor Portal.The DCI shall be specific with regard to drawing/document no. and the exact title. Proper sequencing of the drawings/documents should be ensured in schedule date of submission.

4.6.2 Submission of Drawings/Documents / Data

Drawings/documents, data and DCI shall be uploaded on the EIL Vendor Portal as per approved DCI. The detailed guidelines for uploading documents on EIL VendorPortal are available on URL:**http://edocx.eil.co.in/vportal**

4.6.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Supplier, the Supplier shall submit copy of approval by the authority to EIL.

4.6.4 Manufacturing Schedule

Supplier shall prepare milestone based(milestones such as document submission, sub ordering, manufacturing, Inspection, dispatches, etc.) manufacturing schedule for the order, to meet delivery as per FOA/PO terms. Supplier shall submit manufacturing schedule to concerned Regional Procurement Office (RPO) of EIL, with a copy to Head office monitoring team/Owner for review within 7 days from date of FOA/PO.Same shall be uploaded in the EPS portal of EILi.e.,https://www6.eil.co.in/epsinspection/supp

4.6.5 Schedule and Progress Reporting

Supplier shall submit Monthly Progress Report(MPR) on or before the 9th of every monthindicating following milestone-based progress details as minimum:

- Drawing submission and approval status and schedule for submission of revised drawing / fresh Drawing requiring approval as per approved DCI
- Sub-ordering plan/details for all major items indicating item description, sub-order number, Date of sub-ordering, sub-vendor name, Location, contractual delivery data and expected delivery dates at main vendor's shop and other critical details requiring timely receipt of sub-ordered items at shop.
- Shop manufacturing progress indicating major milestone progress, in case of missing any milestone date, catch up plan for the same and expected dispatch date from shop and expected delivery date at site.
- Area requiring special attention/concern and proposed action plan to resolve the same.

First Monthly Progress Report (MPR) shall be submitted within2 weeks from FOA/LOA.In case of exigencies, EIL/Owner can ask for report submission as required on weekly/fortnightly/ad-hoc basis depending upon supply status and supplier shall furnish such reports promptly without any price implication.Format for progress report shall be submitted by the Supplier during kick off meeting or within 2 weeks of receiving FOA/LOA, whichever is earlier.

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4.7 Inspection and Testing

4.7.1 Quality Assurance Plan/Inspection and Test Plan

If Inspection and test plans (ITP)are attached with MR/PR same shall be followed along with additional tests requirement (if any) mentioned in MR/ PR. However for cases wherein EIL Standard ITPs not available/ have not been attached with MR/PR, Supplier shall submit within one week of receiving FOA/LOA, the Quality Assurance Plan for inspection & testing at various stages of production, quality control records for critical bought out items/ materials and site assembly & testing as may be applicable to the specific order and obtain approval from concerned Regional procurement Office of EIL/third party inspection agency, as applicable.

For Package equipment contracts, the supplier shall prepare a list of items/ equipment and their inspection categorization plan for all items included in the scope of supply immediately after receipt of order and obtains approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and/or EIL.

4.7.2 Inspection Requirements:

Supplier shall perform internal inspection as per ITP/ approved QAP at their works based on approved documents/drawings. Upon satisfactory internal inspection, supplier shall raise inspection call through Inspection call Module of EPS (https://www6.eil.co.in/epsinspection) to concerned Regional Procurement Office (RPO) of EIL/ TPIA/ Owner with advance notice as per contractalong with Internal test reports. Where inspection is not in the scope of EIL and is carried out by nominated Third Party Inspection agency (TPIA), Inspection Release Note (IRN) issued by the nominated TPIA along with Manufacturer's Test Certificate (MTC) shall be uploaded in EIL EPS Portal (https://www6.eil.co.in/epsinspection).

All changes w.r.t. PR shall be recorded through agreed variations or Concessions & Deviations. Conflict, if any, between PR / Job specifications and approved drawings, shall be brought to the notice of EIL / owner bythe supplier/ contractor. Decision of EIL / owner will be binding on the supplier and to be complied without time and cost implications.

Identified bought out items/ raw material shall be procured under TPIA as per ITP.

4.7.3 Inspection Release Note (IRN)/ Inspection Certificate (IC)

IRN/ IC shall be issued by EIL Inspector/ third party inspection agency on successful inspection, review of test reports/ certificates as per specifications &ITP/ agreed quality plan (as applicable) and only after all the drawings/documents as per DCI are submitted and are accepted under review code-1or code R. Supplier shall ensure that necessary documents/manufacturing and test certificates are made available to EIL/TPIA as and when desired.

Note 1: Non fulfilling above requirement shall result into appropriate penalty or with- holding of payment as per conditions of PO/PR/MR.

Note 2: For items where IRN/IC is issued by TPIA, supplier to ensure that following as a minimum must be mentioned by TPIA in IRN/IC:

a) PR document number
b) List of drawings/documents with EIL approval code
c) Tests witnessed, documents reviewed

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d) Compliance statement by TPIA that product meets the requirement as specified in EIL PR, standard specifications, Inspection Test Plan/QAP and approved documents.

4.8 Transportation Plan

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA/LOA, for approval. Unless otherwise specified, consignments with parameters greater than following shall be considered as over dimensional.

Dimensions : 4 meters width x 4 meters height x 20 meters length

Weight : 32 MT (Metric Ton)

Dimensions and weight provided above are inclusive of all nozzles, attachments, transportation saddles etc.

Physical Rout survey for ODC movement shall be submitted to EIL within 8 weeks of receiving FOA / LOA.

4.9 Dispatch Details

Upon receipt of IRN/IC from EIL inspector/TPIA, supplier shall dispatch items within 2 days. Item wise dispatch details shall be uploaded in EIL's EPS module within 24 hours of any item dispatched from shop, indicating PR item no, Quantity dispatched, Transporter's name, LR Number/ LR date.

4.10 Vendorshall ensure timely uploading of Manufacturing Schedule, Monthly Progress Report,Inspection Certificate (IRN)issued by the TPIA (as applicable for PO where Inspection is under nominated Third Party Inspection Agency)and updation ofitem wise dispatch details in EPS portal of EIL (https://www6.eil.co.in/epsinspection).

4.11 Final Documentation

4.11.1 Supplier shall prepare final documents in line with VDR(Vendor Document Requirements) attached with PR/Tender. A copy of final document along with filled in Format for Completeness of Final Documentation (Format No. 3-78-0004) to be submitted to EIL Inspector/TPIA for review & approval within 2 weeks from dispatch. Upon receipt of EIL/TPIA endorsement on Completeness of Final Documents, supplier shall submit soft/hard copies of Final documents to EIL/Owner in requisite quantity as per PO/PR details, along with covering letter. A copy of covering letter to be submitted to the concerned Regional Procurement Office (RPO) of EIL/Owner.

4.11.2 As Built Drawings

Minor Shop changes made by Supplier after approval of drawings under 'Code 1' by EIL and deviations granted through online system, if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the supplier.These 'As-built' drawings shall be reviewed and stamped by EIL Inspector/TPIA.Supplier shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously Supplier shall incorporate the shop changes in the native soft files of the drawings also.

4.11.3 Packing/Presentation of Final Documents

Final Documents shall be legible photocopies in A4, A3 size only.Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

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Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm (10½-inch x 12½-inch) and shall not be more that 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume.Where number of volumes are more, 90mm thickness can be used.Each volume shall have top PVC sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clips.In case of imported items documents, 4 lever clip shall also be accepted.All four corners of folders shall be properly metal clamped.Indexing of contents with page numbering must be incorporated by supplier.Spiral/Spico bound documents shall not be acceptable.As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a Title Block indicating package Equipment Tag No. & Name, PO/Purchase Requisition No., Name of Project and Name of Customer.Each volume will have hard front cover and a reinforced spine to fit thickness of book.These spines will also have the title printed on them.Title shall include also volume number (say 11 of 15) etc.

4.11.4 Submission of Soft Copies

Supplier shall submit to EIL, the scanned images files as well as the native files of drawings/documents, along with proper index.

In addition to hard copies, Supplier shall submit soft copies of all the final drawings and documents in pen drive or any other specified medium with proper identification tag, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues/manuals/proprietary information and data, PDF files can be furnished). All soft files shall be appropriately named, systematically indexed, and duly bookmarked in PDF format to facilitate ease of reference and access.

All the above documents shall also be uploaded on the EILVendor Portal and if applicable on Client Server also.

4.11.5 Completeness of Final Documentation

Supplier shall get the completeness of final documentation verified by EIL/TPIA,as applicable, and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL Inspector or TPIA as applicable to the final document folder.

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COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No.:
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's/ Contractor's Works Order No.	:	

Certified that the Engineering Documents/ Manufacturing & Test Certificates submitted by the supplier (as per Index sheet mentioned in Annexure-1) are complete in accordance with the Vendor Data Requirements of Purchase Requisition / Tender.

Signature	: ……	Signature	: ……
Date	: ……	Date	: ……
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……
	Supplier/Contractor		EIL/TPIA

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Department	: ……	Department	: ……

Supplier / Contractor

EIL / TPIA

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वैसल्स, पाइपिंग तथा इक्वीपमैंट्स के ऊष्ण इन्स्यूलेशन हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR HOT INSULATION OF VESSELS, PIPING AND EQUIPMENT

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	24-11-2020	ISSUED AS STANDARD SPEC.	PP	BS	PS	SM

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Abbreviations:

ASTM	:	American Society for Testing and Materials
CG	:	Cellular Glass
CUI	:	Corrosion Under Insulation
DFT	:	Dry Film Thickness
ESCC	:	External Stress Corrosion Cracking
GI	:	Galvanized Iron
IE	:	Insulation for Electrically traced surfaces
IH	:	Insulation for heat conservation
IJ	:	Insulation for Steam jacketed surfaces
IS	:	Insulation for Personnel safety
IS	:	Indian Standard
IT	:	Insulation for Steam traced surfaces
ITP	:	Inspection Test Plan
max	:	shall indicate a maximum limit value
min	:	shall indicate a minimum limit value
PIR	:	Poly Isocyanurate Foam
PUF	:	Poly Urethane Foam
SS	:	Stainless Steel
SWG	:	Standard Wire Gauge

Definitions:

Ambient temperature:	Unless otherwise mentioned, ambient temperature referred in this specification shall mean 30^0C
Hot service:	Operating temperature from ambient to 760 deg C is considered as Hot service
Dual service:	Operating temperature ranging from minus (-) 200 to + 350 deg C is considered as dual service

Refractory & Insulation Standards Committee

Convenor : Mr Prasenjit Saha

Members :
Mr Biswarup Sarkar
Mr Prasenjit Pal
Mr Udayan Chakravarty (Piping)
Mr Prag Goel (Fired Heaters)
Mr Ayush Mathur (Projects)
Mr Tarun Kumar (Equip Div)
Mr Neeraj Mathur (Inspection)
Dr Arijit Roy (Materials & Corrosion)
Mr Neeraj Rai (Pipeline)
Mr Ravindra Kumar (Construction)

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1.0 SCOPE

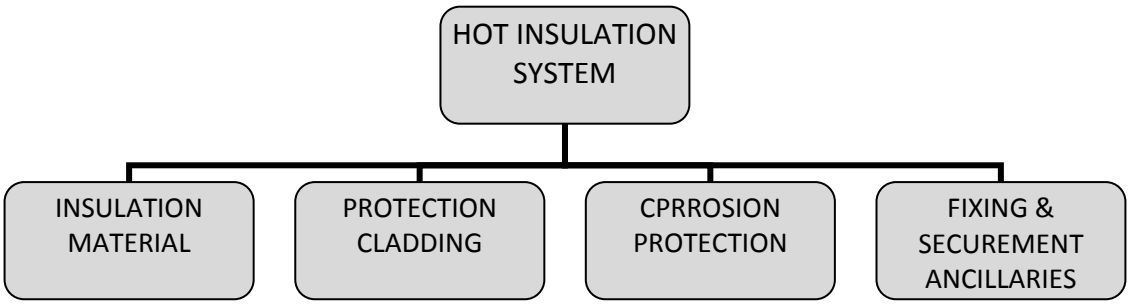
This specification covers the design and material aspects of external insulation of above ground piping, vessels and equipment having operating (process fluid) temperature from ambient to 760^{O}C for the purpose of heat conservation, process stabilization, temperature maintenance, personnel protection and fire protection.

Insulation material and thickness for a project shall be as per Process design basis, BEDB Part-B agreed with client. Insulation system, material properties and specific design requirements are provided in this specification.

Exclusion:
Unless otherwise specified, this specification shall not be binding for insulation of incinerators, boilers, economizers, air pre-heater / ducting of fired heaters etc. for which requirements may be covered in respective package specification. This specification shall not apply to licensed units, where licensor's standard/ specification is applicable.

2.0 GENERAL

Main constituents of a hot insulation system are insulation material and weather protection cladding. Insulation can lead to corrosion to the substrate (commonly known as CUI), especially at low operating temperatures (below 175^{0}C), hence some CUI prevention measures are adopted. Several other materials are used for fixing and securement ancillaries.



2.1 Insulation materials generally used in the industry for hot insulation are given below. Service temperature of each material is different and some may overlap. Material for an application temperature range is selected based on specific advantage of the materials in that range with respect to CUI and other relevant aspects. Insulation material for a project shall be specified in the Process design basis BEDB Part-B.

Insulation Material	General Classification	Temperature limit
Rock wool	ASTM C-547/592/612 / IS 8183	550^{0}C
Calcium silicate	ASTM C-533 / IS 9428	760^{o}C
Moulded Perlite	ASTM C-610	649^{0}C
Ceramic fiber	ASTM C-892	760^{0}C
Cellular glass	ASTM C-552	427^{0}C
PUF/ PIR	ASTM C-591	100/125^{0}C
Glass wool	ASTM C-553	350^{o}C
Aerogel	ASTM C-1728	649^{o}C
Insulating cement	ASTM C-195	760^{o}C

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2.2 Insulation shall be covered with a weather protection jacket, commonly known as cladding. Unless otherwise specified, aluminium is to be used as default cladding material. Stainless steel / aluminized steel cladding shall be used at higher temperature (>550°C) or where fire protection is an intended service requirement and / or fire safe is a criteria. Non-metallic cladding like UV cured GRP and HDPE can also be used for specific purposes.

2.3 Water ingress into insulation is a major concern, especially at low operating temperature, which may remain into the system and can cause corrosion to the substrate. The risk of corrosion is maximum at operating temperature ≤175°C (hereinafter referred as CUI risk zone).

2.4 Painting is used for general corrosion protection for all temperature range and for all types of insulation. Additional corrosion protection measure is necessary at CUI risk zone particularly when insulation material is fibrous in nature (like rock wool, glass wool, calcium silicate) and metal cladding is used for weather protection.

2.5 In order to prevent / minimize moisture ingress into insulation, a layer of moisture barrier / breather mastic shall be used in CUI risk zone where insulation is designed with fibrous material and metal cladding. All insulation system designed with fibrous material and metal cladding, falling in CUI risk zone, irrespective of the purpose i.e. whether it is for heat conservation, acoustic, fire protection or any other service, shall use this barrier layer. This layer is however not necessary when insulation is designed with a closed cellular material like PUF, PIR, Cellular glass or a water repellent material like aerogel or moulded perlite and / or non-metallic cladding like UV cured GRP or HDPE is used for weather protection.

2.6 Inspection window shall be provided at specific intervals to facilitate periodic inspection for CUI.

3.0 DESIGN BASIS

Insulation type and thickness for a project is finalized in Process design basis, BEDB Part-B. Wherever insulation is provided for heat conservation, thickness is decided on the basis of thermal conductivity of the insulation material, allowable heat loss, max allowable surface temperature/ maintenance temperature, emissivity of cladding material and wind velocity.

3.1 Insulation is required to meet any (or combination of) of the following objectives, generally indicated in P&IDs and line lists:

- Heat conservation
- Process stabilization to assist process control.
- Heat tracing (Steam or Electric)
- Hot water or solvent tracing (liquid)
- Hot Oil tracing
- Steam jacketing
- Hot water or liquid or Oil jacketing
- Fire protection
- Personnel protection

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3.2 Insulation type and thickness shall normally be specified in project specification/ SOR and any of the following documents:

- Piping and Instrument Diagrams (P&IDs) and Line Lists.
- Piping General Arrangement Drawings & Isometrics.
- Instrument Piping Details and Schedules.
- Vessel, Exchanger, Storage Tank and sphere documents and Insulation Schedules.
- Equipment suppliers General Arrangement Drawings for equipment items in Package plant.

3.3 Typical details of any vessel part not covered in this specification, but needs insulation as per good engineering practice shall be submitted by the contractor for approval of owner/ engineer in charge. The details shall include the following as minimum:

- Removable insulation housings
- Flashing details
- Additional Insulation supports
- Vessel head insulation supports
- Expansion joints
- Vessel insulation details
- Exchanger removable housings
- Machinery removable housings etc.

3.4 Codes & Standards

This specification shall be used along with relevant standards / code of practice wherever specified. However, specific technical requirement mentioned in this specification shall prevail over standards/ code and in the event of any difference or conflicting requirement between the code and this specification, stringent of the two shall apply.

Latest issue of the codes/standards prevailing on last submission date of the tender shall be applicable.

3.5 Extent of Insulation

Internally refractory lined piping and equipment and any other items for which heat loss is essential shall not be insulated.

Insulation is not desired for piping and equipment for which heat loss is desired - excepting for personnel protection or to avoid thermal stress problems. Instruments and associated piping (other than impulse piping/tubing) 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 or equipment.

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3.5.1 Extent of insulation on piping system

a) Items requiring insulation

- Insulated piping systems shall have straight pipe, bends, tees and pipe-fittings completely insulated.
- Unless otherwise specified, 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.
- For bucket and float type traps the inlet piping and trap shall be insulated.
- Insulation on inlet piping to thermostatic and thermodynamic steam traps shall terminate at approximately 500mm before the trap.
- Steam trap outlet piping other than closed condensate recovery system shall not be insulated except for personnel protection reasons.
- Heat traced instrumentation shall be insulated. The fluid containing sections of such instruments and the associated piping shall be completely insulated. Indication length shall remain visible. Instrumentation other than heat traced shall not be insulated unless otherwise required by Instrumentation department.

b) Items NOT requiring insulation

- Piping which becomes hot intermittently, such as relief valves, vents, steam-out and snuffing steam systems, flare and blow down systems.
- Steam condensate lines downstream of steam traps discharging to drainage system, unless otherwise mentioned.
- Supports for piping, excluding pipe hangers to the extent covered by insulation.
- Steam Traps (except as noted above).
- Valves, including control valves and flanges in process piping systems (except as noted above). However, personnel protection insulation for these items shall be applied, as required.
- Pipe Union fittings.
- Thermowell bosses, temperature and pressure tappings.
- Expansion joints, hinged joints and hose assemblies
- Sight flow indicators.
- Flange joints in Hydrogen service.

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3.5.2 Extent of insulation on equipments

a) Items requiring insulation

- Support skirts of insulated vertical vessel 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 anchor chair.
- Support skirts of insulated vertical vessels of 1200mm and less shall be insulated externally.
- Bottom heads of insulated vertical vessels enclosed by a support skirt shall be insulated without finishing material and shall be insulated only when the vessel outside diameter is greater than 1200mm.
- Turbines shall be insulated for heat conservation.
- Liquid ends of pumps shall be insulated when heat traced and jacketed.

b) Items NOT requiring insulation

- Pumps with operating temperature below 200°C unless pumped fluid has a pour point above minimum design ambient temperature.
- Fans, compressors and blowers and Liquid ends of pumps as noted above
- Internally insulated or refractory lined equipment unless specially designed for metal temperature control.
- Heads of vessels enclosed by support skirts with vessel diameters 1200mm and less.
- Internal surfaces of insulated vessel support skirts with vessel diameter 1200mm or less.
- Turbine casings to be insulated shall exclude shaft seal caps, shaft bearing housings, throttle valves, governors and supports.
- Exchanger channel and covers; shell and channel flanges & Exp. Joints.
- Nozzles flanges, manholes, handholes and flanges of equipment.
- Surfaces of coolers and condensers, Thermowell bosses, temperature and pressure tappings.
- Nameplates of all equipment items.

3.6 Safety Insulation (Personnel Protection)

Exposed surfaces of piping, equipment/ vessels above 60°C in normal or even for a short-term operation, where insulation is not a requirement from heat conservation or process point of view, but in approachable range of operating and maintenance personnel, shall be protected from accidental touch for human safety by appropriate personnel protection. Extent of personnel protection may be decided by the field construction personnel using the criteria that exposed surfaces within 600mm

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horizontally and / or 2100mm vertically of a normal access of walkways or adjacent to handrails, platforms travelled by personnel shall be protected as minimum.

3.6.1 Insulation at low temperature carries a risk of CUI. Hence, insulation to the extent possible should be avoided in CUI risk zone and appropriate personnel protection shall be selected based on the criteria given below.

a) Metal cage / guards may be used for personnel protection for 61 to 175°C

b) Insulation shall be used for personnel protection for 176°C and above

c) Equipment / piping having internal refractory / other lining, shall not be insulated unless specifically required in the design. Personnel protection wherever applicable shall be provided by means of metal cage / guards only.

3.6.2 Requirement and type of personnel protection to be adopted in a project shall be specified in Process design basis BEDB Part-B.

3.6.3 The metal cage / guards, wherever used for personnel protection shall typically be placed at a gap from the surface as given below:

Pipe / Equipment dimension	Gap to be maintained from hot surface (mm)
Pipe diameter up to 6 inches	50
Pipe diameter greater than 6 inch but less than 10 inch	75
Pipe diameter greater than 10 inch	100
Equipment / vessels	100

3.7 Hot insulation in Acoustic service

In specific cases, where a line is to be provided both hot insulation as well as acoustic insulation, following shall be adopted:

3.7.1 Wherever, the material for hot and acoustic insulation are same (e.g. materials like rock wool, glass wool or ceramic fibre), higher of the insulation thickness shall be adopted, cladding shall be as per acoustic requirement.

3.7.2 If the material for hot insulation is different (for example, calcium silicate, PIR, perlite, Cellular glass etc.), hot insulation except the metal cladding shall be first installed over the pipe and then the complete acoustic system installed over it with cladding as per acoustic requirement.

3.7.3 EIL standard specification 6-79-0022 shall be referred for Acoustic insulation.

3.8 Hot & Fire safe insulation

Insulation system in certain service may require serving the purpose of heat conservation and meeting the fire safe criteria. In such cases, insulation thickness needs to be designed for heat conservation during normal operation as well as to limit heat gain in a fire situation, when surrounding is at a higher temperature due to high heat flux released in a hydrocarbon fire.

Wherever insulation material selected for heat conservation is suitable for the fire safe range (for example rock wool, calcium silicate, ceramic fibre etc.), higher of the

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thickness required for heat conservation and fire safe requirement shall be adopted. Cladding shall be of stainless steel / aluminized steel.

Wherever material for hot insulation is not fully fire resistant (for example, PIR, PUF etc.), insulation for heat conservation except the metal cladding shall be first installed over the pipe/equipment and then a layer of fire resistant insulation like rock wool / ceramic fibre etc. of appropriate thickness as applicable for fire safe criteria shall be installed over it with stainless steel / aluminized steel cladding.

3.9 EHT (Electrical heat trace) insulation

Unless otherwise specified, insulation system for the electrically heat traced piping shall consist of pre formed pipe sections of rock wool (LRB is acceptable for higher pipe diameter, refer 4.1.2) with an outer layer of preformed PUF/ PIR, wrapped with a multiplex foil, followed by metal cladding as weather barrier.

Wherever EHT system uses a heat tube, the rock wool pipe section shall be one inch higher size of the pipe diameter. The PUF pipe section shall be of appropriate diameter so that same is snugly fit over the rock wool layer.

Unless otherwise specified, a heat containment shall be created by wrapping a layer of 0.1-0.15mm aluminium foil over the tracing (along with heat tube wherever used) prior to installation of insulation.

3.10 Steam traced insulation

Unless otherwise specified, insulation system for steam traced piping / equipments and instruments shall consist of pre formed pipe sections of rock wool (LRB is acceptable for higher pipe diameter, refer 4.1.3) with a multiplex foil underneath metal cladding as weather barrier. In general, rock wool pipe section shall be one inch higher size of the pipe diameter to accommodate tracer pipes.

A heat containment shall be created by wrapping the tracer pipe (heat tube) along with the parent pipe with a layer of 0.1-0.15mm aluminium foil (or stainless steel foil for >400 deg C) prior to installation of insulation.

Steam tracing expansion loops or couplings extending outside of insulated pipe surfaces shall be insulated for heat conservation.

3.11 Impulse lines

Unless otherwise specified, for impulse lines of austenitic stainless steel, insulation material shall be sodium silicate inhibited ceramic fiber rope (min density 250 Kg/m^3). Ceramic fiber ropes shall comprise of ceramic fibres laid parallel and reinforced with stainless steel wire.

3.12 Removable Insulation

Part of equipment and piping requiring periodic inspection may be provided with a removable and reusable type insulation. Pumps or turbines requiring insulation should have removable insulation cover.

3.12.1 Removable insulation may consist of a fibrous insulation stitched into a quilt of glass cloth fabric envelope and tied with wire around the valve or flange connections. Insulation thickness / number of wraps shall provide equivalent insulation as that of adjacent piping/ equipment.

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3.12.2 Wherever box insulation is used, removable insulation shall be of the same type and thickness as adjacent pipe or equipment insulation.

3.12.3 Removable insulation cover box shall be fabricated from 1mm cladding sheet with insulation installed inside the box. Removable covers box for valves shall cover the body, bonnet, and flanges as applicable.

3.12.4 Insulation covers box shall fit tightly over fittings and protrusions and shall be held in place with straps and stainless-steel toggles. Box shall have an integral metal flashing extending at least 50 mm on adjacent pipe insulation and must be designed to prevent air movement behind insulating covers.

4.0 INSULATION MATERIALS

Insulation material shall be selected primarily based on range of service temperature and other parameters like desired thermal performance, fire protection requirement etc. All materials shall be of high quality and good appearance. Insulation materials shall be of low chloride content, chemically inert, non-sulphurous , rot proof, vermin proof, non-injurious to health and non-corrosive to steel and aluminium (even if soaked in water at ambient temperatures for extended periods), shall not disintegrate, settle, change its form of composition, in a detrimental way during service conditions. Typical details/ minimum technical specification of the major insulation materials and accessories are given in this specification as a guideline.

- Insulation materials in general shall conform to respective ASTM standard/ grade. Equivalent IS grade are acceptable.
- ASBESTOS in any form is NOT permitted. Insulation or finishing materials shall contain no asbestos.
- No inflammable material shall be attached to the insulation.
- Special attention shall be paid for use over austenitic stainless steel surfaces for max permissible chloride level and additional testing for respective material.
- Unless otherwise mentioned, dimensions and tolerances for pipe sections, mattresses & slabs shall generally be as per respective codes. Lesser the number of segments is better. The installed insulation shall fit snugly and shall have a tight joint.

4.1 Rock wool

Rock wool is a fibrous insulation made from molten rock, bonded with resin or suitable binder. The term rock wool shall mean fibrous insulation wool made from natural rock and does not refer to products manufactured from slag or glass. For application over austenitic stainless steel, the material shall be zinc free and shall be inhibited with sodium silicate as per ASTM C-795.

4.1.1 The material may be used up to 550^0C, but shall meet the general classification of respective standards and service temperature requirements as mentioned below:

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Form of Fibrous Material	Quality standard	Max service temperature
Preformed pipe sections	ASTM C547 TYPE-II / IS 9842	760^{0}C
Insulation blanket with wire net facing (details as per 4.1.4, 4.1.5 & 4.1.6)	ASTM C592 CLASS-III/ IS 8183	649^{0}C
Resin bonded mattress (max 2% resin)	ASTM C612/ IS 8183	760^{0}C

4.1.2 Rock wool shall meet following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per IS 8183 / IS 3144 / ASTM C-167	Pipe sections	140	Note-1
	Resin bonded mattress / Insulation blanket (density is measured without metal facing)	128	
Linear Shrinkage (%) at 550°C/ 24 hours as per ASTM-C-356, max		2	
Non fibrous shot (%) as per ASTM C-1335 / 3144, max		15	
Compressive strength at 10% deformation (kg/m^2), min		120	
Alkalinity, pH as per ASTM C- 871 / IS 8183		7-10	
Leachable Chloride as per ASTM C-871, ppm, max		10	Note-1, 2
Thermal conductivity (W/mK) as per IS 3346 / ASTM C-177 / ASTM C-518 at mean temperature, max	(+) 100°C	0.052	Note-3
	(+) 200°C	0.068	
	(+) 250°C	0.080	
	(+) 300°C	0.090	
Test of incombustibility OR fire resistivity	Incombustibility as per IS 8183 / IS 3144	Pass	
	OR flame spread index as per ASTM E84, max	25	
Note-1: Supplier shall provide test certificate for each production Batch *Note-2: Max 20ppm allowed for application over carbon steel and low alloy steel* *Note-3: Supplier shall provide Type test certificate no older than 2 years*			

4.1.3 Forms of rock wool insulation

Nominal pipe diameter	Form of Fibrous Material
Up to 6 inch	Preformed pipe section is mandatory
> 6 inch to 14 inch	Preformed pipe section is desirable
>14 inch & equipments	Insulation blanket with wire net facing OR resin bonded mattress

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4.1.4 For operating temperature up to 175°C for application over carbon steel and low alloy steel pipe, insulation blanket wherever used shall have GI metal facing on one side with hexagonal shaped (25mm) wire-woven netting (0.88 to 0.73mm dia.) stitched with tie wires (0.41mm dia.). Galvanization shall be minimum 30gsm.

4.1.5 For operating temperature 176°C and above, for application over carbon steel and low alloy steel pipe, insulation blanket wherever used shall have metal facing as per ASTM A167 type SS 304 with 25mm mesh and 0.8mm wire diameter, stitched with 0.41mm dia. tie wires.

4.1.6 For austenitic stainless steel and alloy 20 piping, irrespective of operating temperature, insulation blanket wherever used shall have metal facing as per ASTM A167 type SS 304 with 25mm mesh and 0.8mm wire diameter, stitched with 0.41mm dia. tie wires.

4.2 Moulded Expanded Perlite

Perlite block and pipe sections shall be made of expanded perlite and sodium silicate or appropriate binder, shall be suitable for continuous service up to 649°C.

4.2.1 Material shall conform to the general classification of ASTM C-610 and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per ASTM C-302/303, max		240	Note-1
Compressive strength at 5% deformation (kPa), min as per ASTM C 165 (for block)		483	
Linear Shrinkage (%) max at 649°C for 24hrs,	Length and width	2	
	thickness	8	
Water absorption after heat aging at 315°C & 48 hr water immersion, weight gain %		50	
Alkalinity, pH as per ASTM C- 871		6-10.5	
Flexural Strength as per ASTM C203, Proc-D (kPa), min		310	
Leachable Chloride as per ASTM C871, ppm, max		10	Note-1 & 2
Thermal conductivity (W/mK) ASTM C-177 / ASTM C-518 / ASTM C-335, at mean temperature	(+) 93 deg C, max	0.079	Note-3
	(+) 149 deg C, max	0.086	
	(+) 204 deg C, max	0.095	
	(+) 260 deg C, max	0.106	
	(+) 371 deg C, max	0.126	

Note-1: Batch test - Supplier shall provide test certificate for each production Batch
Note-2: Max 20ppm allowed for application over carbon steel and low alloy steel
Note-3: Type test - Supplier shall provide Type test certificate no older than 2 years

4.2.2 For application over austenitic stainless steel, perlite block and pipe sections shall also meet the requirements of ASTM C-692.

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4.2.3 Forms of moulded perlite

Nominal pipe diameter	Form of Fibrous Material
Up to 14 inch	Preformed pipe section
>14 inch & equipments	Pipe sections / Wedge cut from block

4.3 Calcium silicate

Calcium silicate block or pipe sections shall conform to general classification of IS 9428 (950 grade) or ASTM equivalent C533 TYPE II, shall be suitable for continuous service up to 927°C.

4.3.1 Material shall conform to the general classifications of respective ASTM / IS code and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per IS 5688 / ASTM C302/303, min		240	Note-1
Linear shrinkage as per IS 5688 / ASTM C-356 at 927^{0}C for 24hrs, (%) max.		2	
Moisture content , by weight, max, %		20	
Compressive strength (of dry sample) at 5% deformation, kPa	IS 5688 OR	415	
	ASTM C165	688	
Heat resistance after exposure to 927^{0}C for 24hrs, as per IS 5688	(%) loss in weight, max	15	
	Compressive strength at 10% deformation, kPa, max	345	
Leachable Chloride as per ASTM C871, ppm, max		50	
Thermal conductivity (W/mK) at mean temperature as per IS 9490 / AST C-177	(+) 200 ^{0}C, max	0.072	Note-2
	(+) 300 ^{0}C, max	0.078	
	(+) 400 ^{0}C, max	0.084	
	(+) 500 ^{0}C, max	0.088	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.3.2 Forms of calcium silicate insulation

Nominal pipe diameter	Form of Fibrous Material
Up to 14 inch	Preformed pipe section
>14 inch & equipments	Pipe sections / Wedge cut from block

4.4 Ceramic Fiber

Ceramic fiber is a fibrous insulation made from molten alumino-silicate compositions, fibers are mechanically interlocked through a needling process into blanket form

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without use of chemical binder, shall conform to general classification of ASTM C892 Type III, Grade 8 (1260°C Grade) and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per ASTM C-167, min		128	
Linear Shrinkage (%) at 1200°C for 24hrs as per ASTM C-356, max		3	Note-1
Chemical composition	Al_2O_3, min	43	
	SiO_2, max	57	
	Fe_2O_3, max	0.1	
	TiO_2, max	0.3	
Mean fibre diameter (microns), 3% standard deviation		2.5-3.5	
Non fibrous shot (%) as per ASTM C-1335, max		20	
Tensile strength as per BS 1902 Part-6, kg/cm^2, max	Longitudinal	0.6	
	Transverse	0.5	
Leachable Chloride as per ASTM C871, ppm, max		50	
Thermal conductivity (W/mK) ASTM C-177 / IS 3346 at 600°C mean temperature, max		0.13	Note-2
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.5 Cellular Glass

Cellular glass is a closed cellular structured rigid insulation made from glass, a preferred material for cyclic service in the temperature range of (-) 200 to (+) 427 ^{0}C. The material conform to general classification of ASTM C552 Type-II, Grade-6, cut into pipe sections or profile of the substrate as per ASTM C1639 and meet the following minimum properties:

Characteristics		Values	Remarks
Density(kg/m^3), min. (ASTM C303)		98	Note-1
Closed cell content		100	
Compressive Strength (kPa) (ASTM C165), min.		414	
Flexural strength (kPa), ASTM C203, min.		283	
Water absorption (Volume %), max., (ASTM C240)		0.5	
Water Vapour Permeability, ng/Pa.s.m (ASTM E96)		0.007	
Thermal conductivity , w/mK (ASTM C518/ASTM C177)	(+)10°C, max	0.046	
	(-) 18°C, max	0.042	
	(-) 73°C, max	0.033	
	(-)101°C, max	0.030	
Surface burning characteristics as per ASTM E84	Flame spread index, max	5	Note-2

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	Smoked developed index, max.	0	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.6 PIR / PUF Rigid Foam Insulation

Rigid PIR (polyisocyanurate) / PUF (polyurethane) is closed cellular structured plastic foam insulation. PUF is generally suitable for use up to 100^{0}C, whereas PIR can be used to little higher, up to 125^{0}C. Wherever in the specification PUF / PIR or PUF is specified, any of the two can be used, but wherever PIR is only specified, PUF shall not be used.

4.6.1 PIR shall be performed into free rise rigid buns using HCFC free chemicals and cut into pipe sections or required profile using a CNC machine. The material shall be chemically inert, moisture free, rot and vermin proof, shall not disintegrate, settle, change its form or composition in a detrimental way while in service, shall conform to general classification of ASTM C591 Grade-2 Type-II, suitable for application up to 125^{0}C and meet the following minimum properties:

Characteristics		Value	Remarks
Bulk density (kg/m3) ASTM-C302/ ASTM -D1622/ IS-11239, min		40	Note-1
Closed Cell content (%) ASTM D-6226 Procedure-2/ IS-11239 Part-5, min		95	
Chloride content (ppm) ASTM C 871, Procedure 2, max		60	
pH (ASTM C 871)		6-7	
Water vapour transmission (ng/Pa-s-m) ASTM E-96 method-A at 23°C & 50% RH, max		5.1	
Compressive strength at 10% deformation (kPa), ASTM D 1621, min		240.	
Flame spread Index as per ASTM E84 OR Horizontal burning as per equivalent BIS method, max		25	Note-1
Thermal conductivity of 180 days aged sample at mean temp (W/mK) ASTM C-177	(+)10 °C, max	0.024	
	(+)24 °C, max	0.024	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.6.2 PUF shall generally be supplied in performed pipe sections or required profile using HCFC free chemicals from vendor shop. The material will have equivalent physical properties as of PIR except temperature limit shall be 100^{0}C and may exhibit higher horizontal burning characteristics compared to PIR.

4.6.3 In-situ foaming of polyuretnane (PUR)

Certain applications like tank may specify use in-situ polyurethane foam (PUR), where the insulation foam can be formed by in-situ injection of the chemicals into an enclosed volume that after curing will be converted into PUF. The quality of in-situ foaming can

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vary and depends on substrate temperature, ambient temperature, humidity etc. Every time the in-situ foaming going to be adopted, it requires demonstration through mock up for achievement of optimum quality. This shall only be used where in-situ PUR is specified and NOT to be used as replacement for preformed rigid PIR / PUF.

4.7 Flexible Aerogel Insulation

Flexible aerogel insulation is a composite of an amorphous silica-based aerogel, a fibrous carrying media, or reinforcements, or a combination thereof, that allow the construct to be flexible. The material shall be in accordance with ASTM C1728 Type-III, Gr.1A. The material shall have following general properties:

Characteristics		Value	Remarks
Temperature range (°C)		24 to 649	
Density (kg/m^3) ASTM C303, min		160	
Compressive Strength (kPa), min, at 10% deformation (ASTM C165)		20.7	
Linear shrinkage at maximum exposure temperature for 24h , max, % (ASTM C356) in length & width		2	
Water absorption, max, % by weight		8	
Water vapour sorption, by weight, max %, (ASTM C1104/C1104M)		5	
Flame spread index (ASTM E84) , max Smoke developed index (ASTM E84) , max		5 10	
Thermal conductivity (W/mK) at mean temperature (°C) (ASTM C177)	(+) 24 °C, max	0.021	
	(+) 149 °C, max	0.025	
	(+) 204 °C, max	0.029	
	(+) 260 °C, max	0.032	
	(+) 371 °C, max	0.043	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

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4.8 Glass Wool

Glass wool is a fibrous insulation made from molten glass into fibrous form bonded with organic or inorganic binder and suitable for application up to 350°C. Glass wool blanket shall meet the requirements specified in ASTM C553 Type-I and meet the following minimum properties:

Characteristics		Values	Remarks
Density (kg/m^3) as per ASTM C-167, max		64	Note-1
Water vapor sorption % by weight, max, (ASTM C1104/C1104M)		5	
Chlorides, ppm, (ASTM C 871, procedure 2)		10	
pH values, (ASTM C 871)		6-10	
Thermal conductivity, W/mK (ASTM C518)	(+) 24 ^{0}C, max	0.030	Note-2
	(+) 50 ^{0}C, max	0.033	
	(+) 100 ^{0}C, max	0.040	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

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4.9 Insulating Cement

Insulating cement is primarily composed of chopped rock wool and heat resistant cement and may contain inorganic fillers / suitable heat resistant binder. The material shall conform to general classification of ASTM C195 and shall be suitable up to 1038^0C.

Properties		Values	Remarks
Linear Shrinkage (%) (at 871°C) for 24hrs, max, ASTM C356		5	Supplier shall provide test certificate for each production Batch
Volume change (shrinkage) upon drying, max, ASTM C166		35	
Thermal conductivity, at mean temperature, ASTMC177	(+) 93 deg C, max	0.101	
	(+) 260 deg C, max	0.123	
	(+) 482 deg C, max	0.173	

4.10 Materials / Components for Specific Insulation System

Primary insulation type / combination and thickness shall be specified in Process design basis BEDB Part-B. Based on the insulation type and temperature range, additional components like moisture barrier mastic, foil etc. needs to be as per below guideline:

4.10.1 There is always a risk of water ingress into the insulation through joints of metal cladding. Hence, except specific applications were non-metallic cladding like UV cured GRP or HDPE are used, the risk of CUI needs to be addressed by appropriate material selection and moisture barrier system.

4.10.2 The risk of CUI is highest in the operating zone 50-175°C. Materials like Perlite, Cellular glass, PIR (up to 125°C) and PUF (up to 100°C) are preferable in this zone.

4.10.3 When a fibrous material like rock wool / glass wool is used in CUI risk zone (<175°C), a moisture barrier layer of breather mastic must be used underneath metal cladding.

4.10.4 A combination system with inner aerogel (5-10mm) + outer rock wool can provide good CUI prevention in low operating temperature (<175°C) and shall not require this breather mastic moisture barrier.

4.10.5 The breather mastic need not be used in CUI risk zone (<175°C) wherever moulded perlite or a closed cellular material like PIR/ PUF/ Cellular glass is used as insulation material and / or where a layer of aerogel is used in the innermost layer. The joints of the block insulations shall be sealed with appropriate joint sealant and a multiplex foil (commonly known as mylar foil) shall be used over the outermost insulation layer underneath cladding.

4.10.6 In general, the breather mastic and / or multiplex foil is not necessary above 175°C. However, for HP steam lines longer than 2km which uses rock wool as insulation, a layer of multiplex foil shall be used underneath the metal cladding. The multiplex foil need not be used where insulation is designed with perlite or rock wool in combination with a closed cellular material like PIR or aerogel on the outermost layer.

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4.10.7 Cellular glass be shall be chosen where any one of the following is a requirement:

a) Service is dual temperature, the lower range extents below ambient and upper limit of the exposure exceeds (+) 125 ^{0}C
b) The insulation requires fireproofing over it (epoxy intumescent or vermiculite)

4.11 Insulation thickness

Insulation thickness and thickness for inner and outer insulation for combination lining shall be specified in schedule of rate / equipment datasheet.

Unless otherwise specified, layering of insulation as given below shall be followed:

Insulation thickness (mm)	Number of layers
≤ 75	Single layer
76-150	Two layers
>150	Three layers

4.12 Form of Insulation

All the preformed insulation (Cellular glass, PIR, Calcium silicate, Perlite, Pipe section made from Rock wool etc.) should match the contour of pipe /surface profile of the equipment. Half sections or radial sections shall have longitudinal and circumferential faces flat and smooth so as to match with the other half/ section. Ends of the preformed half sections shall be flat and perpendicular to the center line.

Cellular glass shall be fabricated as per ASTM C1639.

Preformed rigid insulation blocks of PIR shall be cut from buns using CNC machine.

Application	Sections
Pipes up to 12 inch NB	Two half sections
>12 inch up to 20 inch NB	Max 3 radial sections
>20 inch NB	Max 4 radial sections
Equipments, Vessel shells	Machine cut radial sections in required contour of the substrate/ underneath layer
Vessel heads	Manually cut slabs contoured to the profile of vessel heads is acceptable

5.0 ANCILLARY MATERIALS

Hot insulation system shall have the following ancillary components:

Primary components	Secondary components	Other ancillaries
• Multiplex foil • Weather protection Jacket • Protection guard	• Heat transfer cement • Painting • Expansion joint • Sealing tapes • Adhesive	• Band • Sealant for cladding • Screw • Clips • Rivets • Compression spring

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5.1 Weather Protection Jacket (Cladding)

5.1.1. Insulation shall be protected with cladding. Type of cladding shall be as below:

a) Unless otherwise mentioned, aluminium jacketing shall be used as weather protection cladding up to temperature 550 deg C. Aluminium cladding shall be as per ASTM C1729, Class-A having polysurlyn lamination on inside surface and shall meet the requirements of ASTM B209 alloy 3003 H14. Equivalent IS code shall be acceptable for the metal sheet.

b) For temperature above 550 deg C and/ or for fire safe insulation (for all temperature range) cladding shall be stainless steel or aluminized steel as per ASTM A167 / A240 type 304 or aluminized steel as per ASTM A463, type 2, coating designation T2-100, with polysurlyn lamination on inside surface. Equivalent IS code shall be acceptable for the metal sheet.

c) For grade piping in offsites jacket material shall be galvanized steel. Galvanized jacketing shall not be used over insulation on or near austenitic stainless steel and/or austenitic nickel steel Piping & Equipment. Galvanized steel shall be as per ASTM A526 with 275 gsm of coating of Zinc Layer on both the surfaces. Equivalent IS code shall be acceptable for the metal sheet.

5.1.2. Thickness of metal cladding shall be as follows:

Application	Thickness for Aluminium cladding	Thickness for Stainless steel /Aluminized steel cladding
For shells of vertical storage Tanks & Vessels	0.7lmm (22 SWG) Corrugated; The profile of corrugated sheet shall be 32mm x 5mm	0.56mm (24 SWG) Corrugated; The profile of corrugated sheet shall be 32mm x 5mm
For tank Roofs	1.22mm (18 SWG) Flat	0.91mm (20 SWG) Flat
For Horton Spheres & Horizontal vessel shell and heads; vertical vessel heads	0.7lmm (22 SWG) Flat	0.56mm (24 SWG) Flat
For removable covers	1.22mm (18 SWG) Flat	1.22mm (18 SWG) Flat
For all piping, other than grade piping in offsites	0.7lmm (22 SWG) Flat	0.56mm (24 SWG) Flat
For grade piping in Offsites	0.56mm (24 SWG) Galvanized steel (Refer note below)	

Note: For grade piping in offsites the cladding material shall be Galvanized steel.

5.2 Securement Bands / Wires

1 If material is Aluminium, then specification shall be ASTM B209 Alloy 3003 H16, If Stainless Steel, it shall be 18/8.

2 For securing fibrous insulation

A On Piping
Band, 24 SWG thick x 12mm (min) wide, Stainless Steel.

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B On Equipments
Band, 24 SWG thick x 20 mm wide, Stainless Steel.

C On Vertical Storage Tanks
Band, Stainless Steel, 25mm wide x 24 SWG thick.

D Horton Sphere
16 SWG SS Wire & Band, Stainless Steel, 25mm wide x 0.8mm thk.

3 For Securing Rigid Insulation

A On Piping upto 16" OD
Wire, stainless steel, 16 SWG.

B On Piping 18" OD & Larger, Vertical and Horizontal equipments
Band, stainless steel. 20 wide x 24 SWG thick.

4 For Securing Cladding on Insulation (all types)

A For Piping
Band, SS 12mm (min) wide x 24 SWG thick.

B On Equipment
Band, SS, 20mm wide x 24 SWG thick.

C On Vertical Storage Tanks & Spheres
Band, Stainless Steel, 25mm wide x 24 SWG thick.

5.3 Compression Spring

Compression spring (commonly known as MITY spring) shall be used on jacketing over tank, pressure vessels and equipment. The compression springs shall be of 100mm length made of SS 302 / SS 304 stainless steel, shall not be stretched more than 13mm during installation.

Requirement for springs on banding to secure metal jacketing shall be as follows:

Equip. OD	Equip. Circ.	Number of Jacket Expansion Springs					
		Steel Temperature					
(m)	(m)	93°C	204°C	315°C	427°C	538°C	649°C
1	2.9	0	0	0	1	1	1
2	5.7	0	1	1	1	2	2
3	9.6	0	1	2	2	2	2
4.6	14.3	1	1	2	3	3	4
6	19.1	1	2	3	3	4	4
7.6	23.9	1	2	3	4	5	6

5.4 Rivets

Rivets required for metal jacket securement shall be the expanding Aluminium "POP" blind eye type/ Stainless Steel, 9.5mm long x 5mm diameter.

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5.5 Screws

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

5.6 'S.' and 'J' Clips

Formed from 25mm wide stainless steel banding.

5.7 Heat Transfer Cement

Maximum Exposure Temperature: 677^{o}C
Heat Transfer Coefficient to Equipment wall: 114-227 W/m^{2o}C
Bond Shear: 1.034 kPa
Electrical resistivity: 1.299 ohm/cm

5.8 Sealant for Cladding

Sealing materials which may either be in the form of a elastomeric sealing compound or fibre based bituminous felt strips.

The technical requirement and typical elastomeric material for joint sealant of metal cladding (aluminium and stainless steel) is specified below.

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 52% volume solid as per ASTM C461	FSI (flame spread index) $\leq$ 20 as per ASTM E-84, tested on a 6.3mm inorganic reinforced cement board with DFT ~2mm	0.0092 metric perms (as per ASTM F-1249 with DFT 2.8mm)

5.9 Moisture Barrier (Breather Mastic)

When a fibrous material like rock wool / glass wool is used in CUI risk zone (<175°C), a moisture barrier layer of breather mastic must be used underneath metal cladding. The moisture barrier shall be a polymeric water based, breather type mastic (vapor under pressure will pass through it), fire resistive, flexible and be compatible with the type of insulation. Material shall be suitable for the range of temperature to which it is exposed.

Material shall be evaluated for fire resistance as per as per ASTM E-84 (flame spread index ~10) and water vapour permeability in accordance with ASTM E96, procedure-B >1perms for 1/16'' thickness. Average nonvolatile content: 60 to 64% by volume (64% by weight).

5.10 Multiplex Foil

Multiplex foil may be used as an alternative to mastic moisture barrier in specific applications (details shall be as per respective SOR). Multiplex foil shall consist of sandwiched sheets of aluminium and polyester be applied over the insulation prior to weather protection jacketing. It shall confirm to the following requirements:

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Foil composition:	12 µm polyester film
	25 µm aluminum foil
	12 µm polyester film
Tensile strength Yield strength Tear resistance	100 MPa 70 N / cm 400 g / mm
Temperature range	+120°C to -60°C
Volumetric mass	1.93 kg / dm³
Water vapour permeability in acc. with ASTM E 96, procedure E (37.8°C, 90% RH)	max. 10.10-6 g / (m².h.mmHg)

5.11 Sealing Tapes for Multiplex Foil

The sealing tape for joints in the multiplex foil shall meet the following requirements:

Foil composition	12 µm polyester film
	25 µm aluminium foil
	12 µm polyester film
	adhesive layer: polyacrylate
Total thickness exclusive of adhesive layer	50 µm
Temperature range	+120°C to -45°C
Volumetric mass	1.93 kg / dm³
Water vapour permeability in acc. with ASTM E 96, procedure E (37.8°C, 90% R.H.)	Max. 10.10-6 g / (m².h.mmHg)

5.12 Joint Sealant for Insulation Blocks

The joint sealant for joints between insulation blocks shall be compatible with the base insulation material and suitable for the temperature range to which it is exposed. Typical material and technical requirement for PUR/PIR insulation system is specified below. For cellular glass insulation, compatibility or specific products shall be recommended/ confirmed by the cellular glass supplier

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 82% volume solid as per ASTM D2369	Flame spread ASTM E-84 and fuel contribution negligible when used as 3.2 mm wide sealant between joints of incombustible insulation blocks	Negligible when measured across 3.2 mm wide sealant between joints of impermeable insulation blocks

5.13 Protection Guard

Guards and their supports shall be manufactured from carbon steel, which may be galvanized or painted or with Stainless Steel (SS-304). (The mesh may be painted with yellow stripes, 50 mm wide, and shall include a hazard sign indicating 'Hot surface'.).

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The guard mesh shall be of 2mm thick and 12 mm square. Guard shall be designed with end cap of 0.7 to 1mm thk from galvanized Al-Zn coated or Al coated carbon steel with recommended spacing of 450mm to 600mm. Care to be taken that end caps are fitted in an orientation that will allow water drainage. If the metal surface requires greater protection, a fibre glass insulation tape can be fitted to area where end caps make contact to protect pipe work and reduce heat transfer. Mesh shall be rolled to shape as per normal cladding and shall be provided with 50 mm of overlap, sharp edges of cut mesh to be filed. In case of removable guard, the same can be made from toggle clips.

In case of protection guard for small bore piping, perforated metal sheet may be used. Sheet thickness shall be 1mm.Perforation hole shall be minimum 5mm, with minimum 40% free passage. Steel sheet shall be stainless steel in accordance with ASTM A167, type 304.

6.0 APPLICATION

6.1 General Requirements

6.1.1 The application methods, given in this specification are general in nature. The Contractor is responsible for applying an insulating 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 debris and the final job shall have a neat, efficient and workmanlike appearance.

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

6.1.3 All hydrostatic tests on piping and equipment, including steam tracing systems, shall be carried out before insulating material is applied. The insulation Contractor shall only insulate those sections of the plant that have 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 completion of pressure test. Then insulation shall be completed.

6.1.4 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 necessary support as per standard or as specified in the bid package/tender.

6.1.5 Surfaces to be insulated shall be thoroughly cleaned, dried and made free from loose scale, oil or grease. It shall be the Contractor's responsibility to remove loosely adhering scale and dirt before applying insulation.

6.1.6 Under Insulation Painting

Equipments and piping shall be protected from corrosion by providing appropriate painting under insulation, as per applicable painting specification for the project. Austenitic stainless steel especially 300 and 400 series are susceptible for external stress corrosion cracking (ESCC). For to avoid ESCC in stainless steel, 0.1mm thick aluminium foil up to 550^{o}C, above which stainless steel foil can be wrapped with an overlap of 50mm. Overlap joint shall be sealed with barium chromate sealer or self-

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adhesive (chloride free) aluminum tape at the edge of foil. Foil shall be secured in position either by pressure sensitive tape or aluminium band.

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

6.1.8 Wet or Damaged Insulation shall not be used under any circumstances. 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.

6.1.9 Insulation shall be finished, bevelled and weatherproofed at all terminal points where it is required to remove bolts etc. without damage to the insulation.

6.1.10 Equipment nameplates shall remain visible after insulation has been applied by bevelling back the insulating material and carefully sealing the exposed edges to prevent ingress of moisture.

6.1.11 All projections, such as lifting lugs, trunnions 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.

6.1.12 Thermowell bosses, pressure tappings and weephole nipples shall not be insulated in but left accessible.

6.1.13 A minimum clearance of 25mm between outside surface of any insulation finish and adjacent equipment, pipe or structural members shall be maintained.

6.1.14 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.

6.1.15 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 structure upon which the shoe rests by 25mm minimum.

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

6.1.17 Packing and transport to site

Insulating materials should be packed in cartons, crates, bags or shrink film wrapping to minimize mechanical damage and to provide adequate weather-protection and to avoid contamination. Preferably, insulating materials should not be unpacked on site until required for immediate use.

All forms of packaging of insulating materials should be carefully marked. The marking should indicate the type of material and the size, thickness, quality, and quantity contained in each package.

6.1.18 Protection of Materials During Storage

Insulation materials 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, blankets and sections shall be stored on a flat surface in a horizontal

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position. Insulation material shall never be stacked directly on the ground. The contractor shall make own arrangement for covered storage for insulation materials as directed by the Engineer-in-Charge.

6.1.19 Protection of Partially Completed Jobs

Precautions must be taken to ensure that each day's work is adequately protected before being left over-night to prevent seepage of water. Unfinished / partially finished / ongoing insulation jobs shall be protected from water ingress by appropriate water shed / wrapping and other protective means.

6.2 Piping Applications

6.2.1 Horizontal Pipe

a) General

Insulation material shall be applied to fit snugly against the contours and shaped only where necessary to achieve this requirement

b) Pipe Section / Moulded Blocks / Segments

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

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

- Further, minimum arc 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 layers 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.

c) Blankets (Fibrous insulation) shall be applied over the surface with joints tightly butted and laced together with stainless steel lacing wire.

d) 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 end and at least one loop to be equally spaced between end 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 and moulded expanded perlite, all joints shall be sealed with insulating cement of same composition as the Moulded block.

- For Cellular glass, Polyurethane foam and polyisocyanurate, joints shall be sealed with suitable compatible material

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e) 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 forms; 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 these rings shall be equivalent to 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 suitably painted for corrosion protection. Stays shall be provided at intervals of not more than 300 along the circumference 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 CF paper shall be provided at the joints of the stays and pipes. Joints between M.S. Spacer Ring and stays shall be riveted by 6 dia M.S. Rivets with 2 Sheets of 3 thick mill board interposed.

6.2.2 Vertical Pipe

Insulation on vertical or near vertical piping (i.e. greater than 45 deg. angle from horizontal) shall be supported by bolted on metal collars. Metal collars shall be of 6 thick M.S. or Alloy Steel bar (to suit piping material).

Outside diameter of collar shall be around 12 less than O.D. of insulation. Where multi-layer 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.(°C)	Support Spacing (mm)
Upto 400	4500
401 to 500	3500
501 to 550	2500
551 to 650	2000
651 to 760	1500

6.2.3 Expansion Joints (Both vertical and horizontal piping. Rigid insulation Materials)

Expansion joint shall be provided at regular intervals as below:

Temp.(°C)	Spacing (mm)
Upto 200	Not required
201 to 300	10
301 to 350	8
351 to 400	6
401 to 550	5
551 to 650	4
651 to 760	3

Expansion joint shall be formed by a 25mm space between the pipe insulation sections and the space shall be filled by compressed loose rock wool. Expansion joints in each layer shall be offset at least 150 from each other in case of multi-layer insulation.

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Expansion joint for first layer for vertical pipe shall preferably be just below insulation support collars.

6.2.4 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 bends / elbows of nom. pipe size 6" & below, due to lack of space, for all insulation materials, insulation shall be secured by spirally wound 16 SWG SS wire for hard materials & 10 SWG SS wire for soft materials.

Insulation joint for calcium silicate shall be suitably sealed by insulating cement. 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 insulation cement shall be reinforced with 25mm No. 20 SWG wire netting.

6.2.5 Tee (All Insulation Materials)

Preformed 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 mate upto the material applied to the parent pipe without the creation of voids or gaps, at the junction. Insulation shall be adequately secured by wire / bands of same specification as that of same size pipe.

6.2.6 Flanged Joints or Valves (all insulation materials)

Flanged Joints or Valves, if to be insulated, shall be insulated with removable type insulation.

6.2.7 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 place 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 waterproof sealing material.

6.2.8 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.

6.2.9 Steam Traced Piping (All insulation materials)
Steam traced piping and fittings 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 clearance 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 manifolds after the run of tracers.

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6.2.10 Electrical Traced Piping

Electrical traced piping shall be provided with the same size insulation as would be provided if the piping were not electrically traced, unless otherwise specified.

6.3 Horizontal Equipments

6.3.1 Application in horizontal vessel

a) The vessel fabricator shall provide insulation cladding support /securement as per fabrication drawing / standard. Insulation contractor shall verify the same before commencing.

- For vessels of diameter 2000mm 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 diameter holes. These are to be used for insulation securement.

- At vessel heads above 600mm outside diameter 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 stainless steel rod.

- Boot of vessel, if any, is provided with circular support ring with holes, as indicated in sketch.

b) Blanket shall be applied over the surface with joints tightly butted and laced together with 1mm dia stainless steel 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 suitable sealant.

6.3.2 Insulation Securement

Each layer of insulation on shells of equipment shall be secured by bands at every 300 centres. 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 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 16 SWG annealed 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.

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6.4 Vertical Equipments

6.4.1 Application in vertical vessel

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

6.4.2 Insulation Securement (For all insulation materials)

Bottom and Top Head insulation shall be supported by 16 SWG SS 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 vessel.Shell insulation shall be supported by bands at every 300 centres on the cylindrical portion and the bands shall be kept horizontal.

Insulation Securement for Bottom head for vessel supported on legs shall be identical to that of Top head.

For insulation securement of bottom heads inside skirt no floating rings/bands need be provided; Firm securement should be ensured just by 16 SWG annealed SS wire drawn over insulation tightly and through the holes on support rings provided by the fabricator.

6.4.3 Expansion Joints (For rigid insulation)

Expansion joints shall be provided every 4000mm (max.). The expansion 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 fibre.

6.5 Flange, Nozzle, Channel Cover, Manway & Handhole Flanged Cover (For 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 stopped short of uninsulated flanges and nozzles etc., a sufficient distance to permit withdrawal of bolts without disturbing the insulation. Insulation shall be weatherproofed and sealed at these locations.

6.6 Application over Irregular Surfaces Such as Pumps, Compressors, Turbines etc.

a) Rockwool: This shall be prefabricated removable covers, lined with pipe sections / lags / slabs / mattresses.

b) Calcium silicate/ Moulded expanded perlite: Insulation material shall be loose fill insulating cement/block insulation cut and fitted.

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

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Each layer shall be covered with a layer of 25mm hex. 20 SWG galvanised iron wire mesh for other than SS surfaces and with SS wire mesh for SS surfaces. The final layers shall be trovelled to a smooth finish with a 6mm thick finishing cement.

Insulation shall be beveled back at 45 deg. from all casing flanges, shaft seal caps and bearing boxes.

6.7 Vertical Storage Tanks (Carbon Steel)

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

- Shell

The extent of insulation/ cladding support/ securement details shall be as per the relevant tank fabrication standard/ drawings. Insulation contractor shall check for its presence before insulation application work.

Water Shed

At the junction of shell and roof, a watershed is provided to act as top covering for the shell insulation. The details of water shedding shall be as per the relevant tank fabrication standard/ drawings. Insulation contractor shall check for its presence prior to insulation application work.

Insulation Support

Insulation support will consist of 5mm dia steel rods provided at 400mm dia diamond pitch. Length of these lugs is 3mm less than insulation thickness.

Cladding Support

From tank top, horizontal rings shall be provided at every 1175mm on tank shell.

- Tank Roof

Shall be provided as per relevant tank fabrication standard.

b) Insulation laying and securement

- Shell (Application of fibrous insulation)

Insulation shall be applied between rings in horizontal mode. Mattresses insulation shall be applied with joints tightly butted and laced together with 1mm dia. Stainless steel lacing wire. Matts 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 150mms). Rods and speed washers of spring steel should be selected to suit each other. While rods are provided by tank fabricator, speed washers shall be furnished by insulation contractor. Insulation shall be further secured by bands spaced centrally between insulation supports.

- Shell (Application of Polyisocyanurate / Polyurethane foam)

Shall be foamed cast in-situ as per vendor's procedure (approved by Client/Client's representative) and to the satisfaction of Site-in-Charge. The

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minimum requirement for thermal conductivity, density, compressive strength, fire properties and water vapour permeability shall be as specified herein this specification. Contractor shall ensure that cladding & band thicknesses are capable of withstanding foaming pressures which are developed at the time of injection of foam. Contractor can use foamed cast in-situ insulation only after getting the approval to material specification and application procedure.

- Roof (For all materials)

  Application fibrous insulation, Polyisocyanurate / Polyurethane foam shall be similar to that as for shell. Insulation support from 5mm dia M.S. lugs shall be exactly same as in shell.

6.8 Horton Spheres

c) Structural members provided by spheres fabricator for insulation/cladding securement. Insulation & Cladding supports shall be as per relevant sphere fabrication standard

d) Insulation laying and securement

Insulation shall be applied between rings. 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 16 SWG 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 rightly 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.

6.9 Inspection Windows

Removable plug type inspection window shall be provided on the outside thermal insulation metal jacketing to facilitate the maintenance inspection of substrate. The removable plug shall be made of silicon rubber and secured with small chain or lanyard made of stainless steel. Sealing flange shall be made of stainless (SS-304). An O-ring made of rubber shall be placed for any metal seal flange for proper retrofit.

Plug flange shall be fixed by screws and washers to outside metal jacketing and same shall be silicon sealed for a perfect watertight assembly sealing.

When inspection window installed on corrugated metal jacketing, a neoprene transition gasket shall be installed between cladding and flange

6.9.1 Piping

Plug type inspection windows of ellipsoidal shape shall be provided on all the insulated pipelines having diameter 2” and above. The locations of inspection plugs shall be as follows:

- Straight section:

  Two inspection window at 0-6 o’clock position shall be provided at a distance of every 12 meters.

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- Bends/Elbows:

  There must be three inspection window shall be installed near the bends. In case of no supports are welded at the centre of the elbows, one inspection window at the centre of the outer arc and another two at 100 mm away from the above and downstream of the plug. In case of supports are welded at the centre of the elbows, one on side of the elbows and another two at 100 mm away from the support upstream and downstream.

- Tee joints:

  Two no. inspection window shall be installed, one at the Tee bottom and another at the side of Tee.

6.9.2 Exchangers

All the heads shall be provided with one inspection window each. Minimum two inspection windows shall be provided on the shell side.

6.9.3 Columns & Vessels

Heads shall be provided with one inspection window each. One inspection window shall be provided at every platform. Minimum two inspection windows shall be provided on shell portion.

6.9.4 Tanks

One inspection window shall be provided at each course of the tank and also at the top.

6.9.5 Dimension of Inspection window

Application	Size
Pipe dia 2''	35mm minor diameter x 120mm major diameter
Pipe dia 3"	45mm minor diameter x 120mm major diameter
Pipe dia 4"	75mm minor diameter x 120mm major diameter
Pipe dia 6"	100mm minor diameter x 120mm major diameter
Pipe dia 8"	100mm minor diameter x 120mm major diameter
Pipe dia > 8"	120mm minor diameter x 120mm major diameter
Exchangers, Columns& Vessels and Tanks	120mm minor diameter x 120mm major diameter

6.10 Impulse Lines for Heat Traced Lines

Wrap the impulse lines with insulation (Sodium Silicate inhibited Ceramic rope) of required thickness after cleaning the impulse lines from dust, rust, grease etc. Ensure that the rope(s) have been tightly wrapped without leaving any gaps. Apply two layers of self adhesive Aluminium foil tape of minimum 0.1 mm thick spirally bound over the fibre rope surface with the joints in two layers staggered. Ceramic rope shall have minimum density of 250 Kg/m^3, other property like maximum use temperature, tensile strength, linerar shrinkage, non-fibrous content etc. shall meet the requirement specified as per ASTM C892, Type III. A suitable sealant shall be provided to stop the water ingress at the termination points of insulation.

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Note: Impulse line insulation details shall be as follows:

Size of Impulse line (inch)	Temperature (°C)	No. of layers	Thickness of each layer (inch)
1/2	150	2	1/2
3/4	150	2	1/2
1/2	250	2	3/4
3/4	250	2	3/4

6.11 Impulse Lines for Hot Insulated Lines

Wrap impulse lines with sodium silicate inhibited ceramic fiber rope (SS-wire braided) with thickness of layer as 3/4" irrespective of temperature, after cleaning the impulse lines from dust, rust, grease etc. The wrapping of the rope around impulse line shall cover it completely without leaving any gap. Apply two layers of self adhesive Aluminum foil tape of minimum 0.1 mm thick spirally bound over the fiber rope surface with the joints. Ceramic rope shall have minimum density of 250 Kg/m³, other property like maximum use temperature, tensile strength, linerar shrinkage, non-fibrous content etc. shall meet the requirement specified as per ASTM C892, Type III. A suitable sealant shall be provided to stop the water ingress at the termination points of insulation

6.12 INSULATION FINISH

6.12.1 Multiplex vapor barrier

In case of closed cell material (Cellular glass, perlite etc.) in CUI risk zone and on PIR in case of electrical tracing and multiplex vapour barrier shall be applied over the outer surface of Insulation. The joints of the vapor barrier foil shall be overlapped by 50mm. The joints shall be sealed with a tape confirming to the specification as mentioned herein in this specification.

6.12.2 Moisture Barrier

(Applicable for application on outer surface of the fibrous insulation in CUI risk zone)

The mastic shall be applied in two coats with glass cloth reinforcement such that total dry thickness is ~ 3mm.

Immediately after the insulation, a 3mm thick coating of the mastic shall be applied to the surface and a 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. The glass cloth shall have min 75mm overlap at joint. A second coat of 3mm shall be applied after approximately 12 hrs. 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.

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6.12.3 Insulation Finish with metal jacketing

The insulation finish shall provide a weatherproofed and 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.

a) Piping

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

- A single bead shall be made on all overlaps to ensure tight metal to metal water tight arrangement. Self-tapping screws, at every 150, shall be provided at all longitudinal overlaps for both horizontal & vertical piping.
- At all operating temperatures the seams at overlap positions shall be rendered watertight to ensure that insulation remains dry and unwetted, whether the possible water impingement is from rain, hose or fire sprinklers.

- 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 spacings. The band securing seals shall be kept neatly in line and positioned away from viewing angles as much as is possible.

- Vertical overlaps on vertical or near vertical piping shall be staggered to provide overlaps at 'North,' and 'South' positions in alternate sections of covering.

- Each sections of metal covering on vertical piping with insulation OD's 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.

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

- Insulated bends 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 self tapping screws and metal sealants are to be provided to get a completely waterproofed arrangement.

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

- 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 strongly discouraged. The joints shall be located to shed water.

b) Equipments

- 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.

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- The panels shall be applied commencing at the bottom of the vessel. Each circumferential ring of panels 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.

- The panels shall be held tight over the vessel insulation by means of circumferential bands and sealed. The bands shall be positioned on all horizontal overlaps and at 300mm centres. Bands shall be held in their relative positions with 'J' clips fastened to the jackets with screw. Each band shall have J-clips on 1.8m maximum centre but not less than four J-clips per band. Each band shall have compression spring as specified in this specification.

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

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

- 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 watertight by use of self-tapping screws and sealing mastic.

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

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

- Horizontal overlaps shall be secured with No. 8x12mm long self-tapping screws set in the overlap at 150mm intervals and shall be so arranged that staggered bands of panelling encircle the equipment. Vertical overlaps shall not be screwed for horizontal equipment.

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

- The insulated heads of vertical and horizontal equipment shall be fabricated from flat metal, 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 watertight.

- 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 weatherproofed with self-tapping screws and mastics.

- Insulation at bottom heads of fully skirted equipments does not require weatherproofing.

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- Heads of equipments 24" OD and smaller shall be finished and waterproofed with square ended fabricated covers.

c) Vertical Storage Tanks

Cladding Applications and Securement

➢ 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 & selftapping screws at 150mm pitch.
- Cladding shall be secured to support ring by bolting. Bolts are provided by tank fabricator 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 portion of the curb angle. Shell cladding and extended roof cladding shall be secured to curb angle by bolting as per relevant fabrication standard.
- Horizontal stainless steel bands over-cladding to be provided every 800mm 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 metres .

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

d) Horton Sphere

➢ Cladding Support

Insulation contractor shall provide 25mm x 0.8mm S.S. Bands over insulation and install them longitudinally from top to bottom of the sphere in such numbers so as to afford a maximum spacing of 1175mm at the equator. The

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S.S. Bands are spanned between four floating rings, the one at the top and bottom of the sphere are provided by the sphere fabricator. Generally the other two rings and SS bands are provided after insulation is applied prior to application of cladding. Floating rings will be constructed of 10mm diameter rods of S.S.. Diameter of ring at the top and bottom, to be provided by sphere fabricator would 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.

- Cladding Application

While applying cladding, following shall be ensured

-Minimum overlap both horizontal and vertical shall be 50mm.

- Cladding Securement and Scaling of Joints

All joints to be sealed using elastomeric metal sealant.

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

Cladding shall be secured to the insulation angle support by bolting the cladding on the bolts provided at every 300 pitch.

Further cladding shall be secured by 25mm x 0.5mm 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 & details shall be identical to that of insulation securement. Bands shall be secured to cladding every 2M by one SS 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.

7.0 QUALITY CONTROL

7.1 Incoming Material Control

7.1.1 Insulation materials and accessories shall be inspected by appropriate authority according to inspection categorization of the materials as per project execution philosophy.

7.1.2 Irrespective of the inspection performed by TPI / PMC / Owner's representative, contractor shall submit QAP (quality assurance plan) of the materials and internal test reports for every production batch and type test wherever specified in this specification.

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The QAP shall include every stage of manufacturing process starting from raw material stage to final stage of manufacturing. The QAP shall also include reference of purchase order number and date, the types of checks, methods of tests followed, frequency of checks, lot size & acceptable criteria with permissible deviations.

7.1.3 Besides the inspection performed at supplier premises and / certificate of conformance provided by supplier, at the discretion of engineer-in charge, random inspection may be performed on the supplied materials. Parameters and extent of testing shall be advised by engineer-in charge.

On the advice of engineer-in charge, the contractor shall organize the testing on representative sample selected at random from an independent NABL approved laboratory. In the event of non-conformance in testing, repeat test may be performed. Failure in repeat test may call of rejection of the batch.

7.2 Installation Quality Control

7.2.1 Insulation shall be installed after hydrostatic testing and inspection. Insulation shall be protected from weather before and during installation.

7.2.2 Insulation system should be applied as per approved drawings/sketches, installation procedure and quality plan.

7.2.3 Contractor shall prepare an inspection test plan (ITP) for installation of insulation identifying inspection / witness points, frequency etc. and submit for approval of owner / engineer in charge at construction site.

7.2.4 The engineer in-charge may finalize the same with consultation of HO specialist. If so desired by engineer-in charge, HO specialist may assist inspection of insulation work at critical stages.

7.3 Qualification of Application Crews

Prior to start for installation work, contractor's credential shall be approved by engineer in-charge of insulation work. The application crew must be fully trained work force. At the beginning of every installation, the application shall be demonstrated and quality checks shall be carried out at site and shall be certified by Owner/Engineer in charge.

7.4 Documentation

Insulation contractor shall submit Insulation Application Procedure for review and approval. Such procedure shall contain minimum following information:

- Product data sheet, material safety data sheet and compliance certificate of all the insulation and ancillaries material.
- Insulation detail drawings showing insulation system, expansion/contraction joints, insulation supports, terminations etc.
- Method statement for insulation system application and repair.
- Quality Control Plan for Insulation application (QCP)

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7.5 Safety

The insulation contractor shall provide adequate protective appliances like hand gloves, masks, glasses etc. to the workmen carrying out the insulation work, to protect them from inhaling and touching insulation dust and fibers.

7.6 Specification Deviation / Concession Control

The insulation contractor shall notify Owner/Engineer in charge of any apparent conflict between this specification, product data sheets, the codes and standards, and any other specification or document noted herein. Resolution and/or interpretation precedence shall be obtained from the Owner/Engineer in charge in writing before proceeding with application of any insulation material.
Any technical deviation to the purchase order/contract and its attachment including, but not limited to, the data sheets and specification shall be sought by the insulation contractor only through the concession request format. Concession requests require the Owner's/Engineer in charge's review and approval, prior to the proposed technical changes being implemented. Technical changes implemented prior to Owner's approval are subject to rejection.

7.7 Guarantee for Supply and Installation Quality

Contractor shall ensure supplied materials conform to the technical requirements of this specification and relevant standards / codes applicable for the job. The insulation and ancillary materials shall be procured fresh for the project. Use of excess material from other site which does not have proper traceability shall not be allowed. It is the responsibility of insulation contractor to ensure adequate precautions are taken against damage and deterioration during sourcing, transportation and storage of insulation materials. For major insulation materials like rock wool, Perlite, Ceramic fiber PIR, cellular glass, aerogel etc. batch and type test certificates as applicable shall be submitted. For ancillary materials like multiplex foil, band, sealant etc. and metal cladding may be accepted based on supplier's compliance certificate.

Any deviations shall be clearly stated, and work shall proceed only after the deviations are approved by competent authority. The workmanship in execution of the insulation works shall be in accordance with sound engineering practice.

8.0 REFERENCE CODES & STANDARDS

ASTM Standards and Specifications

ASTM A167	Specification for stainless and heat-resisting chromium nickel steel plate, sheet and strip
ASTM A240	Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet and strip for Pressure Vessels
ASTM A463	Specification for steel sheet, aluminum coated, by hot-dip process
ASTM A526	Specification of steel sheet, zinc coated (galvanized) by the hot-dip process, commercial quality
ASTM B209	Aluminum - Alloy sheet and plate
ASTM C165	Measuring Compressive properties of thermal insulations

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ASTM C177	Standard test method for Steady-state heat flux measurements & thermal transmission properties by means of the 'guarded-hot-plate' apparatus
ASTM C240	Standard test methods of testing Cellular glass insulation block
ASTM C302	Standard test method for Density and dimensions of preformed pipe-covering-type thermal insulation
ASTM C303	Standard test method for Density and dimensions of preformed block and board type thermal insulation
ASTM C335	Standard test method for Steady-state heat transfer properties of horizontal pipe insulation
ASTM C356	Standard test method for Linear shrinkage of preformed high-temperature thermal insulation subjected to soaking heat
ASTM C390	Standard criteria for Sampling and acceptance of preformed thermal insulation lots
ASTM C446	Standard test method for Breaking load and calculated modulus of rupture of preformed insulation of pipes
ASTM C518	Standard test method for Steady-state thermal transmission properties by means of the heat flow meter apparatus
ASTM C533	Standard specification for Calcium silicate block and pipe thermal insulation
ASTM C547	Standard specification for Mineral fiber pipe insulation
ASTM C552	Standard specification for Cellular glass thermal insulation
ASTM C591	Standard specification for Unfaced preformed rigid cellular polyisocyanurate thermal insulation
ASTM C592	Standard specification for Mineral fiber blanket insulation and blanket-type pipe insulation (metal-mesh covered) (industrial type)
ASTM C610	Standard specification for block and pipe thermal insulation
ASTM C612	Standard specification for Mineral fiber block and board thermal insulation
ASTM C795	Standard specification for thermal insulation for use in contact with austenitic stainless steel
ASTM C871	Standard test methods for Chemical analysis of thermal insulation materials for leachable chloride, fluoride, silicate and sodium ions
ASTM C892	Standard specification for High temperature fiber blanket thermal insulation
ASTM D1622	Test method for apparent density of rigid cellular plastics
ASTM E96	Standard test methods for Water vapor transmission of materials

EIL Standards and Specifications

7-13-0003	Hot insulation supports for storage tanks
7-13-0015	Hot insulation supports for spheres
7-12-0025	Fireproofing and insulation supports
7-13-0033	Hot insulation supports for horizontal vessels

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6-79-0022	Standard specification for acoustic insulation
6-79-0027	Standard specification for cold insulation of vessels, piping and equipment

IS Standards and Specifications

IS 8183	Bonded mineral wool - Specification
IS 9428	Calcium silicate insulation blocks and pipe-coverings
IS 11239	Method of test for rigid cellular thermal insulation materials

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9.0 INSULATION DIAGRAMS

The drawings/ sketches are general in nature. Specific insulation system/ requirement if any from insulation manufacturer, shall be submitted by contractor for approval by owner/ Engineer in charge.

The attached sketches describe general arrangement of insulation material, ancillaries and cladding. Difference if any on material type & quality between sketch and the description elsewhere in this specification/ SOR, later shall apply.

S.No.	Description	Drawing
1	Pipe insulation details (fibrous &rigid insulation)	DRAWING. No. 01
2	Pipe insulation method of staggering of sections rigid & fibrous insulation (preformed pipe sections only)	DRAWING. No. 02
3	Horizontal pipe : fibrous insulation; detail of spacer rings for cladding support	DRAWING. No. 03
4.	Detail of spacer ring fibrous insulation (mattress)	DRAWING. No. 04
5.	Bolted on insulation support for vertical pipe	DRAWING. No. 05
6.	Insulation details for bends / elbows	DRAWING. No. 06
7.	Insulation details : pipe bends & elbows	DRAWING. No. 07
8.	Insulation details: pipe branched & reducer	DRAWING. No. 08
9.	Example of removable flange box, horizontal	DRAWING. No. 09
10.	Removable flange box, vertical	DRAWING. No. 10
11.	Insulation details pipe supports	DRAWING. No. 11
12.	Insulation of traced piping	DRAWING. No. 12
13.	Horizontal equipment insulation	DRAWING. No. 13
14.	Horizontal equipment heads	DRAWING. No. 14
15.	Use of flexible insulation in combination with rigid insulation to compensate for vessel expansion	DRAWING. No. 15
16.	Insulation details : vertical vessel	DRAWING. No. 16
17.	Insulation details vertical vessel heads	DRAWING. No. 17
18.	Insulation details : vertical vessels	DRAWING. No. 18
19.	Insulation details : vertical storage tank	DRAWING. No. 19
20.	Insulation details : sphere	DRAWING. No. 20
21.	Non- insulated flanges, horizontal and vertical	DRAWING. No. 21
22.	Removable valve box, "T" connection, horizontal	DRAWING. No. 22
23.	Removable valve box, "T" connection, vertical	DRAWING. No. 23
24.	Hanger support	DRAWING. No. 24
25.	Personal protection	DRAWING. No. 25
26.	Details of lifting lugs	DRAWING. No. 26
27.	Removable box for pump	DRAWING. No. 27

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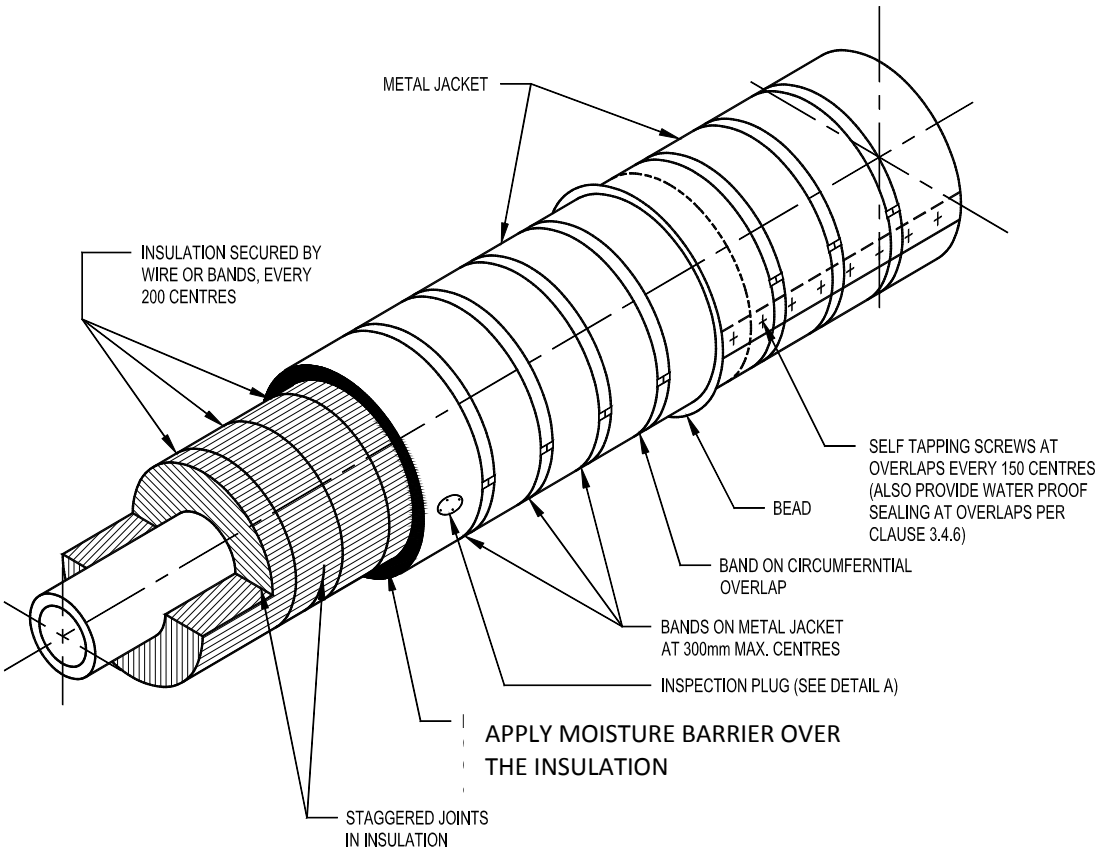

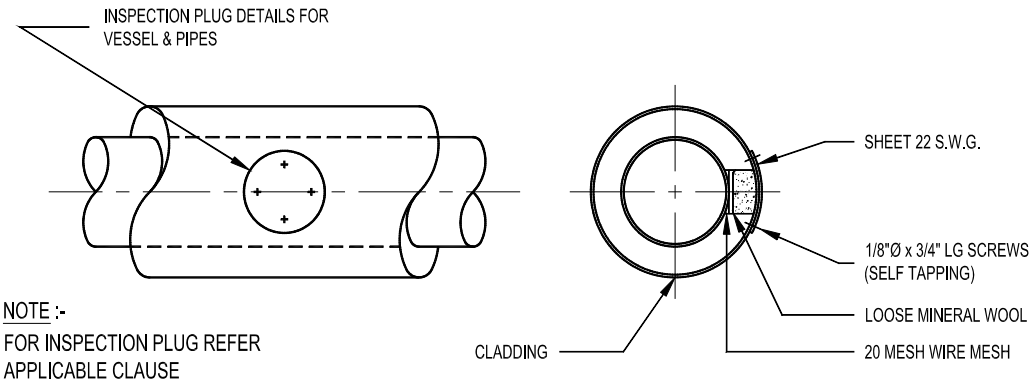

DETAIL 'A'

FIGURE – 01
PIPE INSULATION DETAILS
(FIBROUS &RIGID INSULATION)

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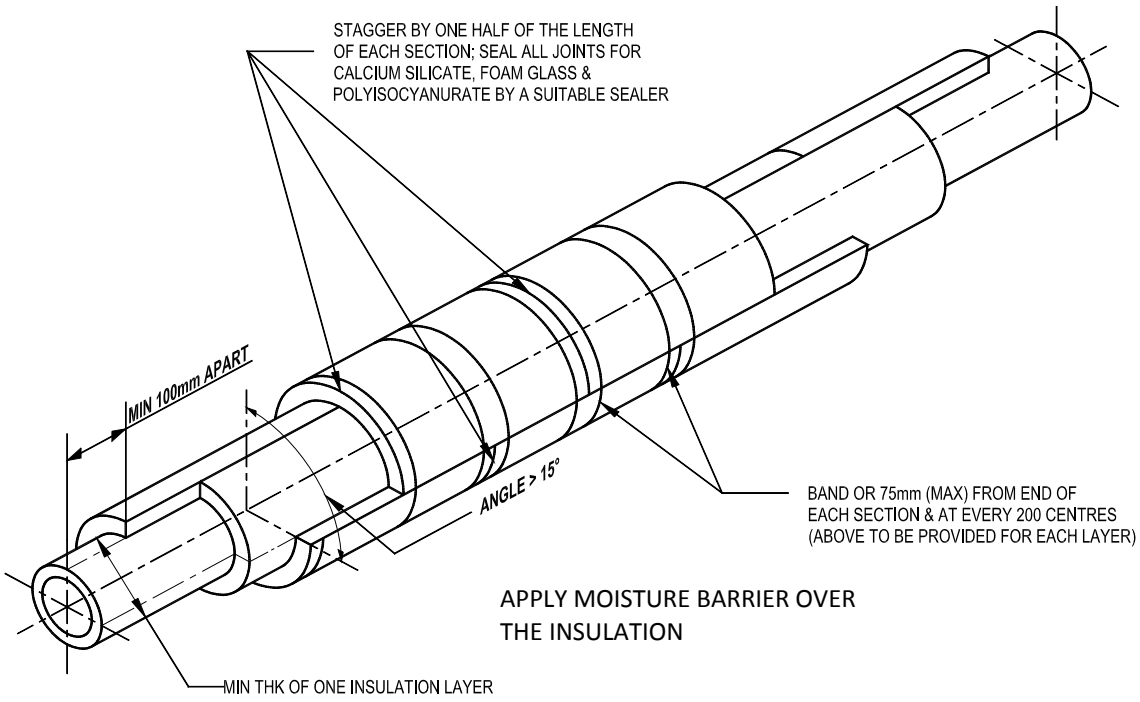

FIGURE – 02
PIPE INSULATION METHOD OF STAGGERING OF SECTIONS
RIGID & FIBROUS INSULATION (PREFORMED PIPE SECTIONS ONLY)

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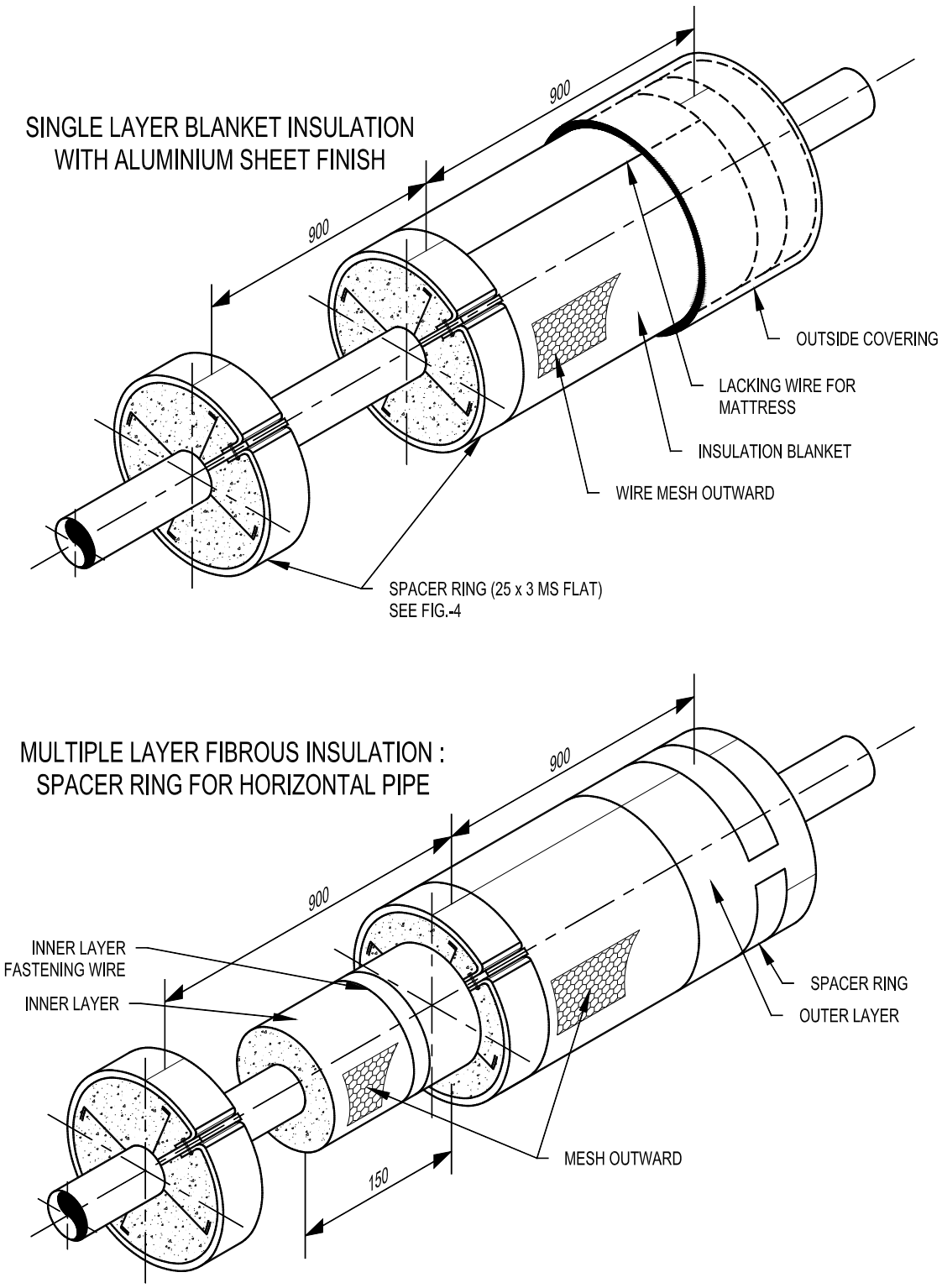

FIGURE – 03
HORIZONTAL PIPE : FIBROUS INSULATION; DETAIL OF SPACER RINGS FOR CLADDING SUPPORT

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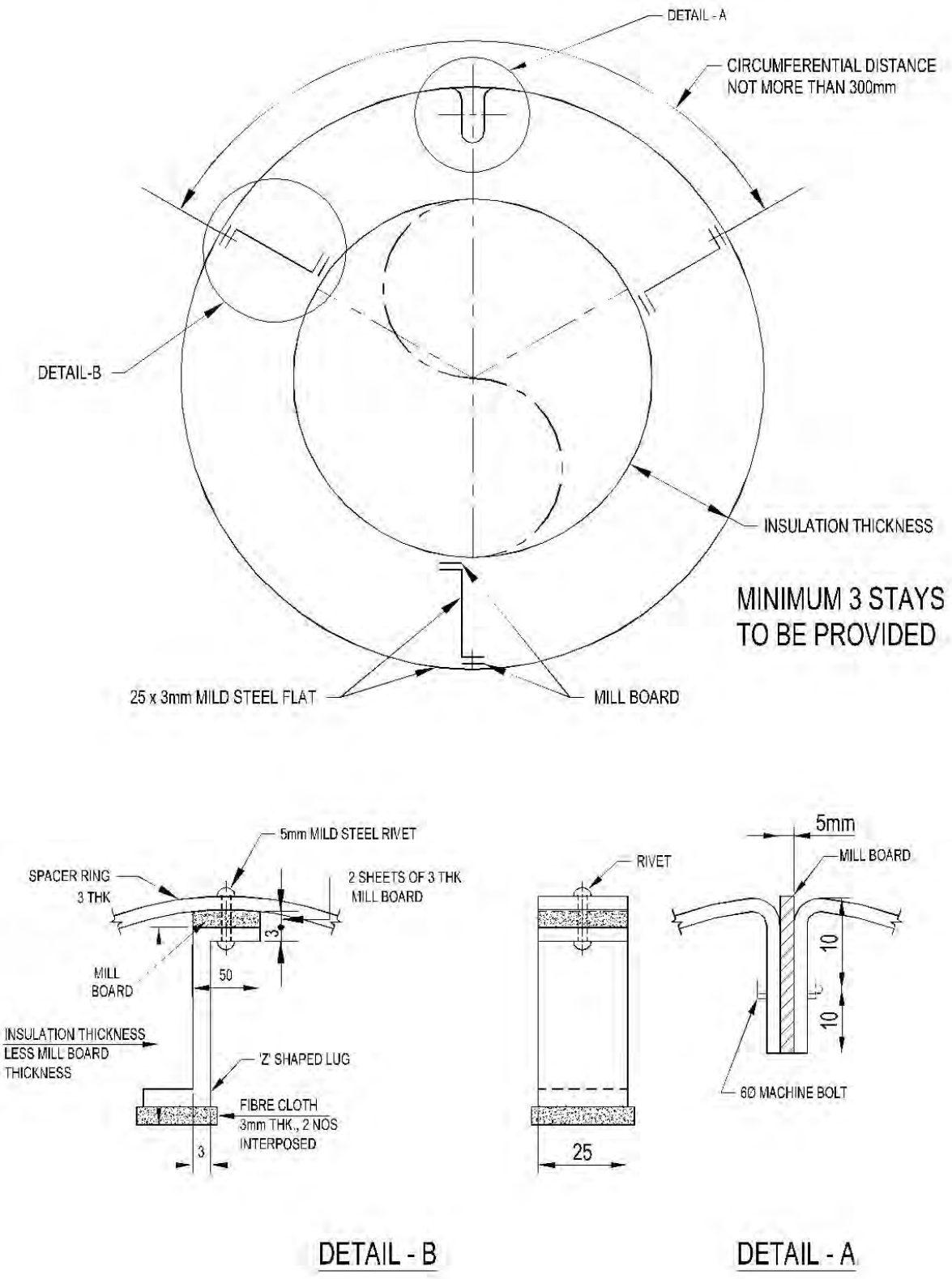

FIGURE – 04
DETAIL OF SPACER RING FIBROUS INSLUATION (MATTRESS)

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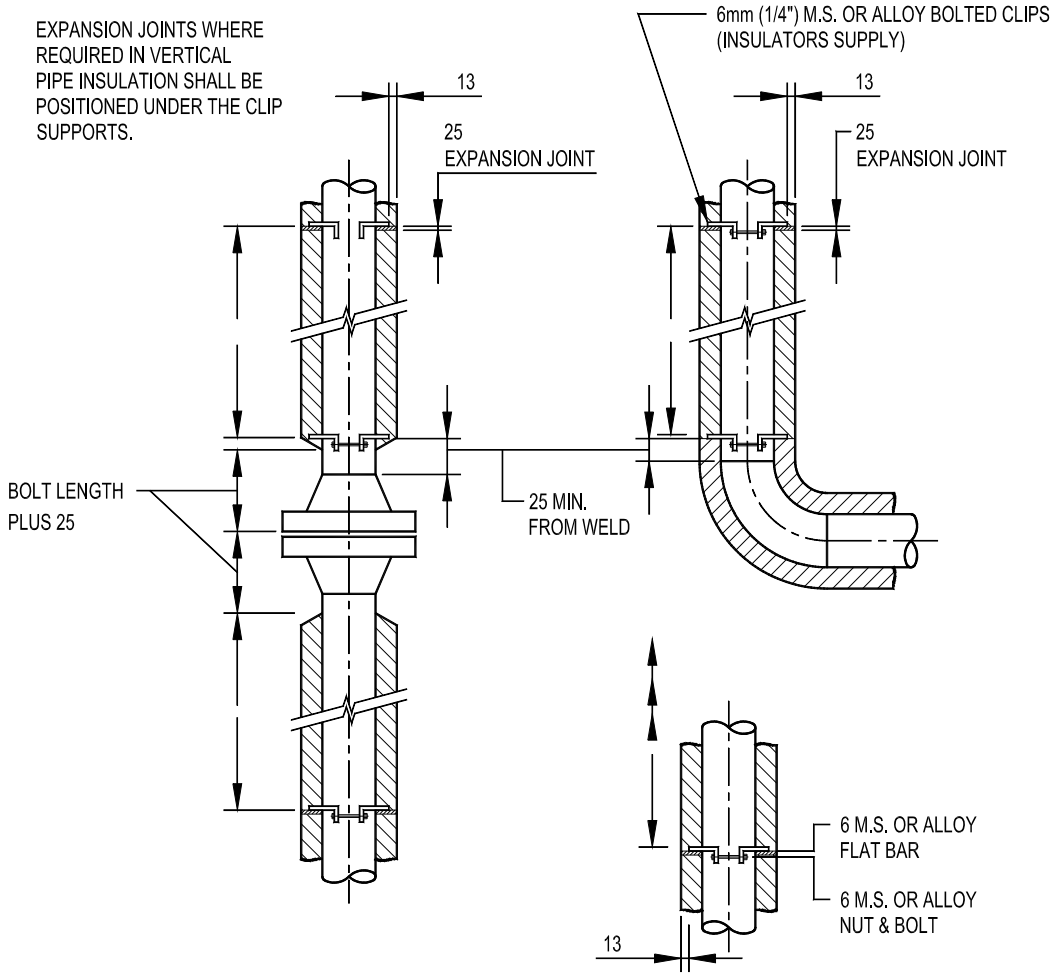

CLIP SPACING

PIPE TEMP. °C	MAX. SPACING 'D' MM
UPTO 400	4500
400 TO 500	3500
500 TO 550	2500

* CIRCUMFERENTIAL EXPANSION SHALL BE CONSIDERED AT THESE OPERATING TEMPERATURES.

FIGURE – 05
BOLTED ON INSULATION SUPPORT FOR VERTICAL PIPE

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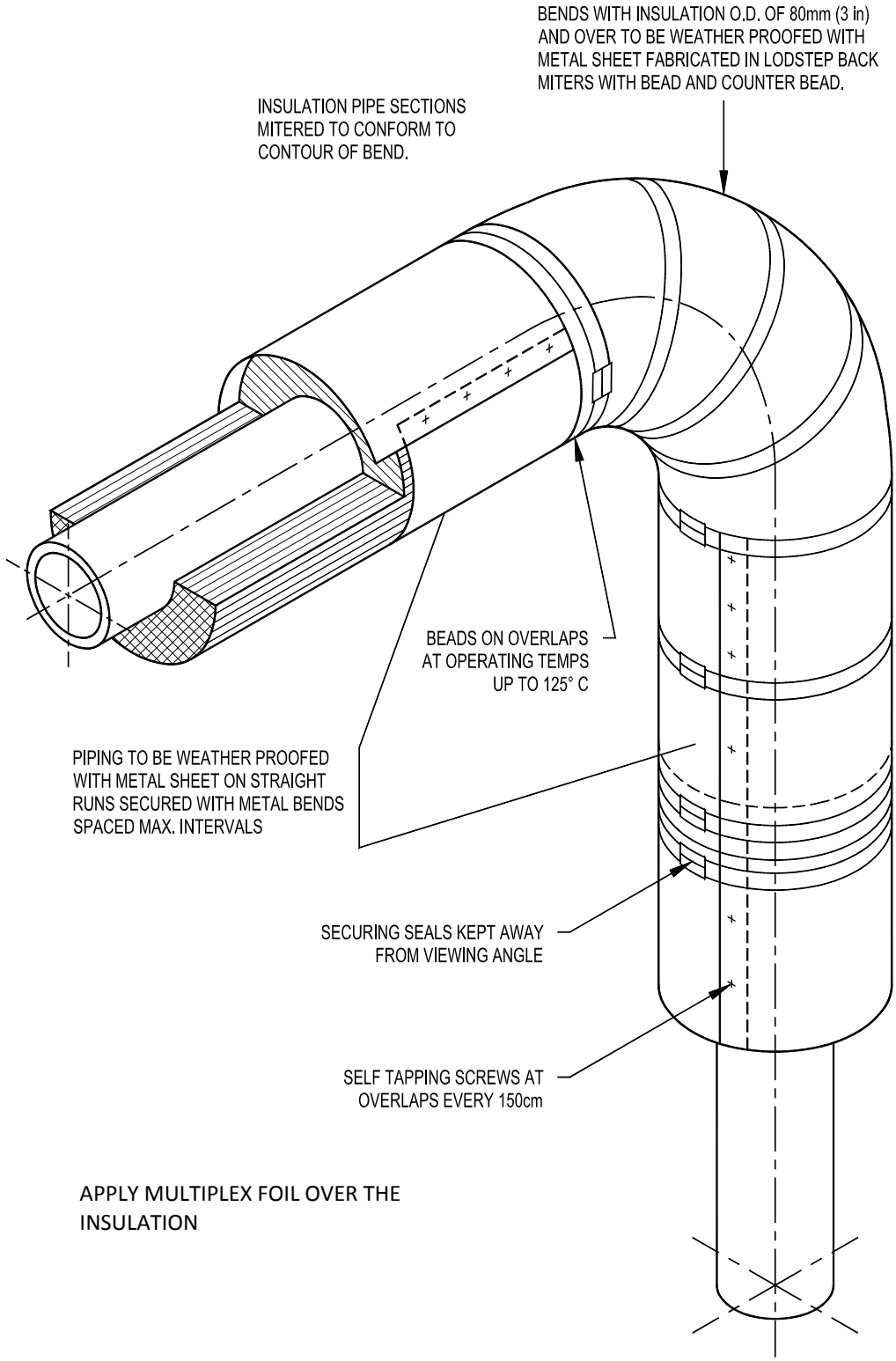

FIGURE – 06
INSULATION DETAILS FOR BENDS / ELBOWS

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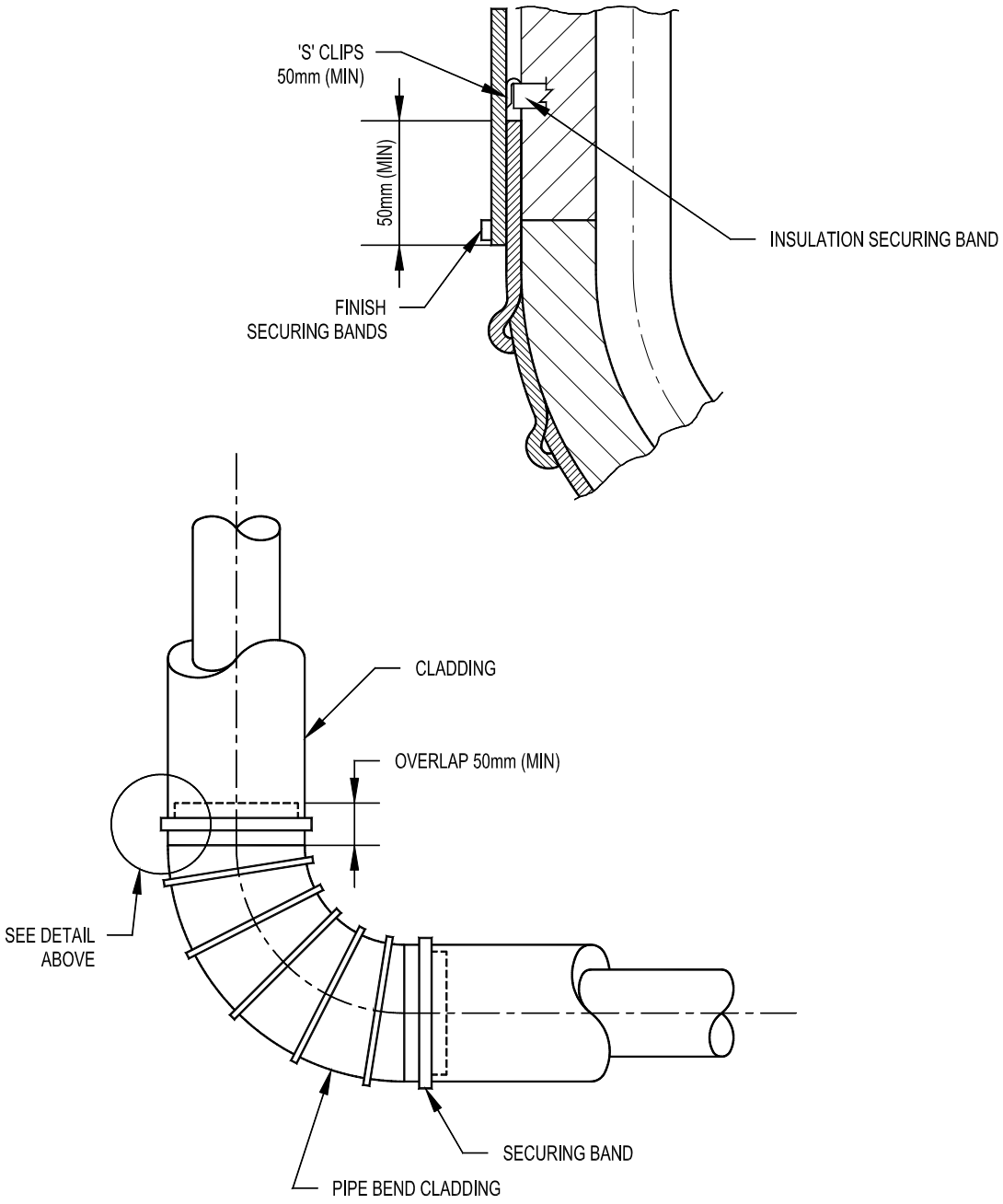

FIGURE – 07
INSULATION DETAILS : PIPE BENDS & ELBOWS

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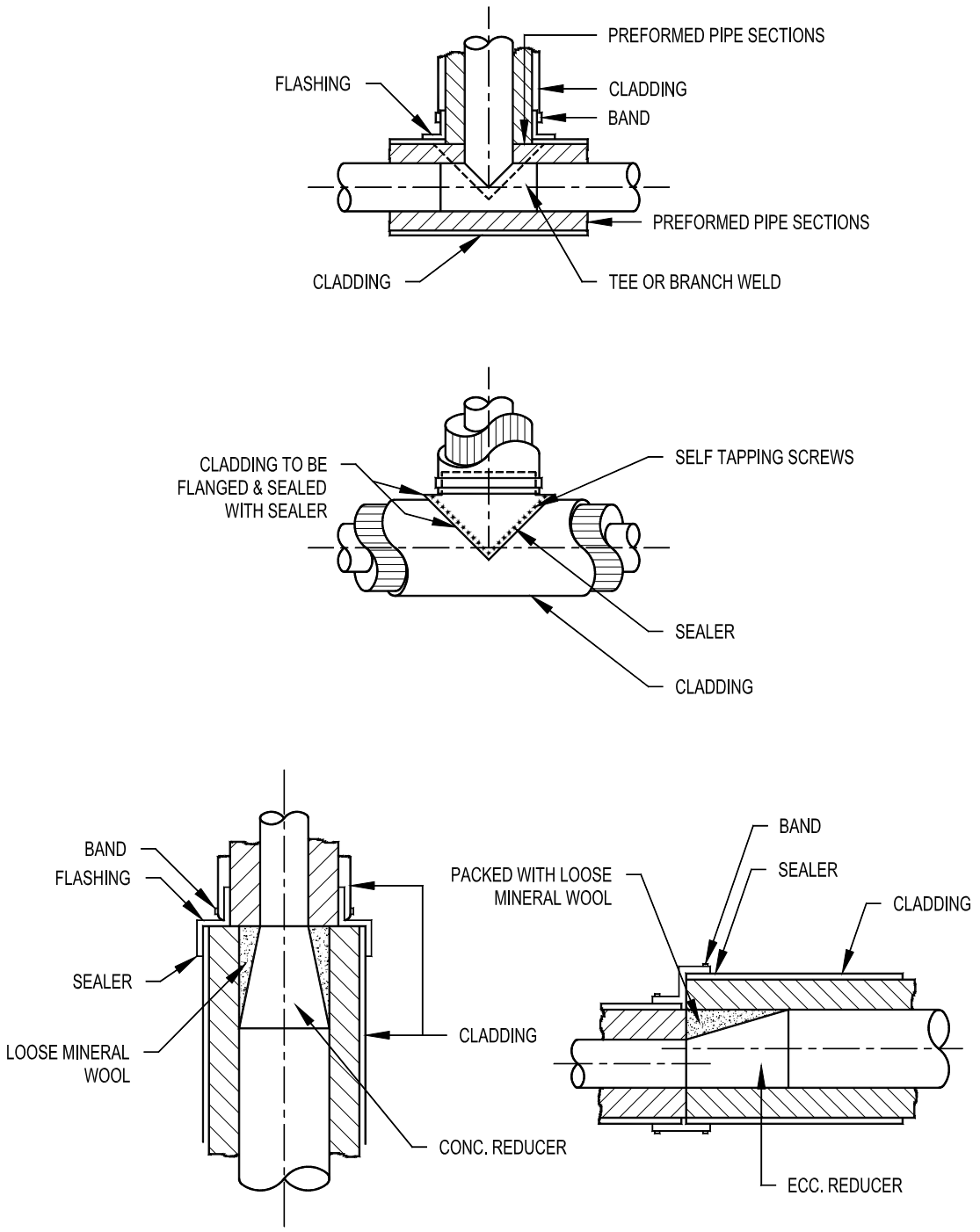

FIGURE – 08
INSULATION DETAILS: PIPE BRANCHED & REDUCER

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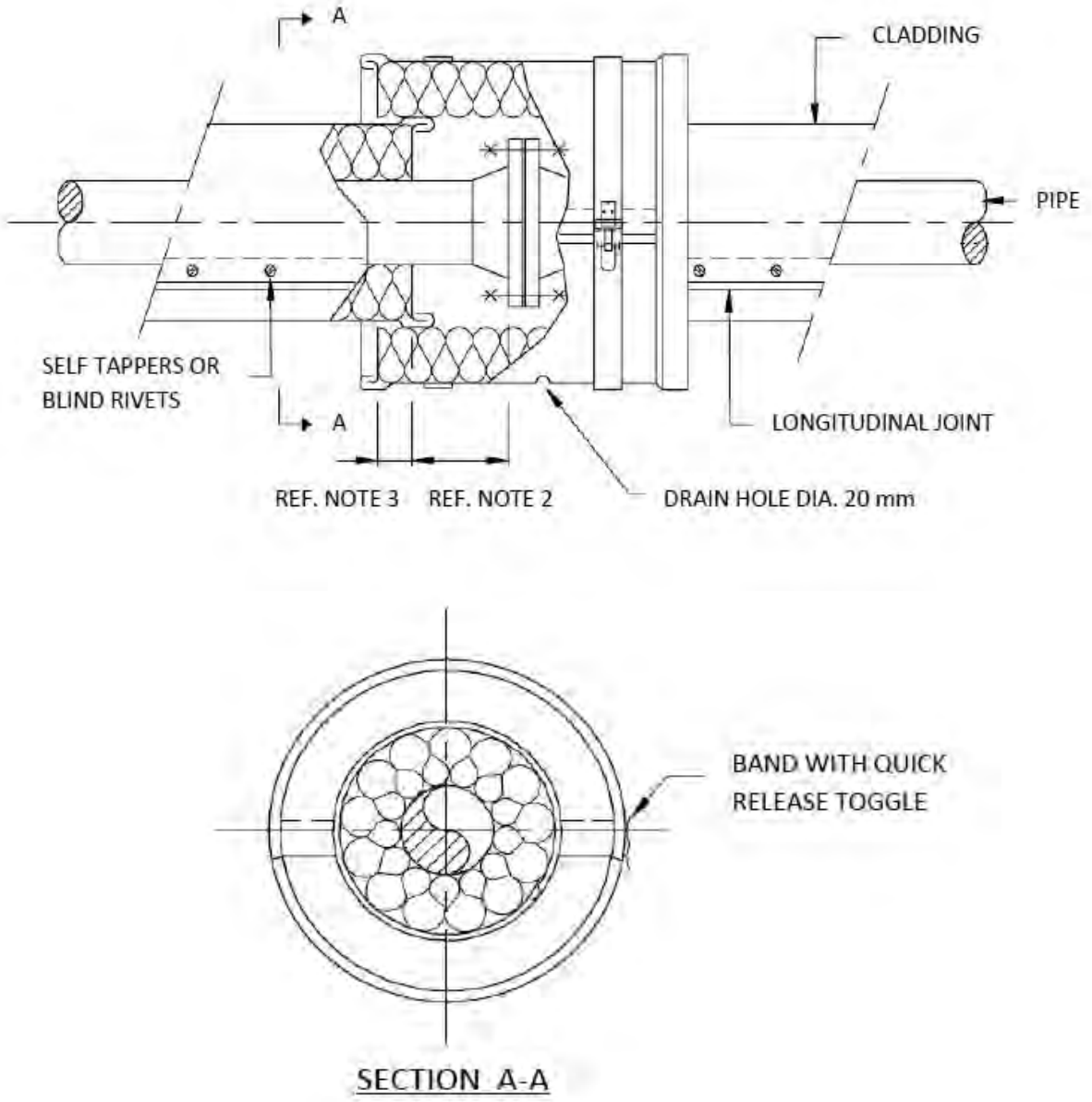

NOTE

1. MATERIAL AND FINSHING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS AND SPECIFICATION
2. DISTANCE BETWEEN INSULATION AND FLANGE TO BE BOLT LENGTH + 30 mm
3. INSULATION THICKNESS

FIGURE – 09
EXAMPLE OF REMOVABLE FLANGE BOX, HORIZONTAL

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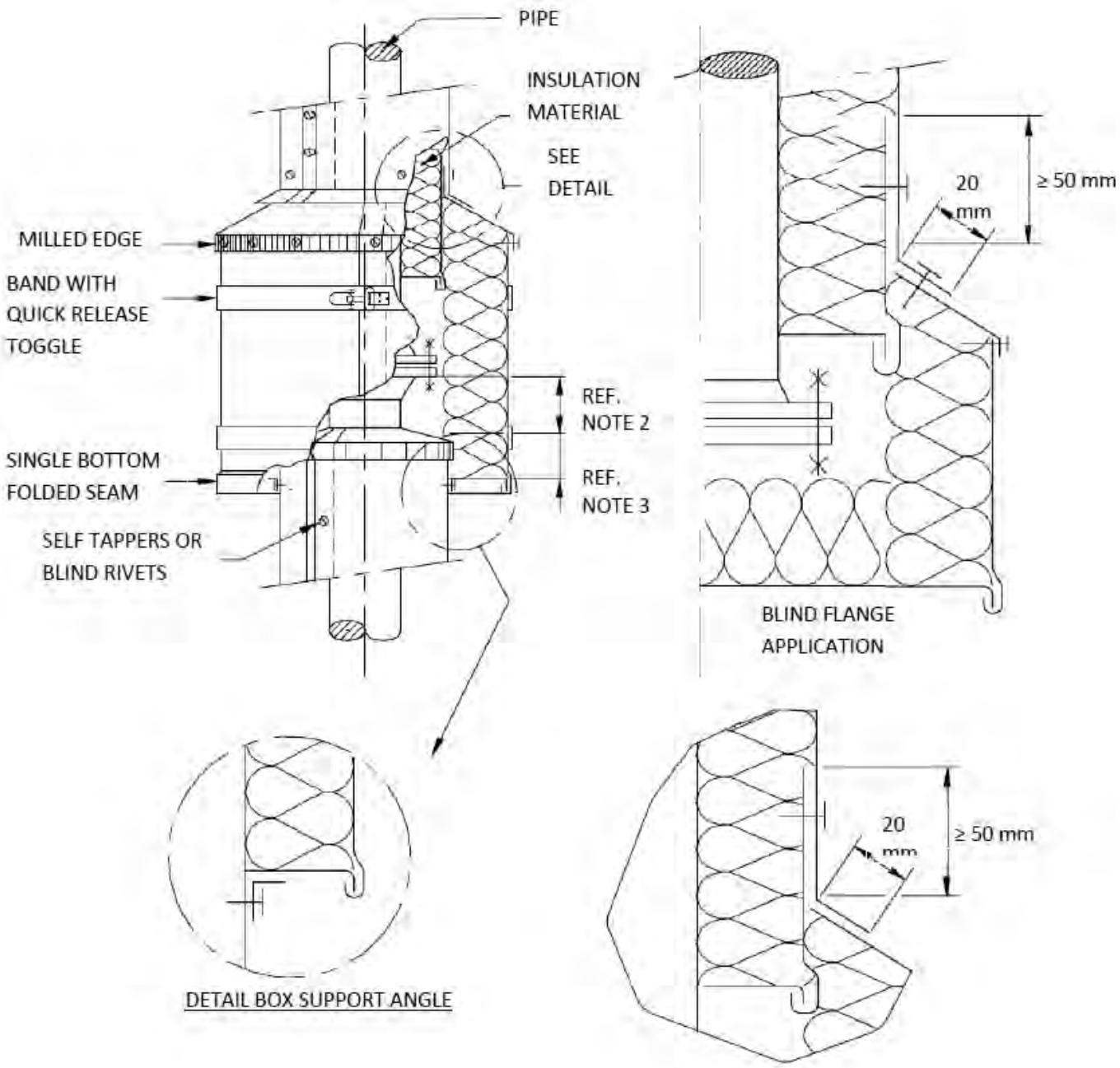

NOTE

1. MATERIAL AND FINSHING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS AND SPECIFICATION
2. DISTANCE BETWEEN INSULATION AND FLANGE TO BE BOLT LENGTH + 30 mm
3. INSULATION THICKNESS

FIGURE – 10
REMOVABLE FLANGE BOX, VERTICAL

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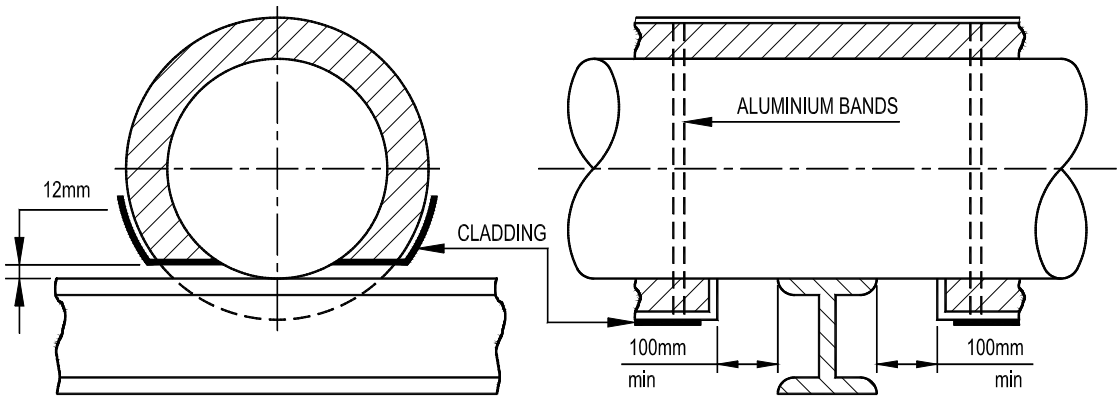
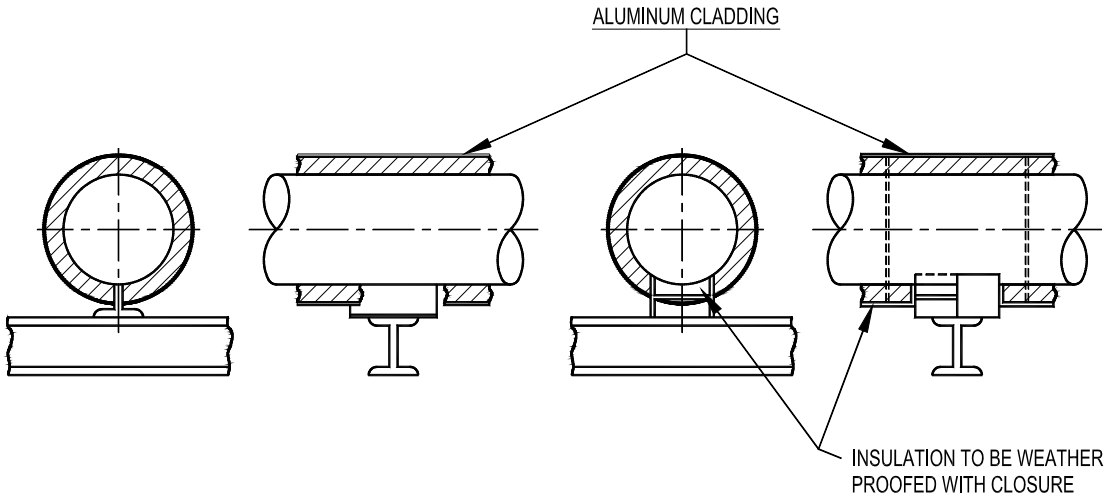


WHERE CLADDING IS TO BE CUT AWAY IT SHALL FIT CLOSELY TO THE PIPE AND TO BE COMPLETELY WEATHERPROOF

INSULATION DETAIL AT LINES WITHOUT SHOES
(THIS SHOULD ONLY BE REQUIRED IN EXCEPTIONAL CIRCUMSTANCES)



INSULATION OF LINE ON SHOES

FIGURE – 11
INSULATION DETAILS PIPE SUPPORTS

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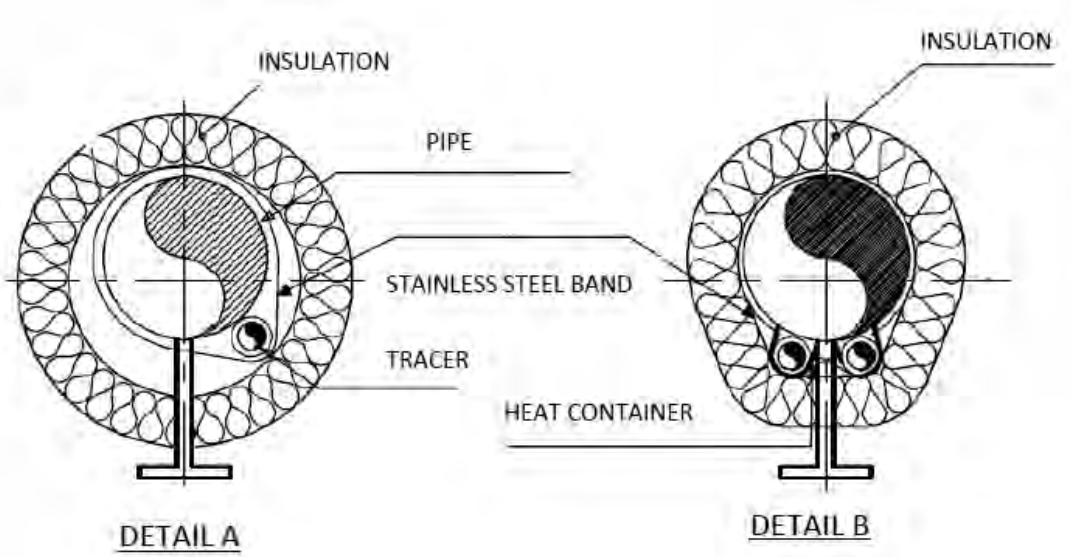

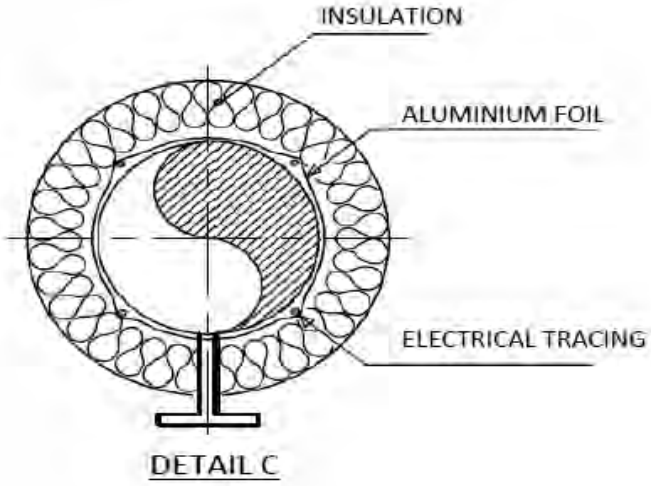

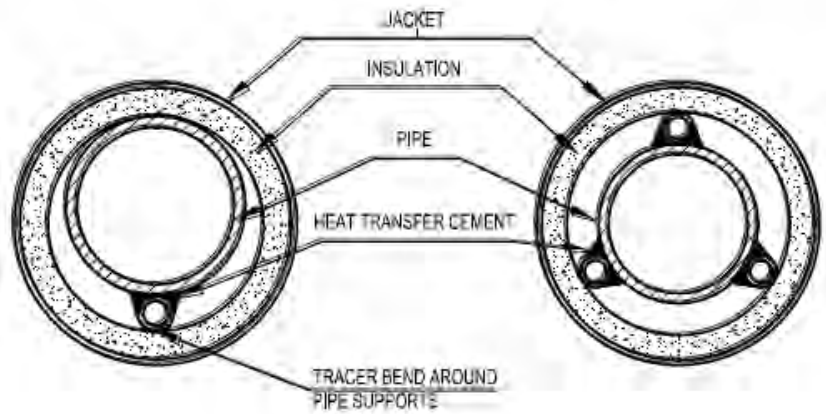

FIGURE – 12
INSULATION OF TRACED PIPING

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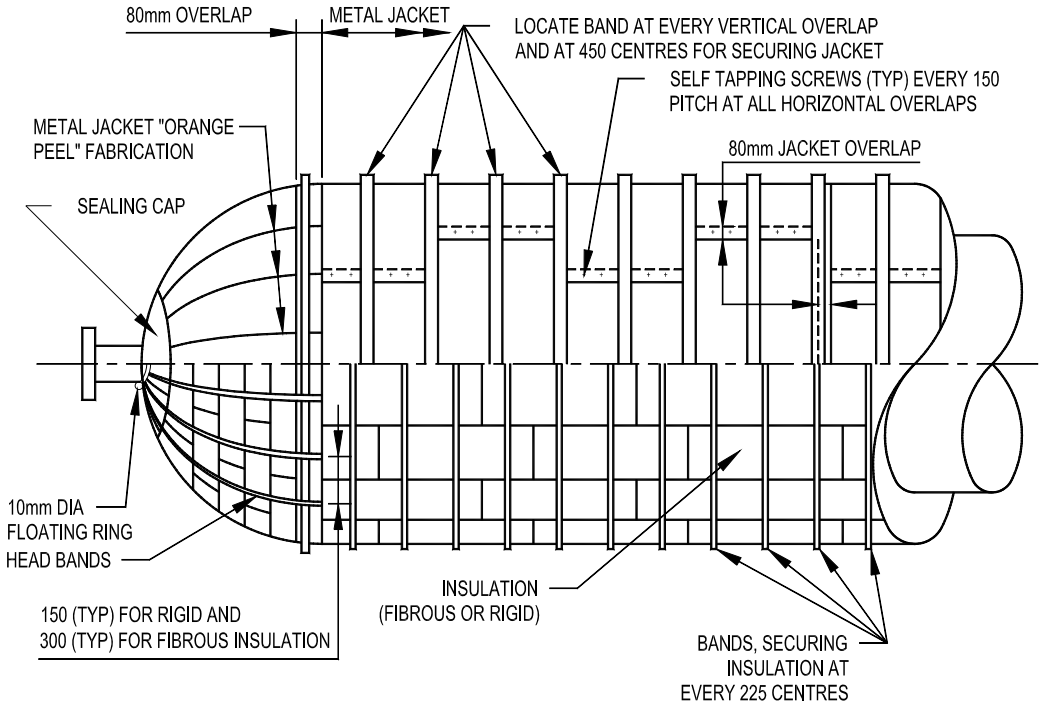

NOTES :-

1. SADDLE SUPPORTS FOR HORIZONTAL EQUIPMENT TOGETHER WITH SHOE AND ANCHOR SUPPORTS FOR HORIZONTAL PIPNG SHALL BE DESIGNED TO INCLUDE ELONGATED CUT-OUTS IN THE SUPPORT AT SUCH A DISTANCE FROM THE SUPPORTED EQUIPMENT AND PIPING TO ALLOW THE PASSAGE OF INSULATION SECURING BANDS AND TIES AROUND THE OUTSIDE FACE OF THE INSULATING AND FINISHING MATERIAL.

FIGURE – 13
HORIZONTAL EQUIPMENT INSULATION

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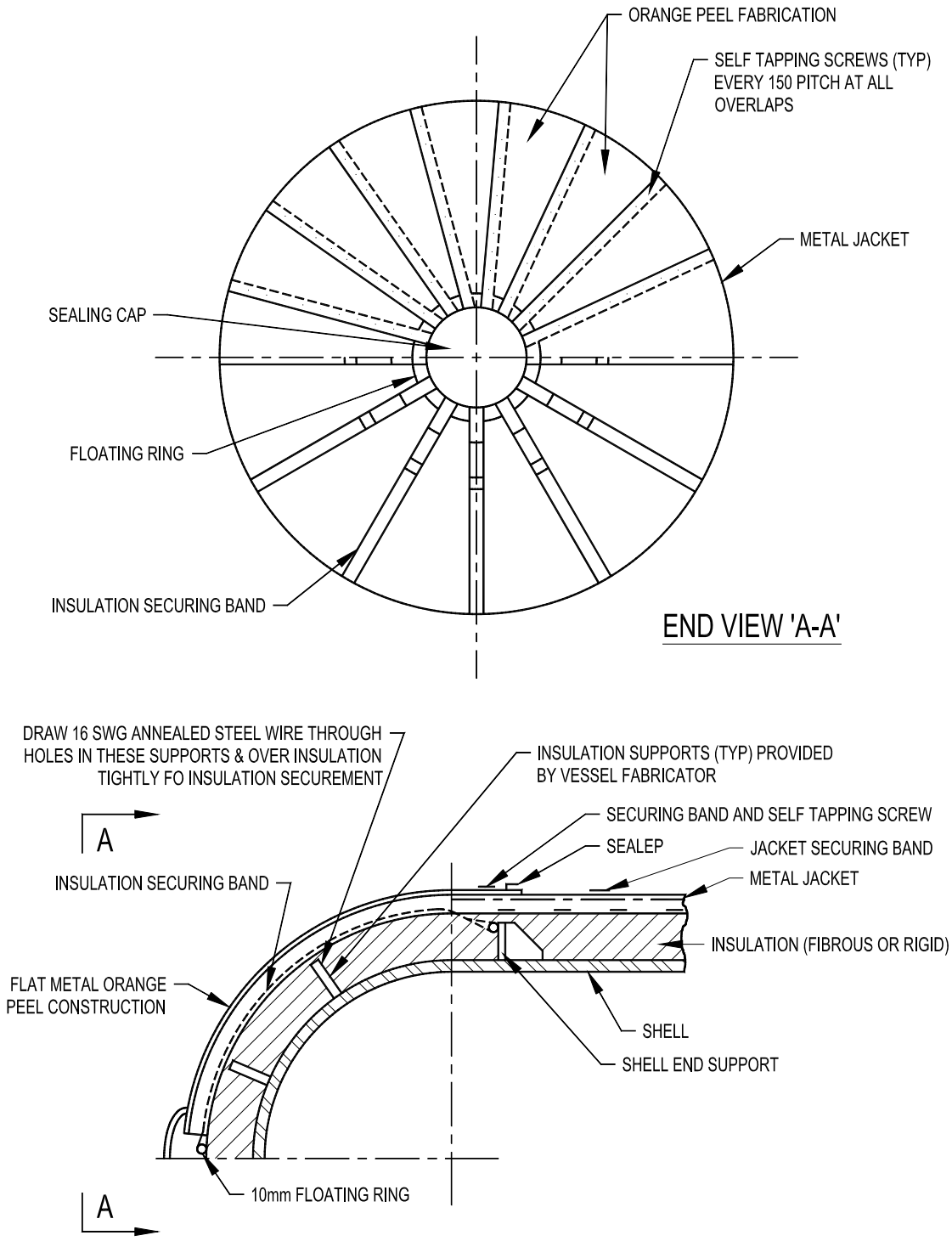

FIGURE – 14
HORIZONTAL EQUIPMENT HEADS

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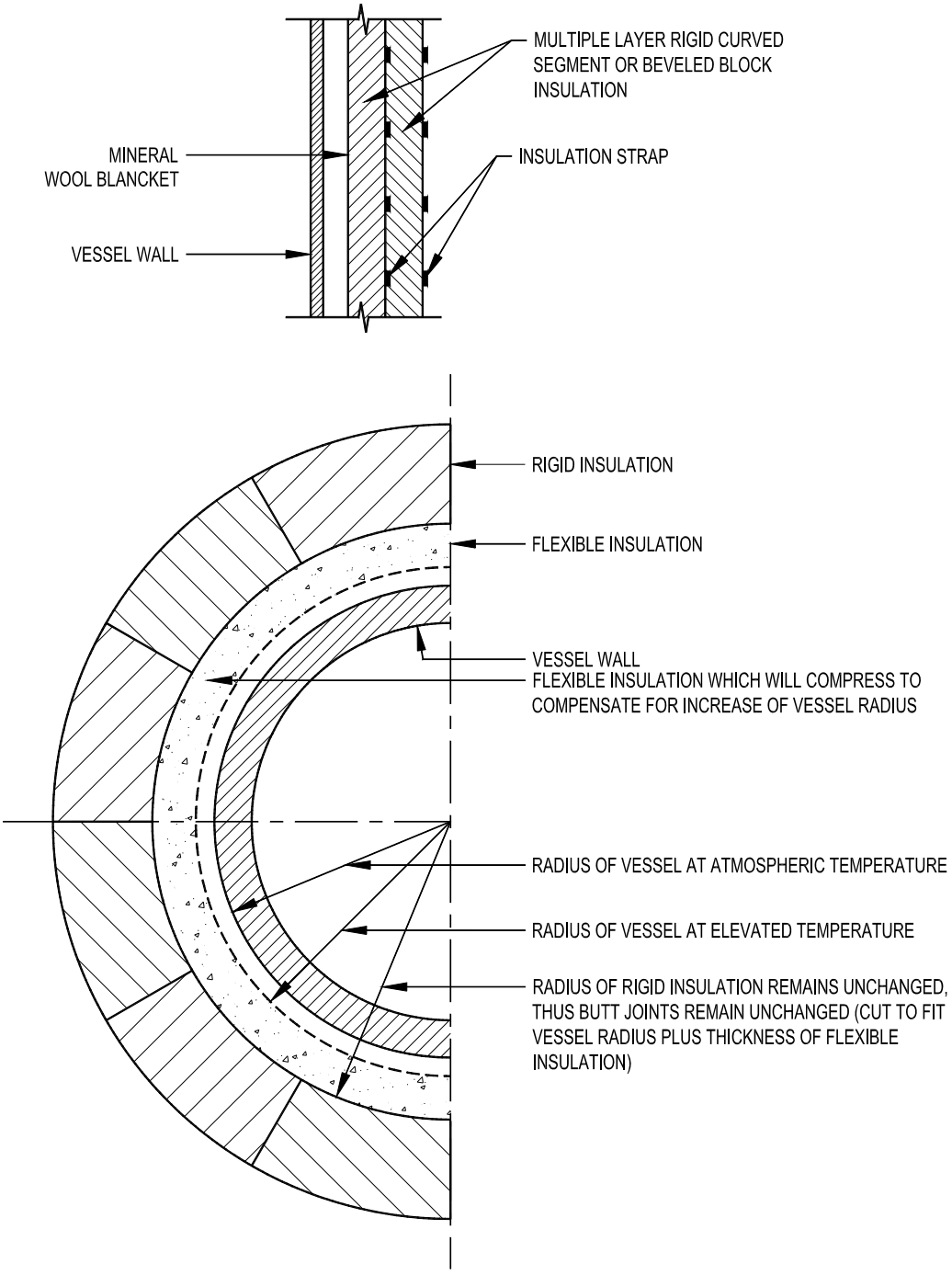

FIGURE – 15
USE OF FLEXIBLE INSULATION IN COMBINATION WITH RIGID INSULATION TO COMPENSATE FOR VESSEL EXPANSION

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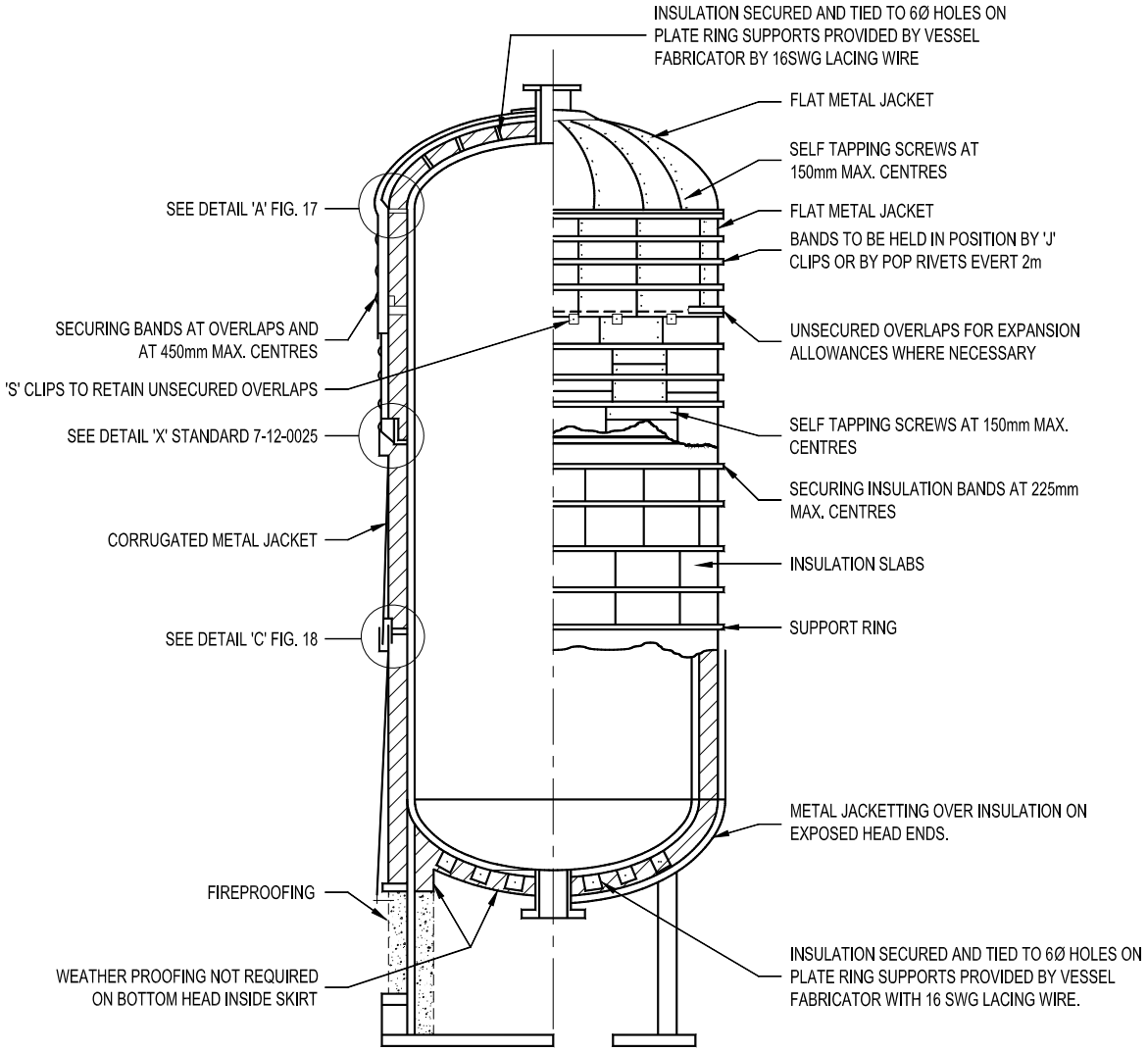

FIGURE – 16
INSULATION DETAILS : VERTICAL VESSEL

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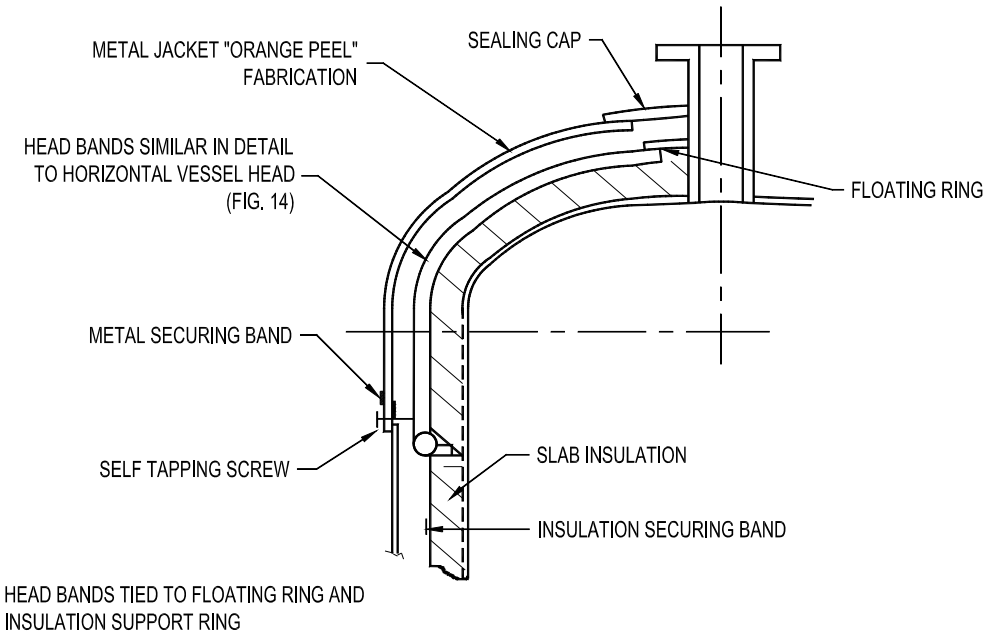

DETAIL 'A'

FIGURE – 17
INSULATION DETAILS VERTICAL VESSEL HEADS

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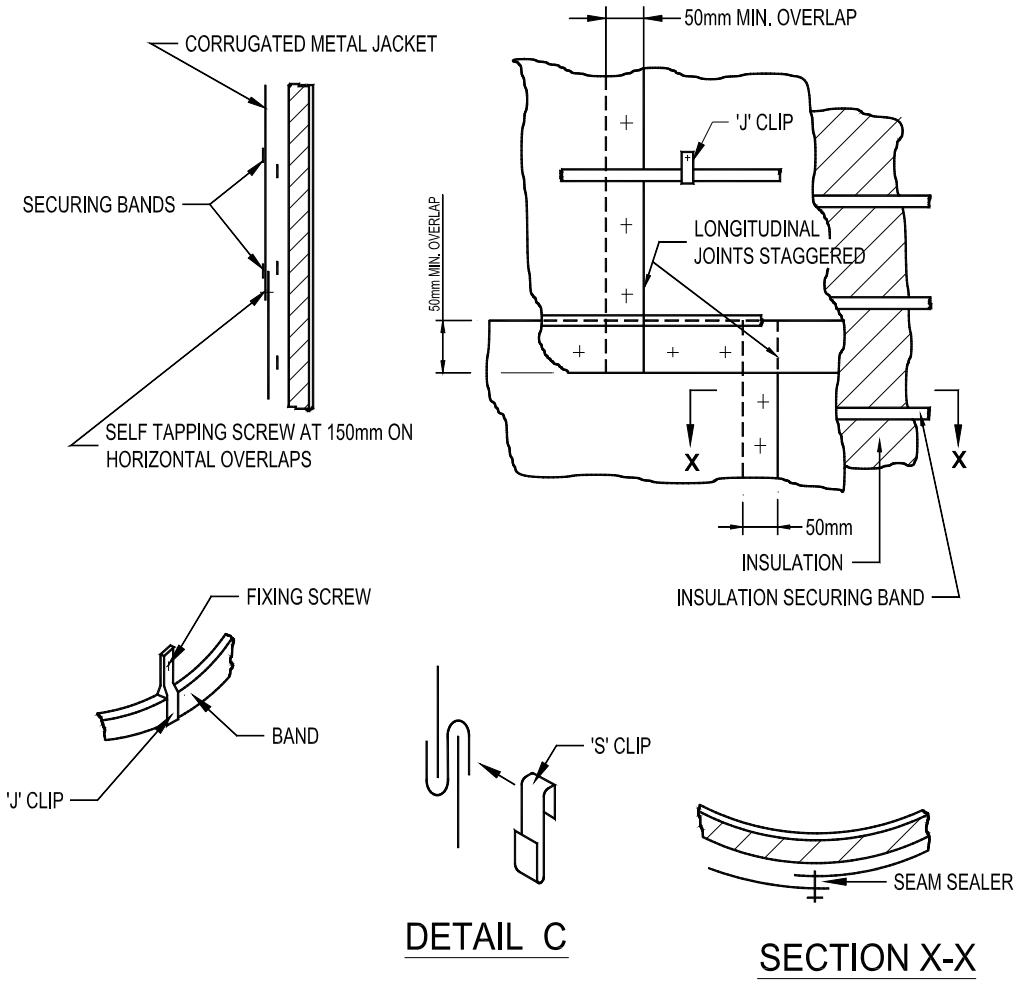

NOTE:

FINISHING SHEETING TO BE BANDED AND SCREWED. HORIZONTAL OVERLAPS LEFT UNSCREWED FOR EXPANSION PURPOSES SHALL BE SECURED AND SUPPORTED WITH 'S' CLIPS.

FIGURE – 18
INSULATION DETAILS : VERTICAL VESSELS

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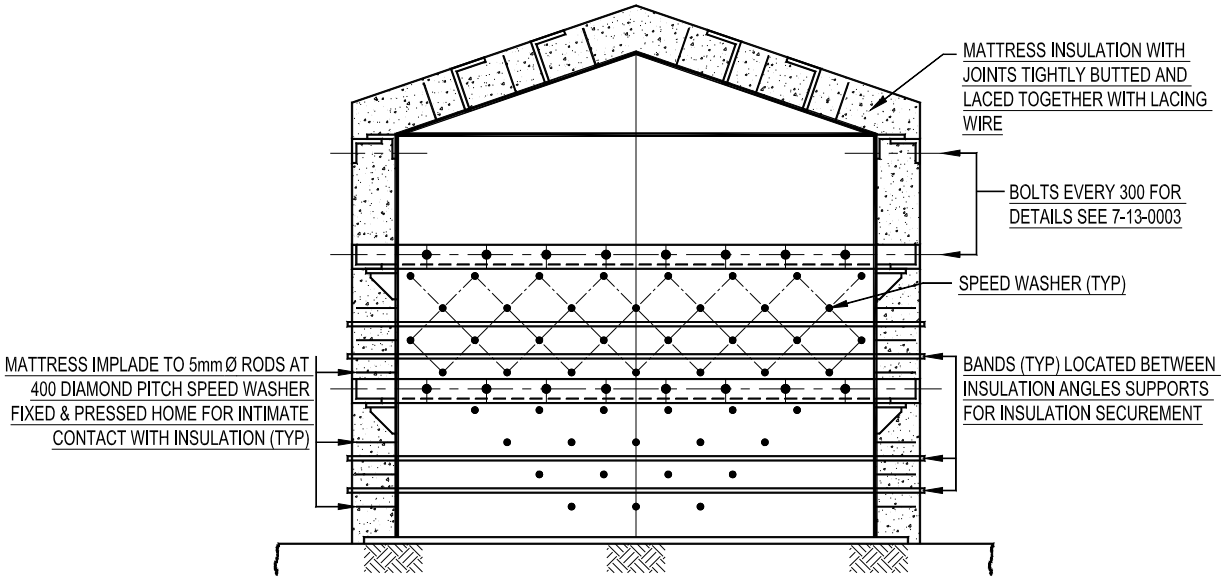
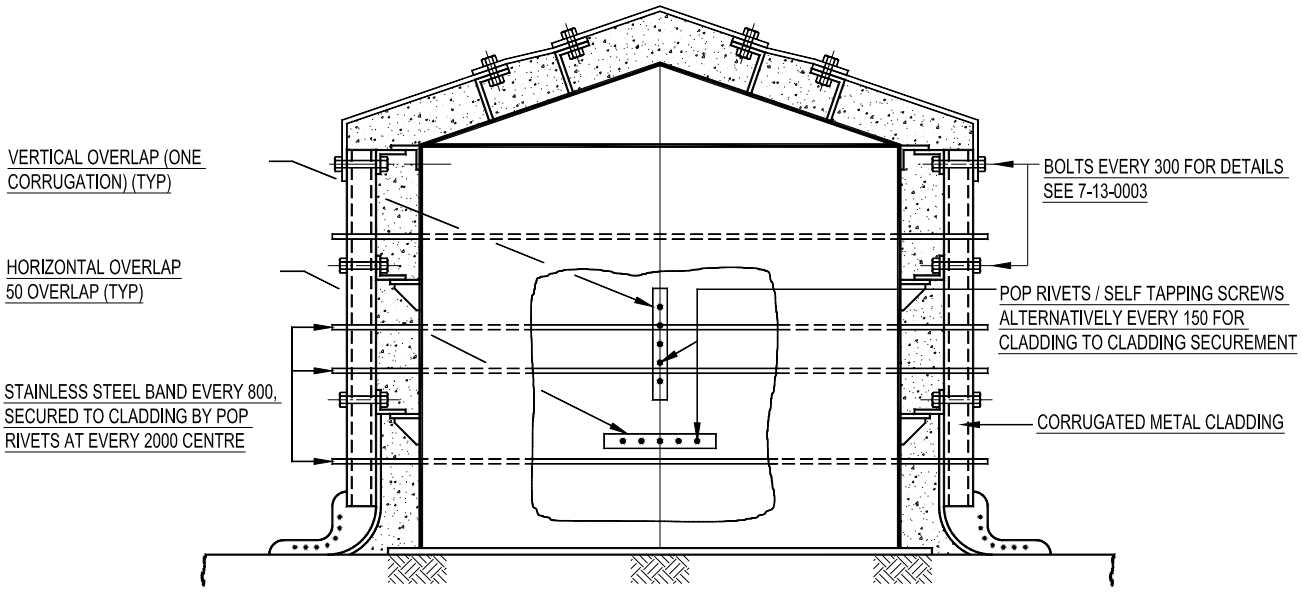


INSULATION SECUREMENT DETAIL



CLADDING SECUREMENT DETAIL

FIGURE – 19
INSULATION DETAILS : VERTICAL STORAGE TANK

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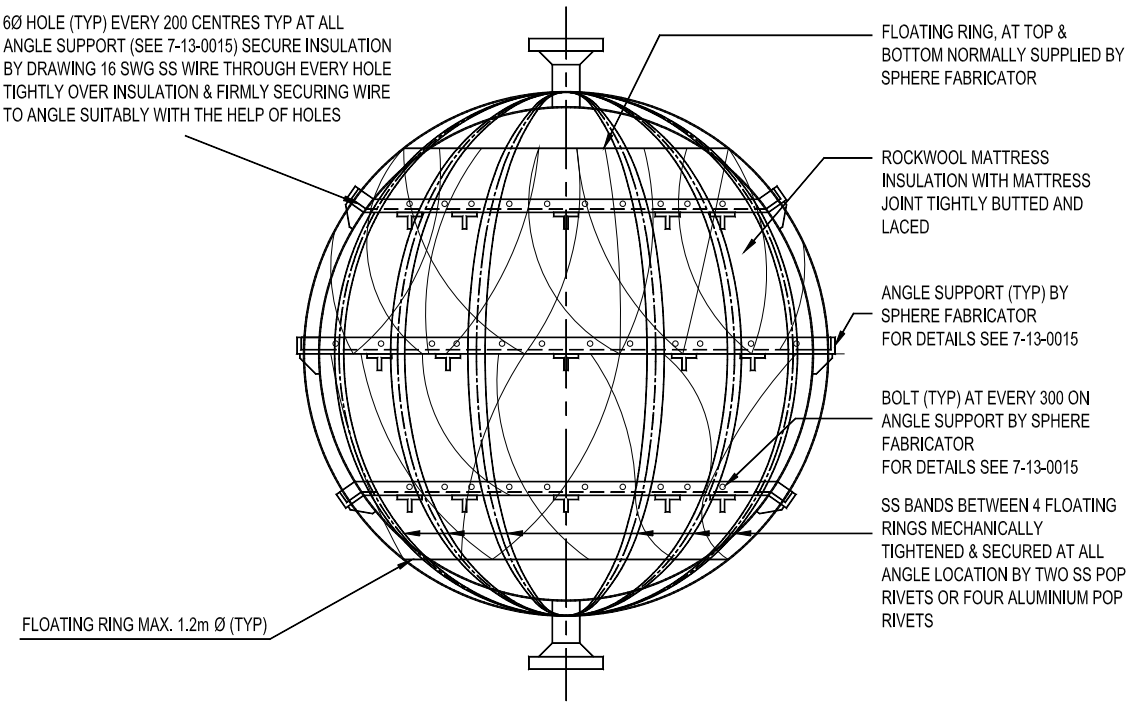
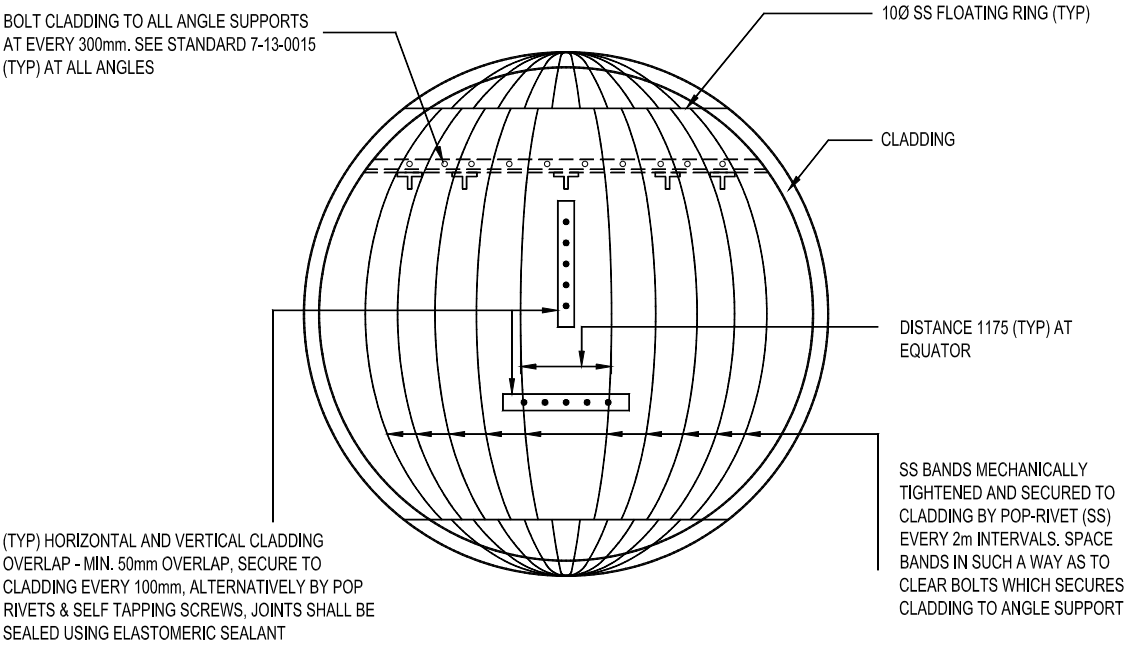


INSULATION SECUREMENT DETAILS



CLADDING SECUREMENT DETAILS

FIGURE – 20
INSULATION DETAILS : SPHERE

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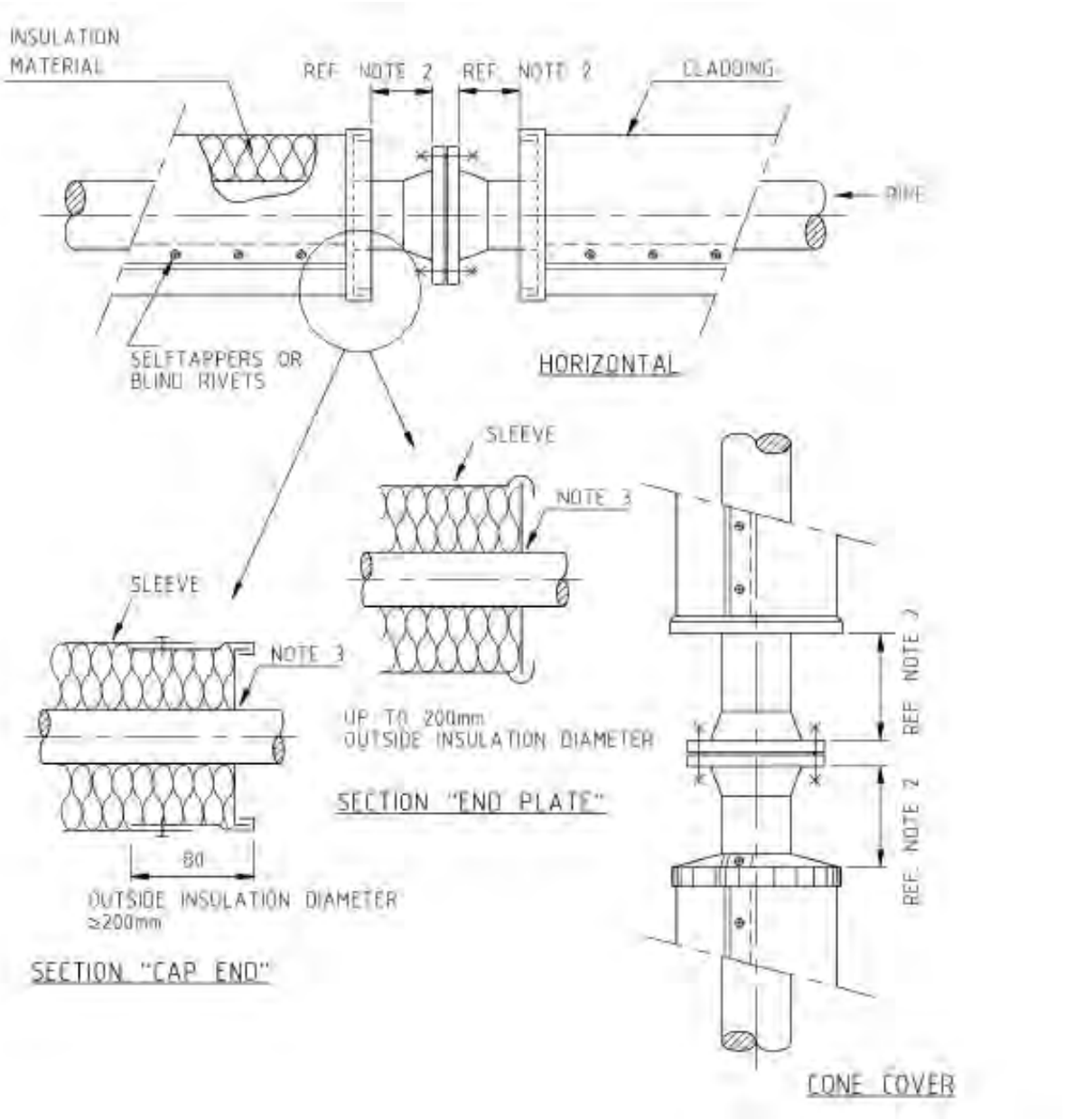

Note

1. Materials and finishing in accordance with installation instructions and specification.
2. Distance between insulation and flange to be bolt length+30mm
3. In case a end plate/cap end may damage the pipe, a heat resistant tape or gasket material to be installed between pipe and plate.

FIGURE – 21
NON- INSULATED FLANGES, HORIZONTAL AND VERTICAL

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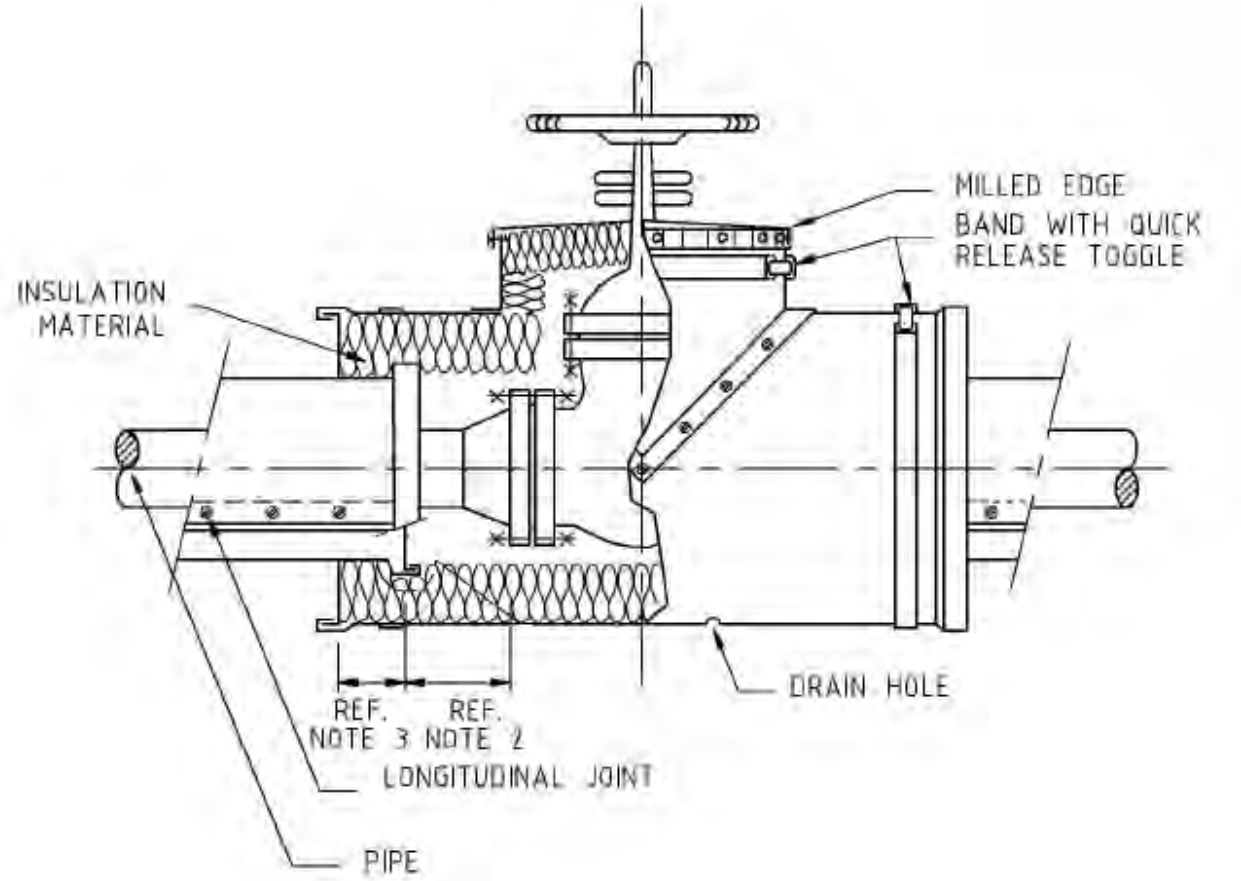

Note
1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm
3. Insulation Thickness

FIGURE – 22
REMOVABLE VALVE BOX, "T" CONNECTION, HORIZONTAL
Applicable only valves which needs to be insulated as per applicable specification

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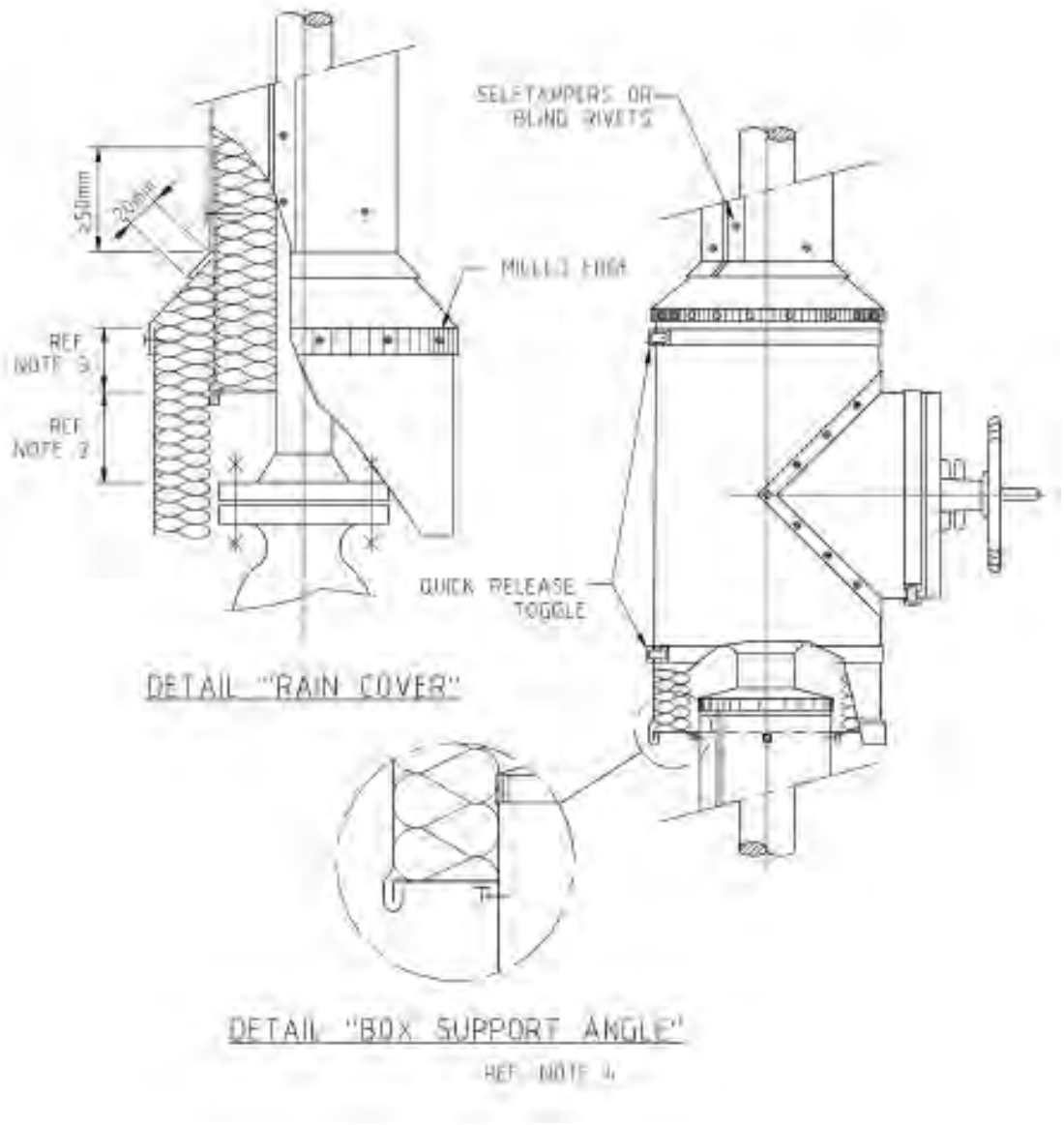

Note
1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm
3. Insulation Thickness
4. Per box minimal 4 support angles ≥ 30mm wide ≥ 0.8mm thick

FIGURE – 23
REMOVABLE VALVE BOX, "T" CONNECTION, VERTICAL
Applicable only valves which needs to be insulated as per applicable specification

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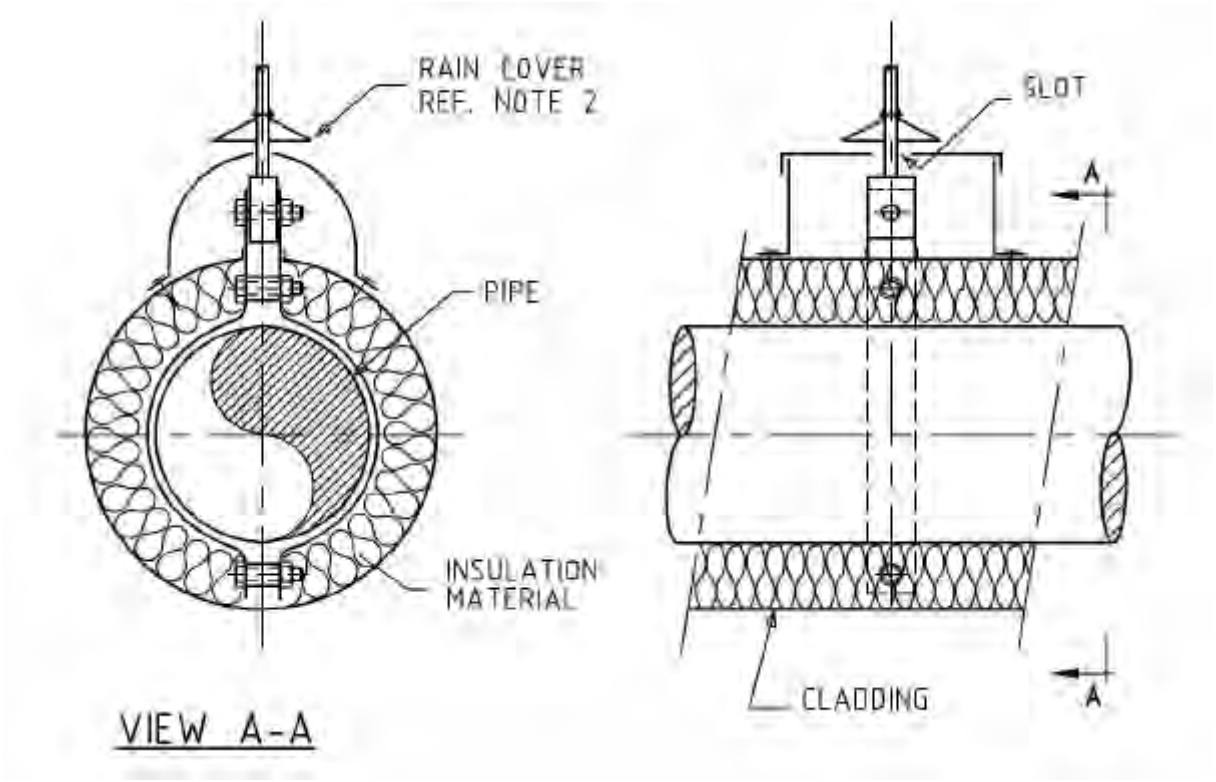

Note
1. Materials and finishing in accordance with installation instructions and specifications
2. Rain cover is a part of the bracket

FIGURE – 24
HANGER SUPPORT

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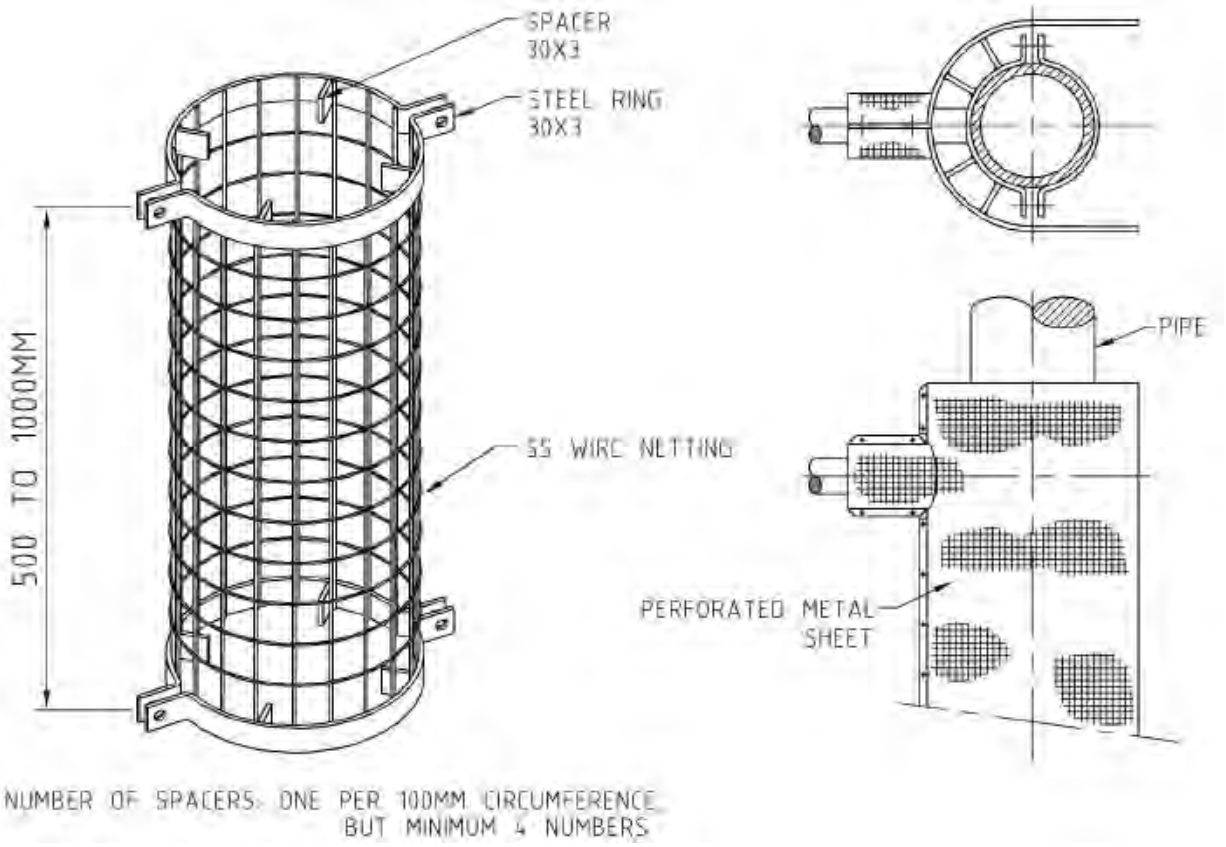

WIRE NETTING

PERFORATED METAL SHEET

Note

1. Materials and finishing in accordance with installation instructions and specifications

FIGURE – 25
PERSONAL PROTECTION

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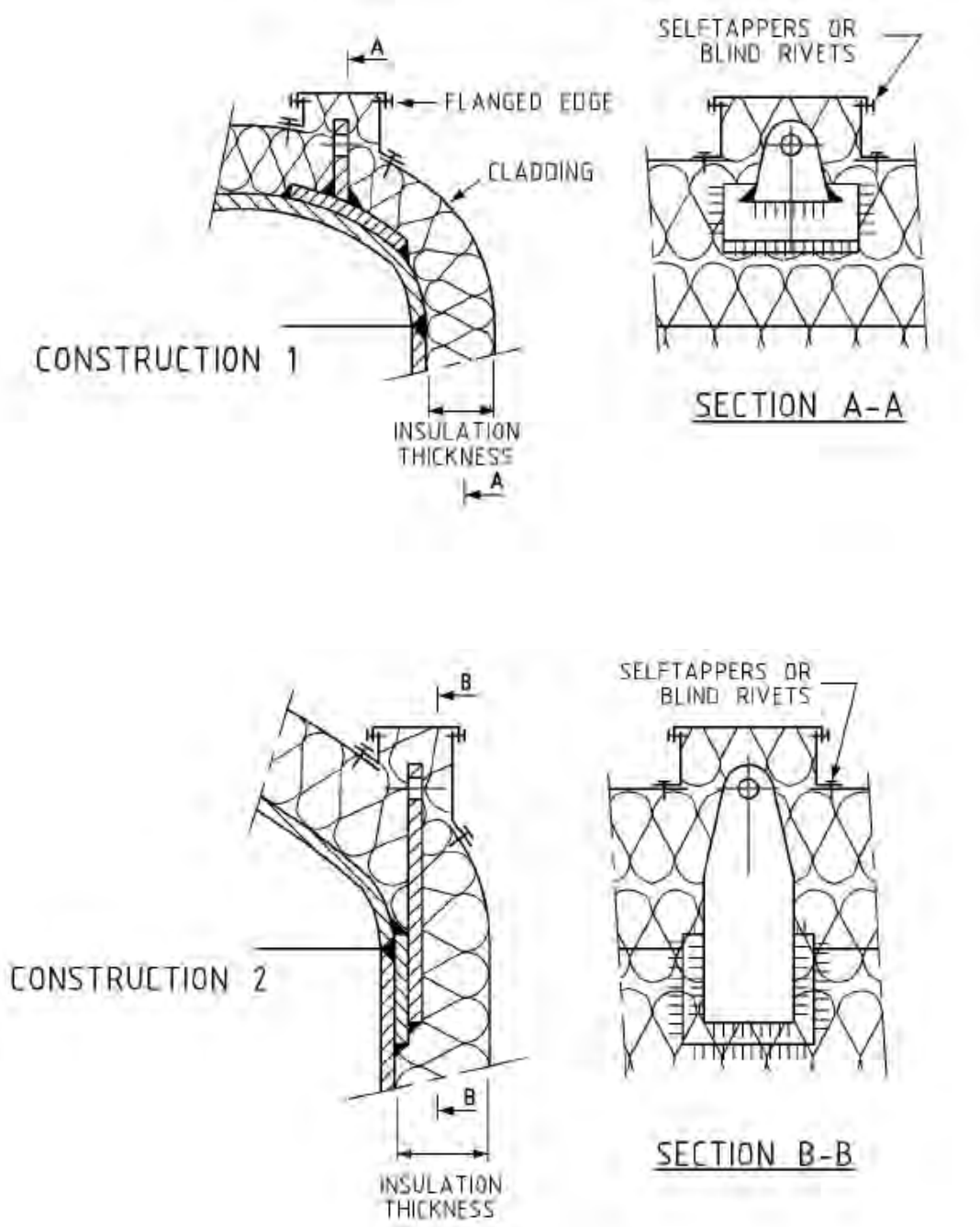

FIGURE – 26
DETAILS OF LIFTING LUGS

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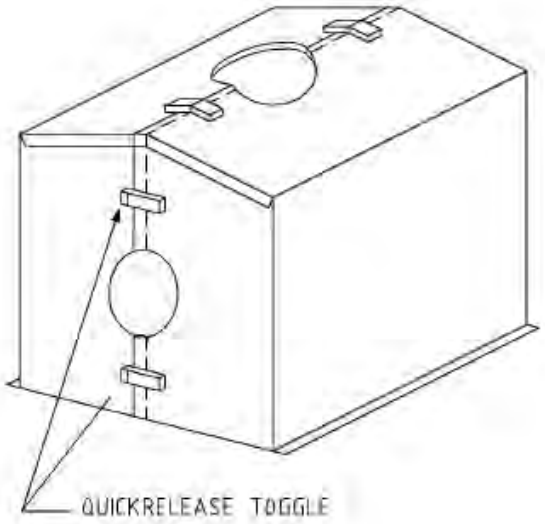

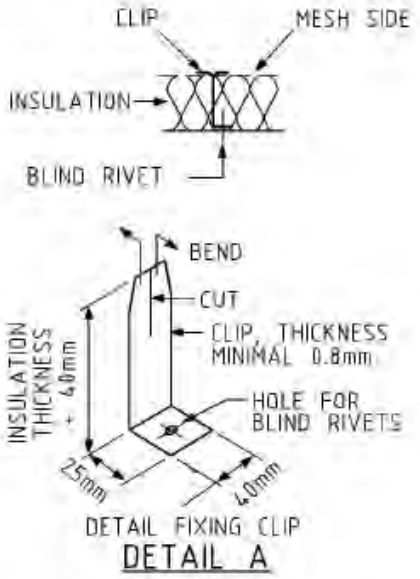

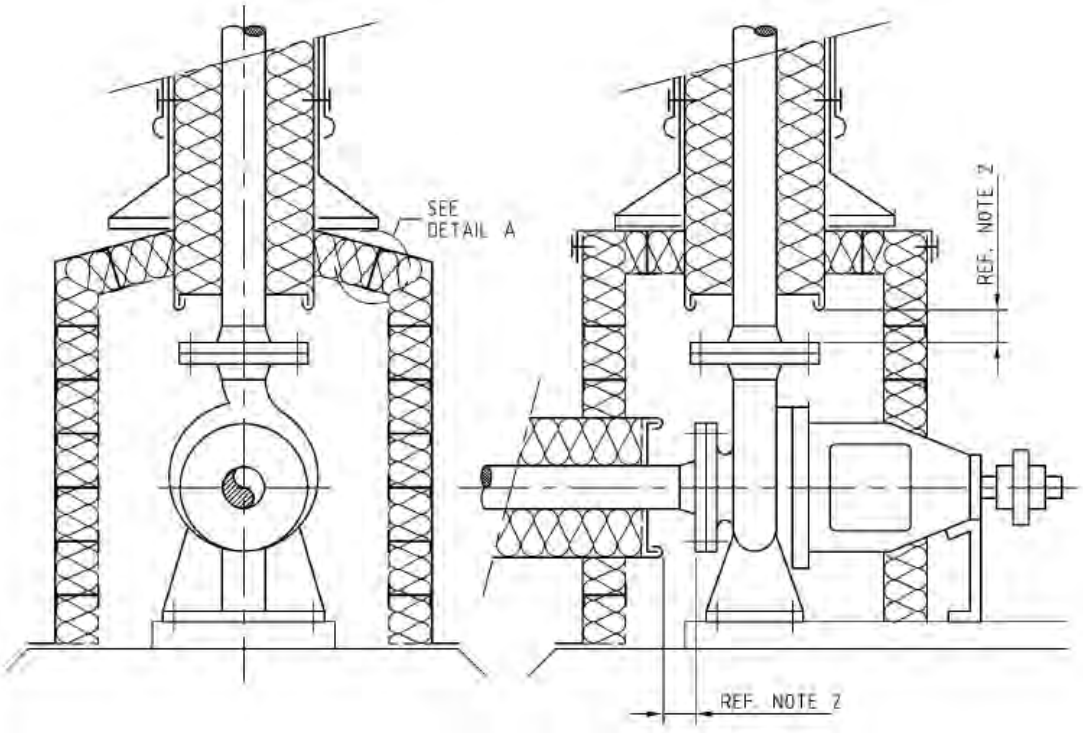

Note
1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm

FIGURE – 27
REMOVABLE BOX FOR PUMP

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वैसल्स, पाइपिंग तथा इक्वीपमैंट के शीतल इन्स्यूलेशन हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR COLD INSULATION OF VESSELS, PIPING AND EQUIPMENT

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
1	30-11-2021	REVISED & ISSUED AS STANDARD SPEC.	PP	BS	PS	SM
0	15-07-2020	ISSUED AS STANDARD SPEC.	PP	BS	PS	SM

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Abbreviations:

ASTM	:	American Society for Testing and Materials
CG	:	Cellular Glass
CUI	:	Corrosion Under Insulation
DFT	:	Dry Film Thickness
ESCC	:	External Stress Corrosion Cracking
GI	:	Galvanized Iron
IS	:	Indian Standard
ITP	:	Inspection Test Plan
PIR	:	Rigid Poly Isocyanurate
PUF	:	Poly Urethane Foam
S.S.	:	Stainless Steel
SWG	:	Standard Wire Gauge

Definitions**:**

Ambient temperature:	Unless otherwise mentioned, ambient temperature referred in this specification shall mean 30^0C
Cold service:	Operating temperature below ambient up to minus (-) 200 deg C is considered as cold service
Dual service:	Operating temperature ranging from minus (-) 200 to + 350 deg C is considered as dual service

Refractory & Insulation Standards Committee

Convenor : Mr Prasenjit Saha

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Mr Neeraj Rai (Pipeline)
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1.0 SCOPE

This specification shall be applicable for external insulation for cold conservation of above ground piping, vessels, tanks, pumps, exchangers, instrument connections at units and off-sites having operating (process fluid) temperature between below ambient to minus (-) 200°C and dual temperature services operating between (-) 200°C to +350°C.

Exclusion: This specification shall not apply to licensed units, where licensor's insulation standard/ specification is applicable.

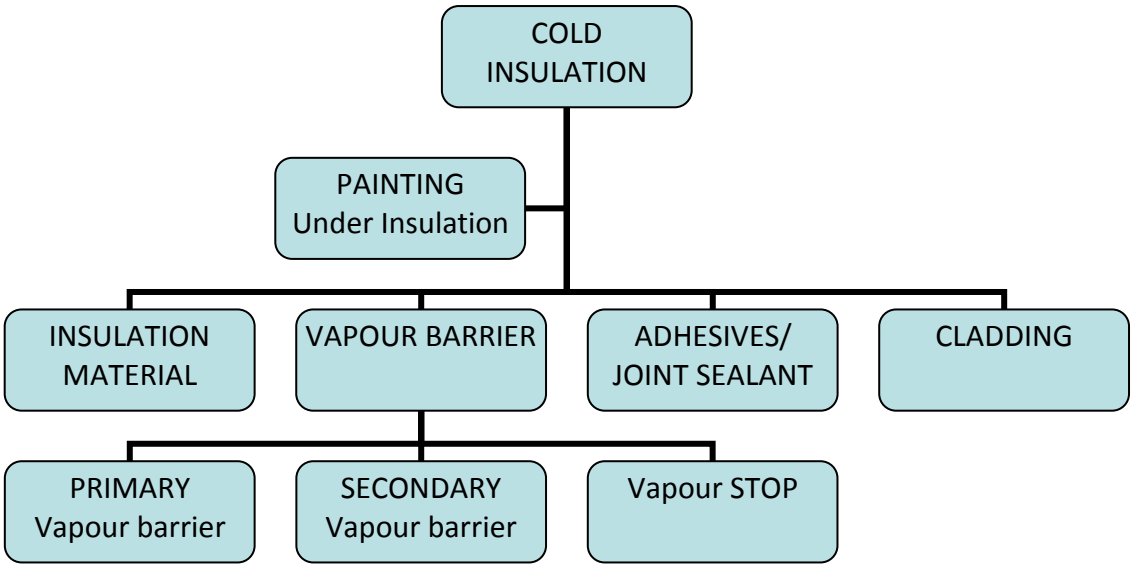
2.0 GENERAL

2.1 Cold insulation is provided to meet any of the following or combination of the below mentioned objectives:

a) Maintain low temperature/ limit heat gain (cold conservation) for process control
b) Prevent/ control surface condensation and ice formation
c) Personal protection from cold burn below minus (-) 10^0C

2.2 Insulation system for cold service shall essentially be VAPOUR TIGHT such that water in any form including moisture present in air is prevented from entering into the insulation. This is achieved by proper selection of insulation material that has almost zero or negligible water vapour permeability and effective designing the insulation system by layering and use of vapour barrier to stop ingress of moisture through insulation joints.

2.3 A cold insulation system shall have following major components. Insulation material is the primary component in the system. Selection of other components such as vapour barrier, adhesives, joint sealants etc. are dependent on the insulation material.



2.4 Insulation design and application shall be as per details provided in this specification. However, for any typical details of any vessel part not covered in this specification, intended insulation practice shall be submitted by the contractor for approval of owner/ Engineer in charge. The details shall include the following as minimum:

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a) Removable insulation housings
b) Flashing details
c) Additional Insulation supports
d) Vessel head insulation supports
e) Expansion joints
f) Vessel insulation details
g) Exchanger removable housings
h) Machinery removable housings etc.

2.5 Extent of Insulation

2.5.1 Items Requiring Insulation

a) Items requiring insulation are specified in the piping line schedule and equipment/vessel/heat exchanger data sheets.

b) All attachments and projections such as vessel supports, structural steel attached to vessels, piping hanger/ supports, instrument lead lines, branch lines like vents, drains and instrument connections connected directly to cold insulated piping, vessels and equipment shall be cold insulated up to a distance of four (4) times the adjoining insulation thickness (or 300mm whichever is greater). Insulation design & thickness same as the main piping/ equipment shall be applied to the attachments/ extensions.

a) All flanged joints, manhole covers, etc. shall be cold insulated with removable box insulation. Valves and fittings shall be same insulation as that of the adjoining piping.

2.5.2 Items Not Requiring Insulation

a) Bonnet of valves above the packing glands.

b) Display of nameplates, stampings, inspection code etc. in any vessel/ equipment shall be specially designed and insulated so that the display is not covered by insulation.

2.6 Codes & Standards

2.6.1 Latest issue of the codes/standards prevailing on last submission date of the tender shall be applicable.

2.6.2 Specific technical requirement mentioned over and above the standards/ code shall be followed irrespective of code requirement. In case of difference, if any between technical requirement of code and the current specification, stringent of the two shall apply.

2.7 General Requirements

2.7.1 Protection of Materials During Storage

Insulation materials 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 surface in a horizontal position. Insulation material shall never be stacked directly on the ground. The contractor shall make own arrangement for covered storage for insulation materials as directed by the Engineer-in-Charge.

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2.7.2 Protection of Partially Completed Jobs

Precautions must be taken to ensure that each day's work is adequately protected 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.

2.7.3 Hydrostatic Test

Insulation shall be applied on vessels, heat exchangers, piping and other equipment only after successful completion of hydrostatic test.

2.7.4 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 necessary insulating blocks (wood/PUF etc.) as per support standard or as specified in the bid package/tender.

3.0 INSULATION MATERIALS

Insulation material shall be selected primarily based on range of service temperature and other parameters like desired thermal performance, fire protection requirement etc.

PIR (poly-isocyanurate rigid foam) is the most common material used for cold insulation, but other materials like cellular glass, aerogel etc. are also used in cold insulation for specific advantages of thermal conductivity or fire resistivity. Following materials options are considered in this standard for cold service for the temperature ranges mentioned below. ASTM grades, referred shall indicate the general classification and minimum requirement, the material shall meet respective specified technical parameters as given in this specification.

TEMPERATURE RANGE	INSULATION MATERIAL	ASTM GRADE		THERMAL CONDUCTIVITY # W/mK	FIRE RESISTIVITY $ (ASTM E84)
(-) 180 to (+) 120 ^{0}C	PIR foam	C-591 Gr-2, Type-II		0.026 (at 10^{0}C)	25
(-) 200 to (+) 427 ^{0}C	CELLULAR GLASS	C-552 Gr-6		0.043 (at 10^{0}C)	5
(-) 196 to (+) 125 ^{0}C*	AEROGEL	C-1728	Type-I Grade 1B	0.017 (at 24^{0}C)	25
			Type-IV Grade 1A	0.022 (at 24^{0}C)	25

Indicative values for comparison, vary with density, grade and temperature
$ Indicative value, lower the value, better is the fire resistivity
* Type-IV Grade 1A is suitable up to 250 deg C

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3.1 Preformed Polyisocyanurate Rigid Foam (PIR)

3.2 PIR rigid foam shall be performed into free rise buns made from HCFC free chemicals and then cut into required shape/ pipe sections using a CNC machine. Material shall be chemically inert, moisture free, rot and vermin proof not disintegrate, settle, change its form or composition in a detrimental way while in service. PIR rigid foam shall conform to general classification of ASTM C591 Grade-2 Type-II and meet the following specification:

Characteristics		Value	Remarks
Temperature range of use ***(Note-1)***		(-) 180 to (+) 120 ^{0}C	
Bulk density (kg/m3) ASTM-C302/ ASTM -D1622/ IS-11239		40 min	Batch test ***(Note-3)***
Closed Cell content (%) ASTM D-6226 Procedure-2 / IS-11239 Part-5		95 min	
Chloride content (ppm) ASTM C 871, Procedure 2		60 max	
pH (ASTM C 871)		6-7	
Horizontal burning (IS11239, Part-12)		25 max	
Water vapour transmission (ng/Pa-s-m) ASTM E-96 method-A at 23°C & 50% RH		5.1 max	
Compressive strength at 10% deformation (kPa), ASTM D 1621		240 min.	
Flame spread Index (ASTM E84)		25 max	Type test ***(Note-4)***
Tensile Strength (kPa) at (-)165°C ASTM D-1623		265 min	
Linear thermal expansion coefficient (-)165°C to 23 deg C (ASTM D-696)		70 x10^{-6}/K max	
E-modulus, at (-)165°C (MPa) ASTM-D1623		16 max	
Cryogenic Thermal Stress Resistance (CTSR) ***(Note-2)***		≥ 1.5	
Thermal conductivity of 180 days aged sample at mean temp (W/mK) ASTM C-177	(+)10 deg C	0.026 max	
	(-) 20 deg C	0.027max	
	(-) 80 deg C	0.025 max	
	(-)120 deg C	0.019 max	

Note-1: For services (-) 50 to (+) 120°C, moulded pipe sections are acceptable. CTSR and relevant properties need not be tested

Note-2: CTSR = σ_t x (1-δ) / (E x α x ΔT) ≥ 1.5, where
σ_t = the average value of the tensile strength
δ = the Poisson's ratio of the material (0.4)
E = the average value of the tensile modulus
α = the average linear thermal expansion coefficient of the insulation materials
ΔT= the temperature difference between service temperature and ambient

Note-3: Supplier shall provide test certificate for each production Batch.

Note-4: Type test certificate no older than 2 years shall be acceptable.

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3.3 In-situ PUR

This is a two component polyurethane rigid foam (slow rise expansion), consisting of one component MDI (Di-phenyl methane-4,4'di-isocyanate) and one component of a polyol blend. The material will have equivalent property as that of PIR (see 3.1), but formed by in-situ injection foaming. After curing the system converts into a rigid cellular polyurethane based plastic foam with a 95% closed cell structure, in accordance with ISO 4590 and manufactured without the use of blowing agents that contain CFC's or HCFC's and with an Ozone Depleting Potential (ODP) of zero (0).

There is certain degree of uncertainty associated with quality of PUR obtained through in-situ foaming. The foaming process depends on many factors like substrate temperature, ambient temperature, humidity etc. Before every injection, the procedure for in-situ injection needs to be demonstrated through a mock up for achievement of optimum quality.
Despite taking all measures, the PUR so formed may have unidentified defects like holiday/ void etc., hence shall only be used in a very limited way for insulation of valves/ flanges where other insulation by prefabricated rigid PIR is not possible.

In-situ foaming is NOT to be used as replacement for preformed rigid PIR.

3.4 Cellular Glass

Cellular glass shall conform to general classification of ASTM C552 Type-II, Grade-6, supplied/ fabricated into pipe sections contour of the substrate as per ASTM C1639 from a proven manufacturer and shall meet the following minimum technical specification:

Characteristics		Values	Remarks
Temperature range of use		(-) 200 to (+) 427 ^{0}C	
Density(kg/m^3), min. (ASTM C303)		98	Batch test ***(Note-1)***
Compressive Strength (kPa) (ASTM C165), min.		414	
Flexural strength (kPa), ASTM C203, min.		283	
Water absorption (Volume %), max., (ASTM C240)		0.5	Type test ***(Note-2)***
Water Vapour Permeability, ng/Pa.s.m (ASTM E96)		0.007	
Closed cell content		100	
Surface burning characteristics, ASTM E84			
Flame spread index, max		5	
Smoked developed index, max.		0	
Thermal conductivity , w/mK (ASTM C518/ASTM C177)	(+)10 deg C	0.046	Batch test ***(Note-1)***
	(-) 18 deg C	0.042	
	(-) 73 deg C	0.033	
	(-)101 deg C	0.030	
Dimensional tolerance		ASTM C1639	

Note-1: Supplier shall provide test certificate for each production Batch.
Note-2: Type test certificate no older than 2 years shall be acceptable.

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3.5 Flexible Aerogel Insulation

Flexible aerogel insulation is a composite of an amorphous silica-based aerogel, a fibrous carrying media, or reinforcements, or a combination thereof shall conform to general classification of ASTM C1728 and meet the following properties:

Properties		Values		Remarks
ASTM Grade / Type		Type-I Grade 1B	Type-IV Grade 1A	
Temperature range of use		(-)196 to (+)125 ^{0}C	(-)196 to (+)250 ^{0}C	
Density (kg/m3) ASTM C303		80-180	160-240	Batch test ***(Note-1)***
Compressive Strength (kPa), min, at 10% deformation (ASTM C165)		34.5	34.5	
Linear shrinkage at maximum exposure temperature for 24h , max, % (ASTM C356) in length & width		2	2	
Water absorption, max, % by weight		8	8	
Water vapour absorption, by weight, max %, (ASTM C1104/ C1104M)		5	5	
Thermal conductivity (W/mK) at mean temperature (°C) (ASTM C177)	-129	0.014	0.015	
	-73	0.015	0.017	
	-17	0.016	0.020	
	24	0.017	0.022	
Flame spread index (ASTM E84) , max Smoke developed index (ASTM E84) , max		25 50	25 50	Type test ***(Note-2)***

Note-1: Supplier shall provide test certificate for each production Batch.
Note-2: Type test certificate no older than 2 years shall be acceptable.

3.6 Selection of Insulation Material

3.6.1 PIR is the most commonly available cold insulation material. Unless otherwise specified, preformed PIR rigid foam shall be used as default cold insulation material in the temperature range (-) 200 to (+) 120 ^{0}C.

3.6.2 Cellular glass shall be chosen where any one of the following conditions is a requirement:

a) Dual temperature service, where upper limit of the exposure exceeds (+) 120 ^{0}C
b) Fireproofing (epoxy intumescent or vermiculite) to be applied over insulation
c) Insulation needs to be fire safe

3.6.3 Use of cellular glass can be optimized in a fire safe cold insulation requiring 75mm or higher thickness by combination lining with inner PIR and outer 50mm cellular glass.

3.6.4 Flexible aerogel blanket can also be a useful for small diameter pipes (< 2 inch NB) where use of rigid PIR may have application constraint and flexible aerogel may have specific advantage of lesser application time.

3.6.5 In-situ PUR may be used for insulation of irregular shape like valves and flanges. But, shall NOT be used as a replacement of PIR where rigid PIR foam is specified.

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3.6.6 Valves and flanges in cold service for which insulation clearance is usually granted late and insulation activity becomes a bottleneck for plant commissioning, combination lining with inner flexible aerogel blanket and outer in-situ PUR could be advantageous. In such cases, commissioning activity may proceed with flexible aerogel applied over the valves and flanges (which can be done faster) followed by in-situ forming of PUR.

3.7 Insulation Thickness

Insulation thickness and thickness for inner and outer insulation for combination lining shall be specified in schedule of rate / equipment datasheet.

Unless otherwise specified, layering of insulation as given below shall be followed for insulation system with PIR/ Cellular glass:

Insulation thickness (mm)	Number of layers
≤ 75	Single layer
76-150	Two layers
>150	Three layers

Flexible aerogel blanket normally comes in thin blankets of 5-20mm thickness, hence multiple layers will be used.

3.8 Form of Insulation

Cellular glass shall be fabricated as per ASTM C1639.

Preformed rigid insulation blocks of PIR shall be cut from buns in the contour of pipe section / surface profile of the equipment using CNC machine. Half sections or radial sections shall have longitudinal and circumferential faces flat and smooth so as to match with the other half/ section. Ends of the preformed half sections shall be flat and perpendicular to the center line.

Application	Sections
Pipes up to 12 inch NB	Two half sections
>12 inch up to 20 inch NB	Max 3 radial sections
>20 inch NB	Max 4 radial sections
Equipments, Vessel shells	Machine cut radial sections in required contour of the substrate/ underneath layer
Vessel heads	Manually cut slabs contoured to the profile of vessel heads is acceptable

Moulded sections made by forming into mould may be used for application temperature (-) 50 to (+) 120°C. Tolerances for moulded sections shall be as under:

Outside diameter	-0%, + 5%
Concentricity	± 3% O.D.
Bore	+ 2mm, -0 mm
Length, width and thickness of slabs	± 2mm

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4.0 ANCILLARY MATERIALS

Cold insulation system with PIR/ Cellular glass shall have the following ancillary components:

Primary components	Secondary components	Adhesives & Sealant	Other ancillaries
• Pipe support • Primary vapour barrier • Vapour stop • Weather protection Jacket	• Secondary vapour barrier • Glass cloth fabric • Painting • Contraction joint	• Adhesive • Joint sealant	• Adhesive tape • Band • Butyl Rubber Sheet • Wire netting

4.1 Pipe Supports

Cradle type cold support shall be used for piping.

Pipe supports shall be in high density PUF (polyurethane foam). Thickness & layering shall be same as that of insulation design of the respective the pipe diameter, supplied in pipe sections. PUF pipe support shall meet the minimum technical specification given below.

Characteristics		**Types** *(See Note below)*	
Bulk Density($kg/m^{3)}$ (ASTM D1622) min.		240	320
Thermal conductivity (ASTM C177) W/mK, max.	at +20°C	0.040	0.050
	at 0°C	0.036	0.046
	at -40°C	0.034	0.044
	at -80°C	0.031	0.040
Compressive Strength, MPa at 23°C in all directions, (ASTM D 1621) min.		3.0	6.0
Tensile Strength, MPa at 23°C in all directions (ASTM D 1623) min.		3.0	4.9
Closed Cell content , % , (ASTM D 6226 procedure-2		95	
Water Vapour Permeability, g/m2.h ASTM E-96 method-A at 23°C and 50% RH, min.		0.8	
Water absorption % (by Volume) max.(ASTM D2842)		5	
Linear Coefficient of thermal expansion max.,/°K (ASTM D 696) between 23°C and -165°C		$70x10^{-6}$	
Chlorides, ppm, (ASTM C 871, procedure 2)		60	
pH values, (ASTM C 871)		6-7	
Combustibility / fire resistance, ASTM E84		FSI < 25	

Note:

1. *Density of PUF support and length of the sections shall be specified in engineering standard elsewhere in the tender.*

2. *Unless otherwise specified, PUF pipe supports 240 kg/m3 may be used for 12 inches NB or below and 320 kg/m3 shall be used for above 12 inches NB.*

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3. *High density Pipe support for cyclic service shall be selected based on the following:*

   a) *High density PUF shall be suitable for temperature range (-) 200 to (+) 100 ^{0}C.*
   b) *For temperature up to (+) 125 ^{0}C, high density pipe support shall be made in PIR with equivalent physical properties as that of high density PUF.*
   c) *For temperature exceeding (+) 125 ^{0}C, composite pipe supports (outer layer High density PUF + inner layer suitable load bearing temperature membrane like Perlite block) may be used subject to approval of owner/ Engineer in charge.*

4.2 Isolation Block

Support structures / equipment legs for cold vessels shall be isolated from foundation / main structure by means of hard wood OR high density PUF of 500 kg/m3.

4.3 Primary Vapour Barrier

Primary Vapour barrier is a very important component in cold insulation. All cold insulations, irrespective of insulation type and service temperature shall have a thick mastic (min 1.5mm when dry) 'Primary Vapour Barrier' over outermost insulation layer, underneath weather barrier jacket (cladding).

Primary vapour barrier shall be chlorosulfonated polyethylene (hypalon) rubber based fire retardant elastomeric polymer mastic, compatible with base insulation, stable in the range of minus (-)40 to (+)100^{0}C. The mastic is applied in two coats reinforced with glass fiber cloth sandwiched between two coats. When cured, the film shall be durable, have good tensile strength and puncture resistance, shall not wrinkle or crack when exposed to the limiting temperatures for 3 hours.

Industry benchmark for Primary Vapour Barrier is **Foster make 60-38/39**. Proposed materials shall be technically equivalent and shall have proven reference for use in a temperature range and shall meet the minimum technical requirement given below:

Characteristics	Parameter	Remarks
Consistency	Thixotropic soft paste	
Water vapour permeance	0.02 metric perms (max) with DFT 1.2-1.3mm as per ASTM E-96 procedure-E	Type test ***(Note-1)***
Combustibility/ fire resistance	FSI (flame spread index) ≤ 25 as per ASTM E-84, tested on a 6.3mm inorganic reinforced cement board with DFT 1.1-1.2 mm	

Note-1: Type test certificate from reputed international laboratories, no older than 2 years shall be acceptable

4.4 Vapour Stop

Vapour stops are used in cold insulation with an objective to create containment so that in the event the insulation is damaged, water ingresses if any remains in that containment zone. Vapour stop is applied across the insulation thickness at regular intervals and stops such propagation. In piping, vapour barrier needs to be used on both sides of pipe support, for equipment / vessels, it shall be applied at support locations, where chances of crack is more due to differential movement of vessel and support structures. Vapour stop is a thick mastic (min 1.5 mm when dry) similar to primary vapour barrier with improved flexibility, tensile

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strength and cryogenic resistance. It is a two component butyl rubber based elastomeric mastic suitable for temperature range of minus (-) 196 to (+)82^{0}C, shall be suitable for application to PIR foam, cellular glass, fibrous glass and aerogel insulations. The mastic is applied in two coats reinforced with glass fiber cloth sandwiched between two coats. When cured, the film shall be durable, have good tensile strength and puncture resistance, shall not wrinkle or crack when exposed to the limiting temperatures for 3 hours.

Industry benchmark for Primary Vapour Barrier is **Foster make 90-66**. Proposed materials shall be technically equivalent and shall have proven reference for use in a temperature range and shall meet the minimum technical requirement given below:

Characteristics	Parameter	Remarks
Consistency	Thixotropic soft paste	
Water vapour permeance	0.007 metric perms (max),as per ASTM F-1249 with DFT 0.5-0.6mm	Type test ***(Note-1)***
Tensile strength (of cured dry film)	> 8 kg/cm^2 as per ASTM-D412 measured with 1.2 mm dry film	

Note-1: Type test certificate from reputed international laboratories, no older than 2 years shall be acceptable

4.5 Secondary Vapour Barrier

Cold insulation for service temperature below (-) 50 ^{0}C shall have an additional membrane 'secondary vapour barrier' between the outermost layer and next insulating layer. Secondary vapour barrier shall be a multiplex laminated foil (~50 micron thickness) consisting of one aluminium foil (25µ) sandwiched between two 12µ polyester films). Materials shall have following characteristics:

Characteristics	Values
Service temperature range (°C)	-60 to 120
Volumetric mass (kg/dm^3)	1.93
Tensile Strength, MPa	100
Yield Strength, N/cm	70
Tear resistance, g/mm	400
Water Vapour Permeability, ASTM E96 Procedure E (Metric perms)	0.0007

4.6 Glass Cloth / Fabric

The glass cloth to be used for vapour barrier/ vapor stop reinforcement shall be prepared from E-glass and open weave 10 mesh. Glass Cloth having glass fibre thickness of 5 mils, 18x12 threads per 25mm and weight 80g/m^2 or in case of synthetic fabric same shall have weight 30g/m^2 and 20x10 threads per 25mm. Other types if specified by mastic manufacturer shall be subject to review and approval by Engineer-in-charge.

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4.7 Cryogenic Adhesive

Adhesives are used for bonding of insulation sections to the substrate and shall be essentially compatible with the base insulation material and suitable for the temperature range to which it is exposed. Typical technical requirement of adhesive for PIR shall meet the following characteristics given below. For cellular glass insulation, compatibility or specific products shall be recommended/ confirmed by the cellular glass supplier.

Application temperature	Characteristics
Ambient to (-) 50 deg C	Synthetic rubber/ resin based or Thermo setting two component solvent free urethane based, suitable for the temperature range to which it is exposed, have average 38% volume solid as per ASTM D1644 and Leachable chlorides max 90 ppm as per ASTM C871
(-) 51 to (-) 100 deg C	
Below minus (-) 100 deg C	Chemically cured epoxy based, in three components, have > 99% volume solid as per ASTM D1644

4.8 PU Adhesive

High density PUF pipe supports shall be installed to the cradle with a PU adhesive. Typical technical requirement of PU adhesive shall meet the following characteristics given below

Application temperature	Characteristics
Ambient to (-) 50 deg C	Synthetic rubber/ resin based or Thermo setting two component solvent free urethane based, suitable for the temperature range to which it is exposed, have average 38% volume solid as per ASTM D1644 and Leachable chlorides max 90 ppm as per ASTM C871

4.9 Joint Sealant for Insulation Blocks

The joint sealant for joints between insulation blocks shall be compatible with the base insulation material and suitable for the temperature range to which it is exposed. Typical material and technical requirement for PUR/PIR insulation system is specified below. For cellular glass insulation, compatibility or specific products shall be recommended/ confirmed by the cellular glass supplier

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 82% volume solid as per ASTM D2369	Flame spread and fuel contribution negligible when used as 3.2 mm wide sealant between joints of incombustible insulation blocks	Negligible when measured across 3.2 mm wide sealant between joints of impermeable insulation blocks

4.10 Contraction Joints

Contraction joints shall be provided in the insulation. At contraction joint location, provision shall be made in the metal cladding to accommodate contraction of pipe or vessel.
The material to be used in the contraction joints shall be light weight fiber glass blanket. The material shall have the following properties:

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Properties	Values
Density (kg/m^3), ASTM D1622	23-24
Compressive strength (kPa), at 10% deformation at 24°C, ASTM C165	0.215
Thermal conductivity (W/mK) at 25°C, max, ASTM C177	0.034
Leachable chlorides content (mg/kg), max, ASTM C-871	10
pH, ASTM C-871	6-10.5

Typical contraction joint requirements are specified below:

a) Contraction joints shall be provided at regular intervals depending on pipe or vessel material contraction/expansion co-efficient and design temperature. Unless otherwise specified, contraction joints shall be provided in all insulations exposed to (-) 40°C and below at intervals of 6m on straight run of pipes or vessels.

b) Contraction joints in horizontal vessel insulation shall be close to support points while on vertical pipes & vessels, the same shall be provided at support ring location and at an interval of 4.0m straight run. Both longitudinal and circumferential joints in insulation shall be staggered.

c) A contraction joint shall consist of 12mm gap in the Insulation, loosely packed with filler material (refer section painting & ancilliaries) to a depth of 6mm less than the adjacent insulation thickness. The outer 6 mm shall be filled up with Joint Sealer and finished smooth with adjacent insulation surface and applied a butyl rubber membrane overlapping 75mm onto adjacent insulations (after the sealer has cured). Expansion /contraction joint details in insulation for 'horizontal & vertical pipes' & for 'expansion bellows' are illustrated in the insulation diagrams.

4.11 Weather Protection Jacket

Unless otherwise mentioned, aluminium cladding shall be used as weather protection jacket over insulation. Aluminium cladding shall be ASTM C1729, class A having polysurlyn lamination on inside surface and shall meet the requirements of ASTM B209 alloy 3003 H14.

For **fire safe insulation**, cladding shall be of stainless steel as per ASTM A167 / A240 type 304 or aluminized steel as per ASTM A463, type 2, coating designation T2-100 with polysurlyn lamination on inside surface.

Cladding metal sheets (all types) shall have minimum thickness as below:

Item	Insulation O.D (mm)	Thickness (SWG)
Pipe, Vessels and equipment	< 500	26
Pipe, Vessels and equipment	> 500	24
Valves, flanges and foot traffic areas	-	22

4.12 Joint Sealant for Joints of Metal Cladding

The technical requirement and typical material for joint sealant of metal cladding (aluminium and stainless steel) is specified below.

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General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 52% volume solid as per ASTM C461	FSI (flame spread index) $\leq$ 20 as per ASTM E-84, tested on a 6.3mm inorganic reinforced cement board with DFT ~2mm	0.0092 metric perms (as per ASTM F-1249 with DFT 2.8mm)

4.13 Sealing Tape for Secondary Vapour Barrier

Sealing tape shall be a three layer laminated foil (~50 micron thickness) made of aluminium & polyester (25µ aluminum foil sandwiched between two 12µ polyester films. Material shall have following properties.

Total thickness exclusive of adhesive layer	50 µm
Temperature range	+120°C to -45°C
Volumetric mass	1.93 kg / dm³
Water vapour permeability in acc. with ASTM E 96, procedure E (37.8°C, 90% R.H.)	Max. 10.10-6 g / (m².h.mmHg)

4.14 Under Insulation Painting

Equipments and piping shall be protected from corrosion by providing appropriate painting under insulation, as per applicable painting specification for the project.

4.15 Adhesive Synthetic Tape

The tape used to secure the inner layers of polyisocyanurate shall be by pressure sensitive glass fiber reinforced tape. The tape shall have the following characteristics:

a) Materials: Glass fibre-reinforced synthetic tape

b) Dimensions: width min.30mm and thickness min. 0.14mm.

c) Adhesiveness: 200gr/mm^2

Adhesive tapes shall be spaced as follows:

To Secure Insulation	Spacings (mm)
OD of insulation Upto 250mm (10 inch).	300
Over 250mm (10 inch).	200

4.16 Bands

Band to secure last layer of insulation materials shall be stainless steel to ASTM A-167 Type 304. Banding to secure the weatherproof jacketing shall be stainless steel to ASTM A-167 Type 304 or 316. For aluminium cladding, aluminium band (Aluminium 99.5, temper H14) in accordance with ASTM B-209M shall be used. The band shall be 20 mm width x 24 SWG.

4.17 Butyl Rubber Sheet

Butyl rubber membrane, comply to ISO 188-aging of thickness 1.2 and width 20 mm shall be used as flexible covering over contraction joint for weather barrier.

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5.0 APPLICATION

5.1 Surface Preparation and Under Insulation Coating / Wrapping

Ingress of rain water and corrosive products or condensation of water vapour in the insulation may cause severe CUI (corrosion under insulation) and ESCC. The surfaces of piping, vessels & equipments valves etc. on which cold insulation is to be applied shall be free of dust, loose paint or any other foreign matter. The surface irregularities shall be filled up with the approved filler. Anticorrosive coating/ under insulation coating shall be applied over the carbon/Alloy Steel surfaces to be insulated and allowed to dry before application of insulation. Paint system shall be as per applicable for the project. Austenitic stainless steel especially 300 and 400 series are susceptible for external stress corrosion cracking (ESCC). For to avoid ESCC in stainless steel as an alternative of coating, 0.1mm thick aluminium foil can be wrapped with an overlap of 50mm. Overlap joint shall be sealed with barium chromate sealer or self- adhesive (chloride free) aluminum tape at the edge of foil. Foil shall be secured in position either by pressure sensitive tape or aluminium band.

5.2 Insulation Layer Application and Securement (General)

a) Before application of insulation, surfaces shall be clean, dry, and free from oil, grease and dirt. Individual pieces of insulating material shall fit closely, both together and to the surface being insulated. The least number of pieces possible shall be used, and joints between individual pieces shall be staggered.

b) There shall be no gap or cavities between individual pieces of insulation blocks. Adjacent sections of rigid cold insulation materials shall be buttered together with a flexible joint sealant

c) Based on the operating temperature and insulation thickness insulation application can be single layer application or multilayer application. If total insulation thickness exceeds 75 mm, multilayer structures of insulating material shall be used. Layers shall be approximately equal in thickness, and no single layer shall exceed 75 mm.

i) Single Layer Insulation

Insulation blocks cut into appropriate width suitable for handling but not less than 300mm in contour of the surface profile installed on to the surfaces of vessels/piping/equipment adhering to each other with applicable joint sealer and secured in position by SS-304 bands. There shall be no through joints and the insulation shall not be bonded to the vessel.

ii) Multilayer Insulation

The inner layer of insulation shall be bonded to the vessel with cryogenic adhesive. Subsequent 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 layers to seal all joints. Care shall be taken to ensure that the adhesive is evenly spread over the entire surface of the application and the insulation is closely butted to each other both longitudinally and circumferentially. Longitudinal and circumferential joints shall be staggered by approximately 50% of lag or section size. Inner layers of insulation shall be secured with self adhesive tape and final shall be secured with metallic band.

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iii) The securement for insulation by means of metallic band shall be as follows:

To Secure Insulation	Spacings (mm)
Pipe work OD of insulation Upto 250mm (10 inch).	225
Over 250mm (10 inch).	300
Vessels, equipment	300

In case of securement of inner layer insulation by self adhesive tape, the spacing shall be followed as:

To Secure Insulation	Spacings (mm)
OD of insulation Upto 250mm (10 inch NB).	300
Over 250mm (10 inch NB).	200

iv) Projections (e.g., lifting lugs, supports, etc.) shall be insulated with the same thickness of insulation as that specified for the body of the process equipment. The insulation shall extend down the projection as far as required by the process.

5.3 Application of Piping Insulation

a) Horizontal and Vertical Piping

Insulation shall be applied on after ensuring that piping to be insulated is properly installed, supported and tested. Refer insulation diagrams at end of this specification.

The insulation shall be applied to pipes in half round sections in reasonably handy sizes.

The inner layer of insulation shall be bonded to the piping with applicable adhesive. Subsequent layers of insulation shall be bonded to 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 longitudinally and circumferentially.

All the insulation layers except the final shall be secured in position by pressure sensitive tape, while the final layer shall be secured with metallic bands.

Insulation of piping shall be stopped short of flanges to allow for withdrawal of bolts. For fittings, the insulation shall be completed by applying cut segments of the same insulation sections used for pipes. In case of vertical piping insulation support/spacer rings shall be provided at an interval of 4.0m (if other insulation supports do not already exist on the pipe) as illustrated in diagrams at end of this specification.

b) Pipe Supports & Hangers

In all the supporting arrangements of both horizontal and vertical piping, dry hard wood pipe support bearing blocks coated with fire retardant paint/mastic or PUF, as applicable, shall be used. Metal cradles, metal pipe supports and hangers shall be attached to outside of the pipe support bearing blocks and not directly to bore pipe. Provision shall be made to prevent seepage of water into the insulation from pipe hangers.

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c) Flanges & Valves

i) Lining with PIR

Removable covers shall be provided over all flanges and valves. Insulation shall be performed as per the details are illustrated in diagrams at end of this specification. Loose fill mineral wool backed up by slab insulation of thickness equal to that an adjacent pipe shall be applied.

As an alternative to slab insulation, injection foaming by in-situ PUR is also acceptable. Metallic 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 Engineer-in-Charge.

ii) Combination lining with flexible aerogel + PUR

Wherever combination lining with aerogel is used, valves and flanges shall first be applied with a flexible aerogel blanket and proceed with commissioning activity. Remaining of the insulation matched with adjacent piping is installed by in-situ PUR injection foaming within metal cladding.

iii) Refrigerant Traced Lines

When lines are traced with one or more tracers, insulation shall be of sufficient size to house the assembly without distortion or damage to the insulation.
The refrigerant traced assemblies shall be first wrapped with specified wire netting, thus ensuring tracer pipe wearing tightly against the line refrigerant – traced. Application of insulation for piping are illustrated in diagrams at end of this specification.

5.4 Insulation Application on Vertical Vessel

a) Shell (Cylindrical)

Insulation blocks cut into appropriate width suitable for handling but not less than 300mm in contour of the surface profile to 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 300 mm. Care shall be taken to ensure that no air pockets are formed in the finished insulation.

b) Top Heads

Shaped insulation blocks cut into appropriate width suitable for handling shall be installed on top head, banded and butted tightly to each other. Insulation may be held in position by making use of galvanized iron floating ring (25mm x 0.6mm) 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 floating ring and the other end shall be anchored to the band(s) placed around the cylindrical section close to the head. Radial bands shall be spaced on 300mm centres measured around the circumference of the vessel.

c) Bottom Heads

In all the skirt supported vessels, insulation supports are provided inside the skirt as indicated in the equipment drawings, illustrated in diagrams at end of this specification

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Floating ring and wire loops around the nozzle and bands shall be used to support downward facing of insulation. Such a floating ring shall be positioned centrally around the nozzle but over the insulation by radial bands anchored to the lagging support angle ring fixed inside the skirt at a pitch of 300mm measured over the support angle ring.

If nozzle is not existing, metallic bands shall be stretched across the bottom head and anchored with lagging support angle ring inside the skirt.

5.5 Insulation Application on Horizontal Vessel

Insulation blocks cut into appropriate width suitable for handling but not less than 300mm in contour of the surface profile to be applied in close contact with the faces to be insulated and held in position metallic bands at a pitch of 300mm. Where more than one layer is required, each layer shall be banded separately.

Insulation sections on the vessel heads shall be secured in position by 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 shell shall be of a pitch of 300mm max. Method of application of insulation are illustrated in diagrams at end of this specification.

5.6 Insulation Application on Tank

Material and method of application for tanks shall be the same as specified for vessels.

5.7 Insulation Application on Spherical Vessels

Insulation of spherical vessels shall be performed as illustrated in diagrams at end of this specification. Shaped insulation to fit curvature of sphere shall be bonded to the vessel with applicable adhesive. All insulation joints shall be sealed with applicable joint sealer. The inner layer of insulation shall be held in position by 20mm x 20 SWG aluminium bands of 300mm max. centres of the equator. These bands are tied up with suitable rings. The bands being staggered on successive layers and the clips of the bands being recessed into the insulation.

5.8 Application of Primary Vapour Barrier

Cold insulation shall essentially have a thick mastic coating (min 1.5mm when dry) as ‘primary vapour barrier’ applied over external surface of the insulation underneath weather barrier jacket (cladding). The mastic shall be applied in two coats reinforced with glass fiber cloth to obtain the specified dry film thickness.

Primary vapour barrier mastic shall be supplied in two sheds. One shed shall be used for the first coat and the other shed for second coat. The first coat shall be applied to a wet thickness that contributes half of the required thickness by trowel or other method as may be specified by the supplier to a smooth finish by covering the insulation joints. At insulation terminations, including those at flanges, the primary vapour barrier shall extend at least 75 mm beyond the edges of the insulated section onto adjacent uninsulated equipment/ piping.

The fabric (glass cloth) shall be embedded in the wet tack layer such that no wrinkles are formed and all joints have a minimum overlap of at least 50 mm. Apply the second coat (of other shed) after a time gap recommended by the mastic supplier (usually within 2 hours) to a smooth finish fully embedding the fabric and to the required thickness to obtain required DFT.

When cured, the layer shall be durable and have good dry film strength and puncture resistance. Minimum technical requirement for primary vapour barrier is specified below. The total dry layer thickness shall conform to the layer thickness specified by the supplier. There

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shall not be any cracks, holes, thin spots or open joints in the vapour barrier, which shall be applied such that no part of the insulation material is uncovered. The connections with protrusions and in corners shall be carefully finished.

5.9 Application of Secondary Vapour Barrier

At an operating temperature of -50°C or below, in addition to primary vapour barrier, the multiplex foil as a secondary vapour barrier shall be applied between the outermost layer and the next insulation layer. The foil shall be cut to size correctly and shall be installed with dots of adhesive at the surface, tightly stretched and without air inclusions. The joint shall be sealed with multiplex tape of aluminium/polyester.

5.10 Application of 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 joint location, provision shall be made in aluminium cladding to accommodate contraction of pipe or vessel.

The following steps shall be taken:

a) Both longitudinal and circumferential joints in insulation shall be staggered.

b) Contraction joints shall be provided at an interval depending on pipe or vessel material contraction/expansion co-efficient and temperature. Unless otherwise specified contraction joints shall be provided at an interval of 6.0m on straight run of pipes or vessels operating at temperatures (-) 40°C & below.

c) Contraction joints in horizontal vessel insulation shall be close to support points while on vertical pipes & vessels, the same shall be provided at support ring location and at an interval of 4.0m straight run.

d) A contraction joint shall consist of 12mm gap in the Insulation with staggered joints, compressed (minimum compression 50%) with resilient blanket, butyl rubber at the vapor barrier joint and sliding weather barrier sheet at the jacketing joint.

e) The butyl rubber sheet will be centrally positioned and bonded by compatible adhesive and secured on both sides by stainless steel bands.

Expansion/contraction joint details in insulation for 'horizontal & vertical pipes' & for 'expansion bellows' are illustrated in diagrams at end of this specification.

5.11 Application of Finishing Layer

To protect the primary vapor barrier against mechanical damage and influence of weather a finishing layer shall be installed. The following types of finishing layers can be applied:

Appropriate metal cladding system shall be selected depending upon the requirement. The metal cladding shall be constructed such that any condensation (moist) can drain from the cladding. The cladding is fastened with stainless steel bands. For aluminium cladding aluminium bands may be used. All the longitudinal and circumferential joints having an overlap of minimum 50mm. Unless otherwise specified the metal sheeting shall be secured in position by means of bands as per mentioned below mentioned spacing:

To Secure Metal Cladding	Spacing (mm)
Pipe OD up to 250mm	225
Pipe OD over 250mm	300
Vessels and equipment and all tankage	425

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All longitudinal and circumferential joints of metal sheeting shall be sealed with suitable approved non-hardening elastomeric mastic sealer.
For horizontal vessel and piping all the longitudinal joints with overlap shall be kept below the horizontal plane passing through the axis of the vessel to prevent water or other spillage from entering into the insulation. At horizontal piping, in the middle between two supports, at the lowest point , drain holes shall be provided, min 1 hole/6 m, dia 10mm and at the lowest point of vertical bends, connections etc.

The securement of metal sheeting in case of horizontal vessel dish heads, vertical vessels top/bottom heads and spherical vessels shall be carried out as under:

a) Horizontal Vessels

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 bands stretched over the heads. One end of each band is anchored to the circumferential band(s) on the shell while the other is fastened (pop riveted) to 6mm dia. floating rod ring which can be replaced by 6mm thick strip (G.I.) rolled in the form of a ring. Radial metallic bands, measured over the circumference of shell, shall be at a pitch of 300mm.

b) Vertical Vessels

i) Top Heads
Insulation shall be covered with flat 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. Jacket shall be secured in position by radial tensioned metallic bands anchored to the circumferential band(s) of vessel on one side and fastened to 6mm dia. floating rod ring, centralized at the vortex of head on the other side. 6mm thick metallic (G.I.) strip rolled into a ring can be a substitute for 6mm dia. Rod. Pitch of radial bands measured over the circumferential bands of shell shall be max. 300mm.

ii) Bottom Heads

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

iii) Spherical Vessels

Jecketing of each hemisphere of spherical vessel shall be done with metal sheets placed horizontally and a thick circumferential tensioned band (6mm thick) shall be used at the equator to hold the radial metallic bands.

6.0 MISCELLANEOUS ASPECTS

6.1 Insulation of Piping at or Below Ground Level and Likely Hood of Foot Traffic

Material of insulation shall be preformed sections of Polyurethane/Cellular glass. Application of insulation shall be same as piping except that instead of providing metallic cladding over the final layer of vapour barrier.

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 on longitudinal and

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circumferential joints. The roofing felt shall be secured with the specified galvanized iron wire netting, laced with 20 SWG galvanized iron wire.
3mm thick Bitumen Emulsion mastic shall be applied for water and weather proofing.
When bitumen emulsion has completely dried, the surfaces shall be painted with two coats of bitumen based aluminium paint.

6.2 Cold Insulation with Acoustic Service

In case of dual service requirement such as thermal insulation as well as acoustic, insulation system shall have features of both insulation system and needs to be especially designed to meet required objectives. Cold insulations shall be installed first meeting technical requirement (except cladding/ jacketing), above which the acoustic insulation shall be installed with appropriate cladding/ jacketing of acoustic insulation.

6.3 Protection of Materials During Storage

Insulation materials 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 surface in a horizontal position. Insulation material shall never be stacked directly on the ground. The contractor shall provide covered storage for insulation materials as directed by the Engineer-in-Charge.

6.4 Protection of Partially Completed Job

All precautions shall be taken to ensure that each day's work is vapour 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.

6.5 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 starts 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.

6.6 Flashing

All openings through insulation finish shall be flashed weather tight particularly where connections are not insulated. Flashing shall be carried out as per details are illustrated in diagrams at end of this specification. Skirt supported vessels shall have the skirt insulated 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 terminates as are illustrated in diagrams at end of this specification.

6.7 Exchanger Insulation

Exchanger shells except for channels and channel covers shall be insulated and weather proofed as specified for vessels. Exchanger channels and channel covers including flange bolting shall be insulated with removable aluminium covers lined with insulation slabs of required thickness.

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6.8 Machinery

In general, removable aluminium boxes lined with slab insulation of required thickness shall be used for insulation of machinery after giving a coat of anticorrosive paint. The contractor shall submit details of individual pieces of equipment depending on the nature of items to be insulated to the Engineer-in Charge of site for approval.

7.0 QUALITY CONTROL REQUIREMENTS

Insulation system should be applied as per approved drawings/sketches, installation procedure and quality plan.

7.1 Qualification of Application Crews

Contractor's credential shall be approved by engineer in-charge of insulation work. The application crew must be fully trained work force. Mock-up of insulation application shall be carried out at site, resembling the actual insulation application. Mock-up application and applicator shall be certified by Owner/Engineer in charge.

7.2 Installation Schedule and Condition

Insulation shall be installed after hydrostatic testing and inspection. Insulation shall be protected from weather before and during installation.

7.3 Inspection

Inspection shall be carried out on materials and applications during execution of work to ensure compliance with the specifications. The contractor shall prepare Inspection test plan (ITP) identifying inspection stages, hold/ witness points, inspection frequency etc. and submit for approval of Owner/Engineer in charge. The engineer in-charge may finalize the same with consultation of HO specialist. If so desired by engineer-in charge, HO specialist may assist inspection of insulation work at critical stages.

7.4 Safety

The insulation contractor shall provide adequate protective appliances like hand gloves, masks, glasses etc. to the workmen carrying out the insulation work, to protect them from inhaling and touching insulation dust and fibers.

7.5 Guarantee for Supply and Installation Quality

Contractor shall ensure supplied materials conform to the technical requirements of this specification and relevant standards / codes applicable for the job. The insulation and ancillary materials shall be procured fresh for the project. Use of excess material from other site which does not have proper traceability shall not be allowed. It is the responsibility of insulation contractor to ensure adequate precautions are taken against damage and deterioration during sourcing, transportation and storage of insulation materials.

For major insulation materials like PIR, cellular glass, aerogel and vapour barriers, vapour stop etc. batch and type test certificates as applicable shall be submitted. For ancillary materials like glass cloth, sealants, tapes, foil etc. and metal cladding may be accepted based on supplier's compliance certificate.

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Any deviations shall be clearly stated and work shall proceed only after the deviations are approved by competent authority. The workmanship in execution of the insulation works shall be in accordance with sound engineering practice.

8.0 REFERENCES

Following standards have been referred while preparation of the standard:

CINI	CINI manual for industrial insulation
ASTM A240	Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet and strip for Pressure Vessels
ASTM A526	Specification of steel sheet, zinc coated (galvanized) by the hot-dip process, commercial quality
ASTM B209	Aluminum - Alloy sheet and plate
ASTM C165	Measuring Compressive properties of thermal insulations
ASTM C177	Standard test method for Steady-state heat flux measurements & thermal transmission properties by means of the 'guarded-hot-plate' apparatus
ASTM C240	Standard test methods of testing Cellular glass insulation block
ASTM C302	Standard test method for Density and dimensions of preformed pipe-covering-type thermal insulation
ASTM C303	Standard test method for Density and dimensions of preformed block and board type thermal insulation
ASTM C335	Standard test method for Steady-state heat transfer properties of horizontal pipe insulation
ASTM C356	Standard test method for linear shrinkage of preformed high-temperature thermal insulation subjected to soaking heat
ASTM C390	Standard criteria for Sampling and acceptance of preformed thermal insulation lots
ASTM C446	Standard test method for Breaking load and calculated modulus of rupture of preformed insulation of pipes
ASTM C518	Standard test method for Steady-state thermal transmission properties by means of the heat flow meter apparatus
ASTM C533	Standard specification for Calcium silicate block and pipe thermal insulation
ASTM C547	Standard specification for Mineral fiber pipe insulation
ASTM C552	Standard specification for Cellular glass thermal insulation

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ASTM C553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial & Industrial Applications
ASTM C585	Standard Practices for Inner & Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe & Tubing
ASTM C591	Standard specification for unfaced preformed rigid cellular polyisocyanurate thermal insulation
ASTM C592	Standard specification for Mineral fiber blanket insulation and blanket-type pipe insulation (metal-mesh covered) (industrial type)
ASTM C610	Standard specification for block and pipe thermal insulation
ASTM C612	Standard specification for Mineral fiber block and board thermal insulation
ASTM C795	Standard specification for thermal insulation for use in contact with austenitic stainless steel
ASTM C871	Standard test methods for Chemical analysis of thermal insulation materials for leachable chloride, fluoride, silicate and sodium ions
ASTM C892	Standard specification for High temperature fiber blanket thermal Insulation
ASTM D1622	Test method for apparent density of rigid cellular plastics
ASTM E96	Standard test methods for Water vapor transmission of materials
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM C1728	Standard Specification for Flexible Aerogel Insulation
ASTM C1729	Standard specification for aluminium jacketing for insulation
IS 11239	Methods of Test for Rigid Cellular Thermal Insulation materials

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9.0 INSULATION DIAGRAMS

The drawings/ sketches are primarily for insulation system with base insulation PIR/CG. Specific insulation system/ requirement if any from insulation manufacturer, shall be submitted by contractor for approval by owner/ Engineer in charge. The attached sketches describe general arrangement of insulation material, ancillaries and cladding. Difference if any on material type & quality between sketch and the description elsewhere in this specification/ SOR, later shall apply

S.No.	Description	Drawing
1	Vertical vessels- cold insulation with metal jacketing on shell top & bottom heads	DRAWING. No. 01
2	Horizontal vessels -cold insulation with metal jacketing	DRAWING. No. 02
3	Cold insulation for Spherical Vessels	DRAWING. No. 03
4.	Typical single layer cold insulation on pipes	DRAWING. No. 4.1
5.	Typical double layer cold insulation on pipes	DRAWING. No. 4.2
6.	Support ring for vertical insulated piping	DRAWING. No. 05
7.	Method of insulating feet of vessels	DRAWING. No. 06
8.	Typical insulation details for horizontal flange box	DRAWING. No. 7.1
9.	Typical insulation details for vertical flange box	DRAWING. No. 7.2
10.	Typical insulation details for valves box (horizontal)	DRAWING. No. 8.1
11.	Typical insulation details for valves box (vertical)	DRAWING. No. 8.2
12.	Insulation details for manholes	DRAWING. No. 09
13.	Typical contraction joint details for piping	DRAWING. No. 10.1
14.	Contraction joint – mechanical expansion joint	DRAWING. No. 10.2
15.	Contraction joint – vertical vessels	DRAWING. No. 10.3
16.	Supports for block insulation	DRAWING. No. 11.1
17.	Clips on heads and inside skirt for block insulation	DRAWING. No. 11.2
18.	Detail of spacer ring	DRAWING. No. 12
19.	Refrigerant tracing insulation	DRAWING. No. 13
20.	Method of Lagging Flanged Joints of Vessels	DRAWING. No. 14.1 & 14.2
21.	Method of Insulating Vessel Skirt (Alternative for Half or Full Insulation of Skirt)	DRAWING. No. 15
22.	Typical insulation details for pipe support	DRAWING. No. 16.1
23.	Typical insulation details for pipe hanger support	DRAWING. No. 16.2
24.	Typical details for vapor stop at flanges and valves	DRAWING. No. 17
25.	Typical details at insulation termination	DRAWING. No. 18
26.	Typical details for vessel lifting lugs	DRAWING. No. 19
27.	Typical insulation details for T-pieces (single layer	DRAWING. No. 20.1
28.	Typical insulation details for T-pieces (multiple layers)	DRAWING. No.20.2
29.	Typical insulation details for eccentric reducer	DRAWING. No.21.1
30.	Typical insulation details for concentric reducer	DRAWING. No.21.2

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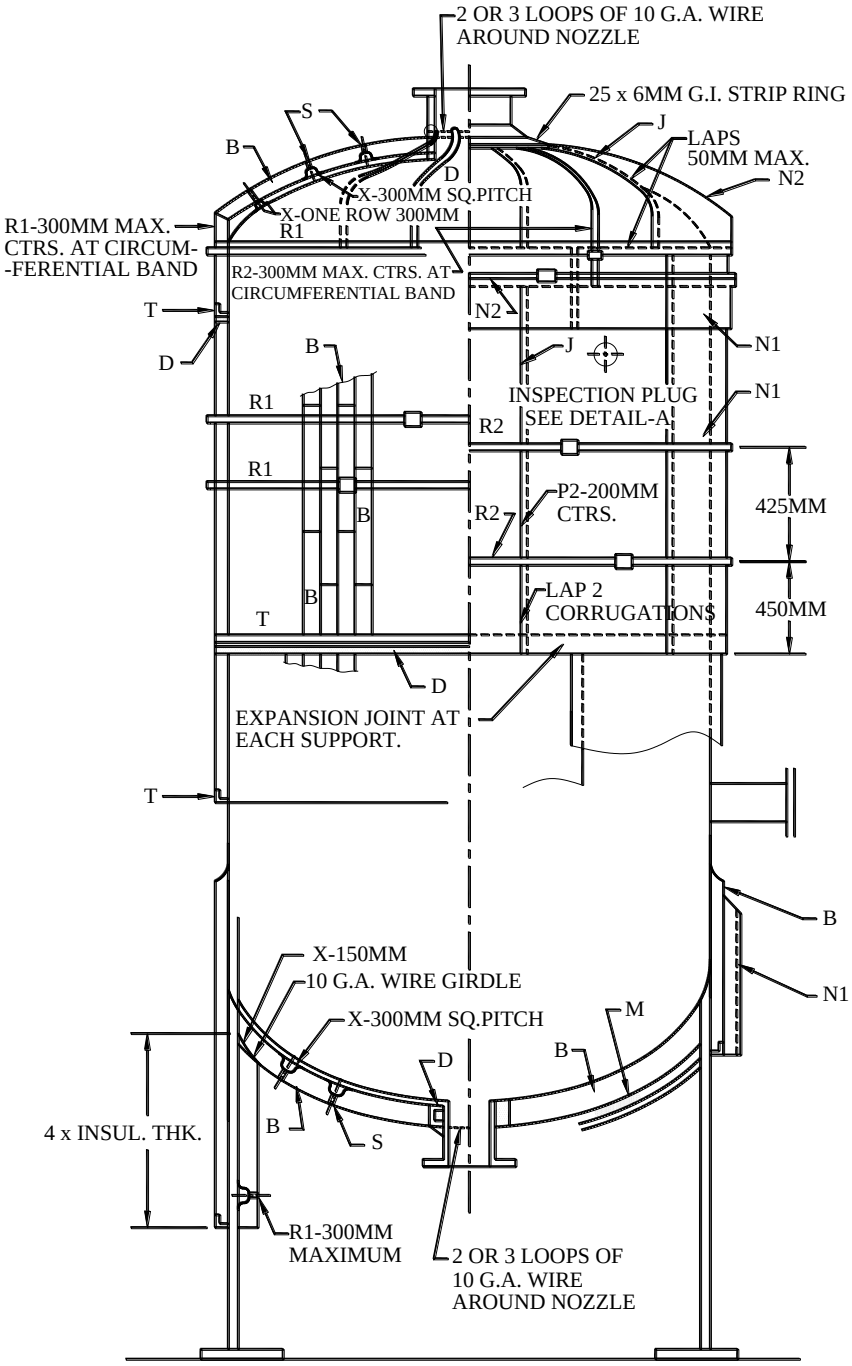

B - BLOCK INSULATION

D - LOOSE MINERAL FIBRE

J - LAP SEALER

M - WIRE MESH-LACE EDGES WITH 16 G.A. WIRE

N1 - WEATHER PROOFING

N2 - WEATHER PROOFING

R1 - BANDS AT 225MM

R2 - BAND

S - 10 G.A. WIRE TIES TO BE USED FOR VESSEL SUBJECT TO HEAT DEFROSTING

T - ANGLE RING SUPPORT & LUGS SEE SEE DRAWING NO.-11.1 ON SHT.28 OF 32

X - CLIPS. SEE DRAWING NO.-11.2 ON SHT. 28 OF 32

VERTICAL VESSELS- COLD

INSULATION WITH METAL JACKETING ON SHELL TOP & BOTTOM HEADS

DRAWING NO. - 01

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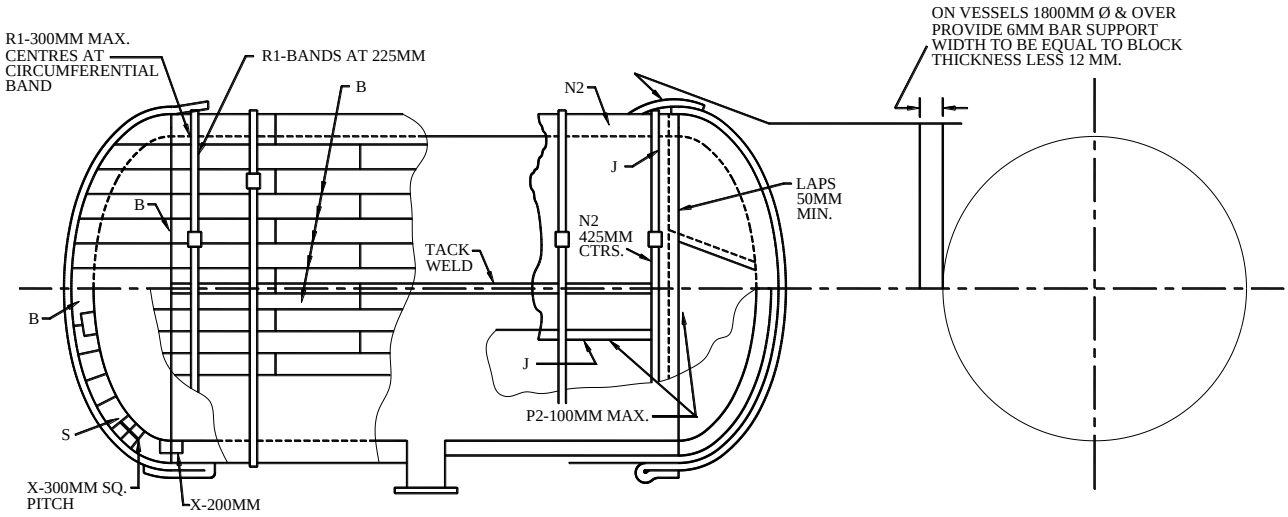

FOR S, B, N1, N2, R1, R2 & J REFER SHT. 17 OF 32

HORIZONTAL VESSELS - COLD INSULATION WITH METAL JACKETING

DRAWING NO.-02

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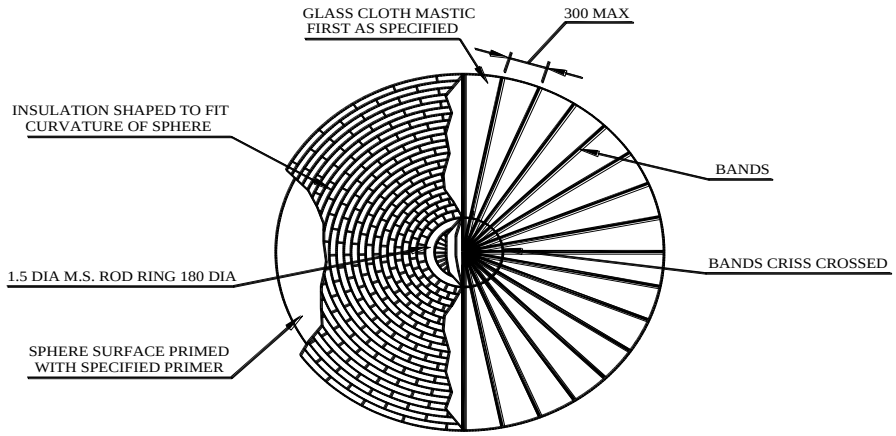
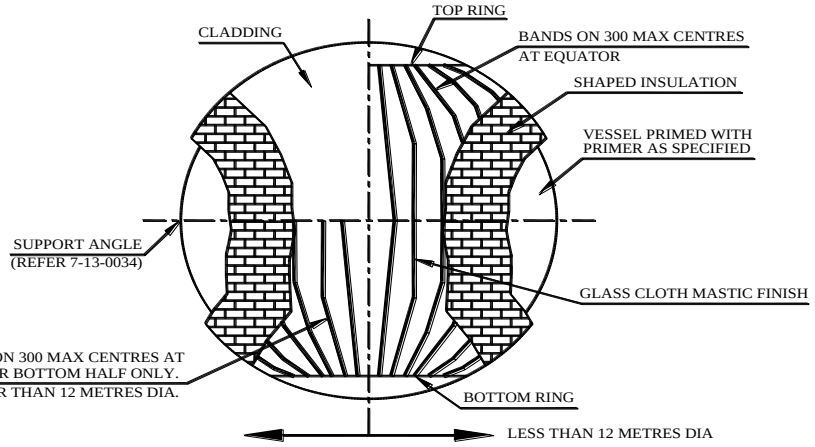


BOTTOM VIEW



ELEVATION VIEW

FIG.3-1 MULTI-LAYER APPLICATION

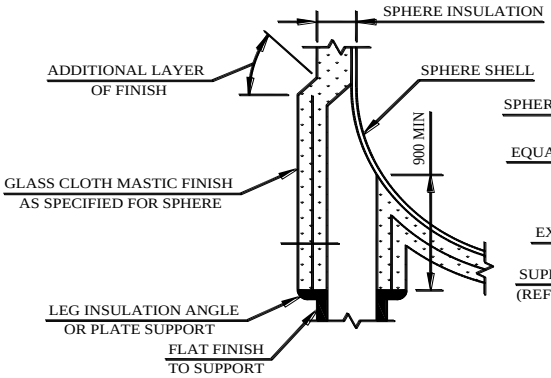
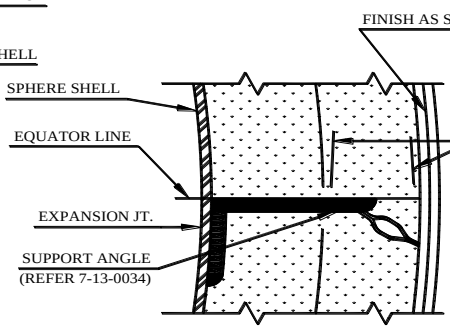


FIG.3-2 LEG INSULATION DETAIL



ADDITIONAL LAYER OF FINISH
300 MIN. WIDTH

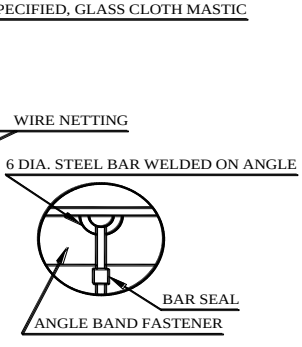


FIG.3-3 INSULATION DETAIL NEAR SUPPORT ANGLE

NOTE: FOR DETAILS OF INSULATION SUPPORTS REFER STD. NO: 7-13-0034

COLD INSULATION FOR SPHERICAL VESSELS
DRAWING No.-3

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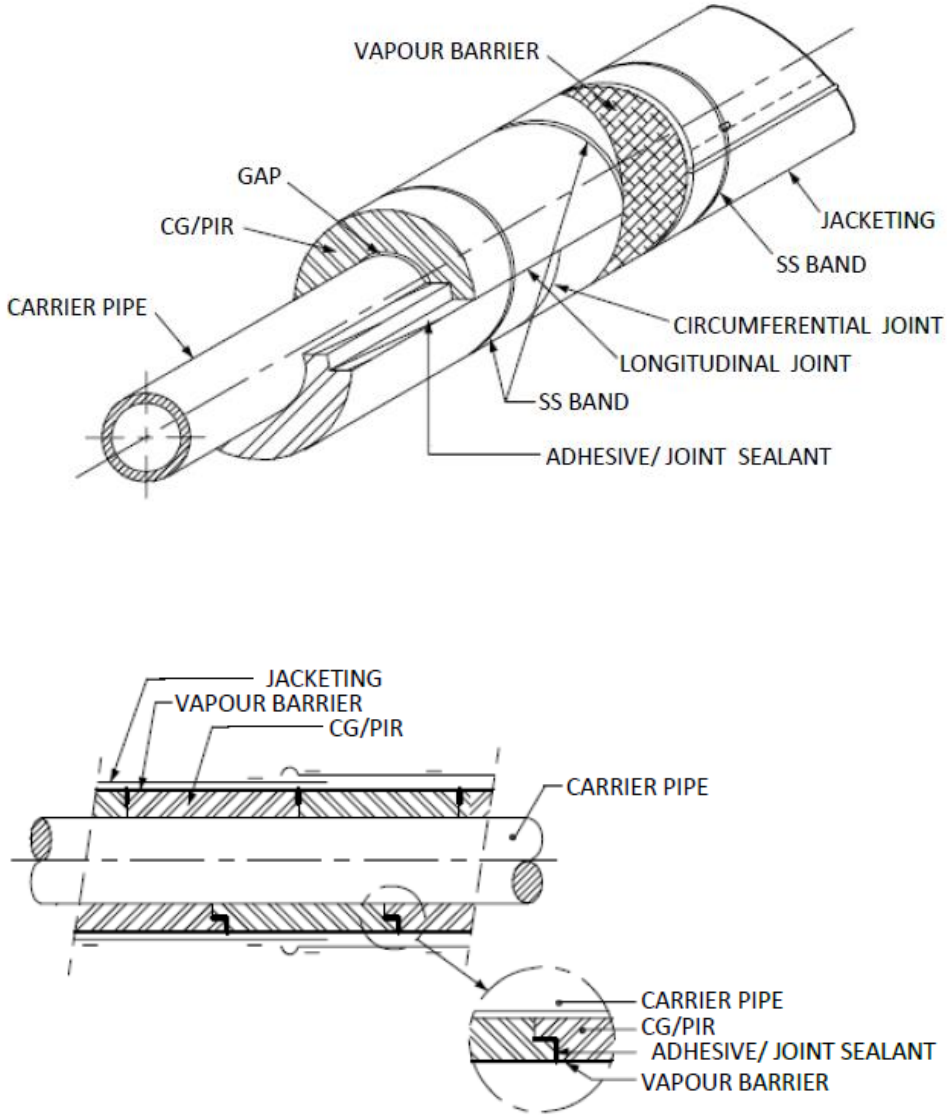

TYPICAL SINGLE LAYER COLD INSULATION ON PIPES

DRAWING NO.-4.1

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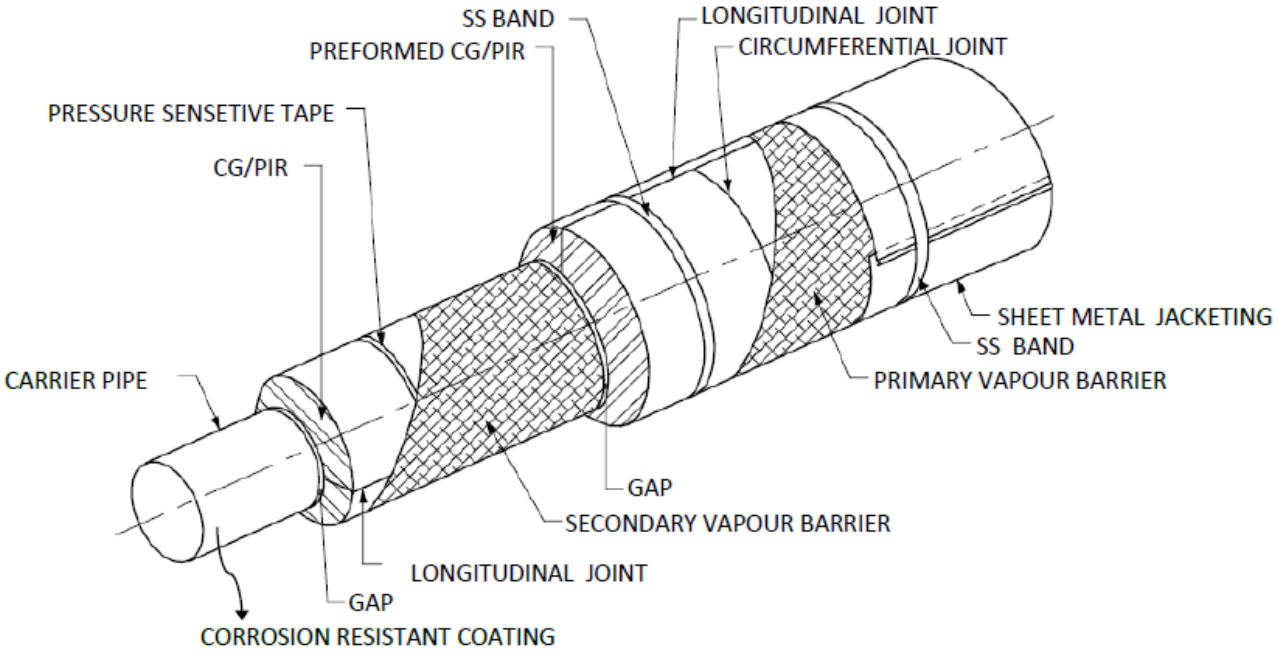

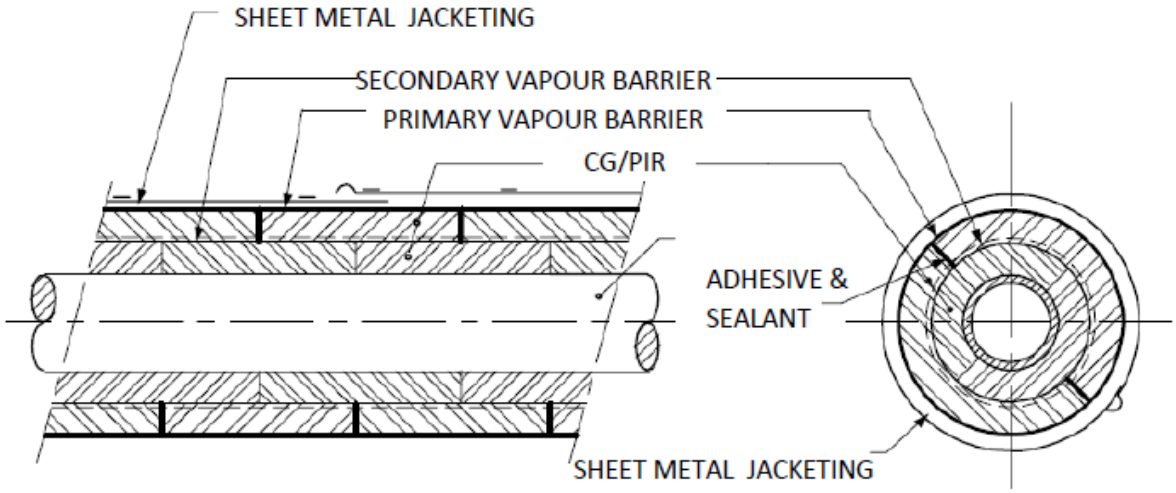

TYPICAL DOUBLE LAYER COLD INSULATION ON PIPES

DRAWING NO.-4.2

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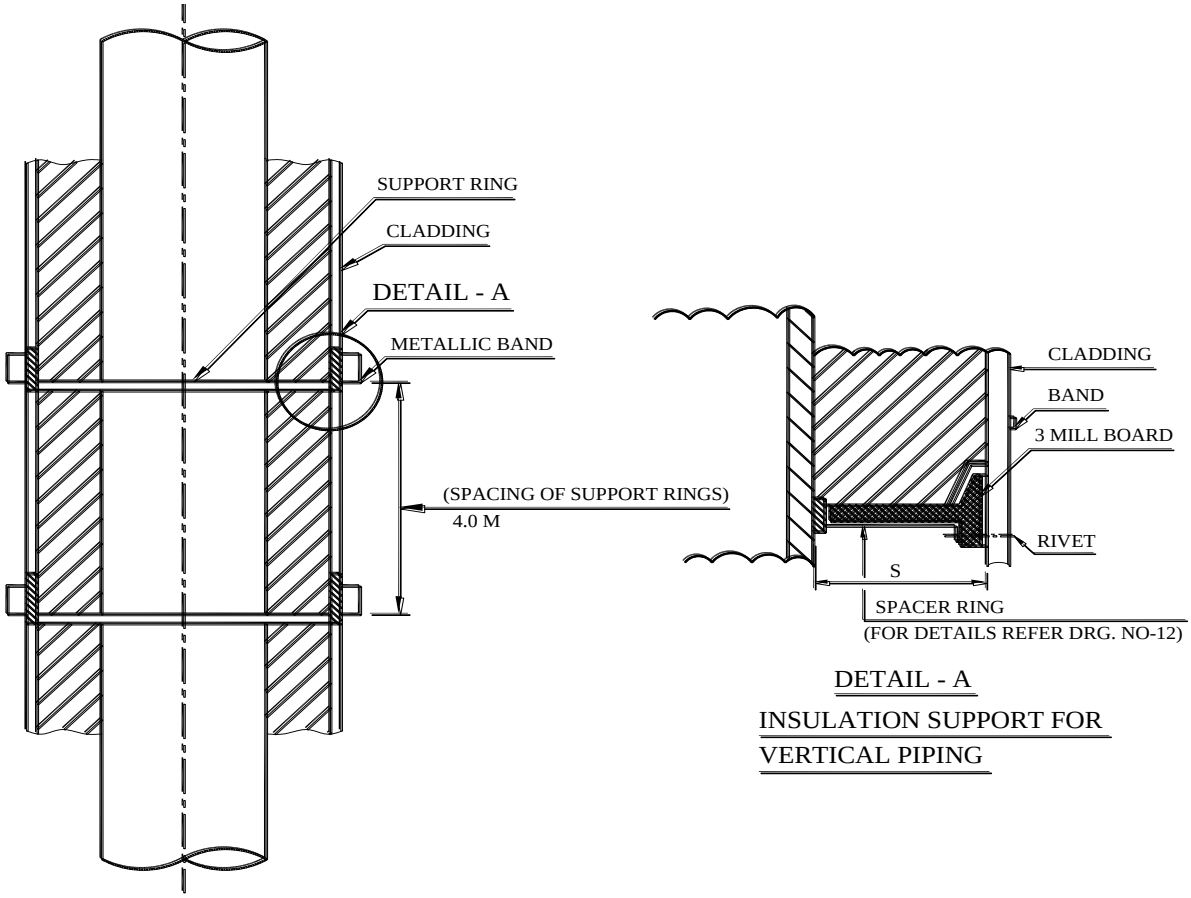
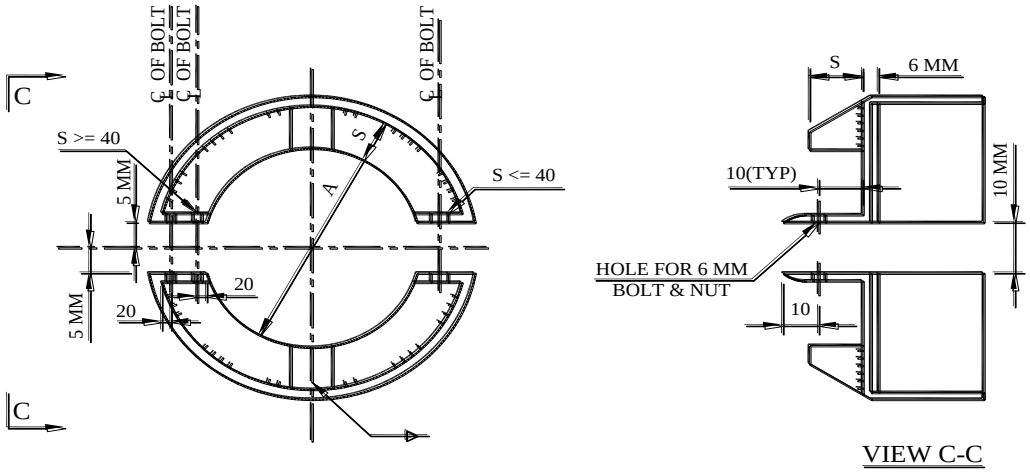


DETAIL - A
INSULATION SUPPORT FOR
VERTICAL PIPING



VIEW C-C

LEGEND:

A DIMENSIONS TO MATCH O.D. OF PIPE OR O.D. OF VESSEL
S INSULATION THICKNESS

SUPPORT RING FOR VERTICAL INSULATED PIPING

DRAWING NO.5

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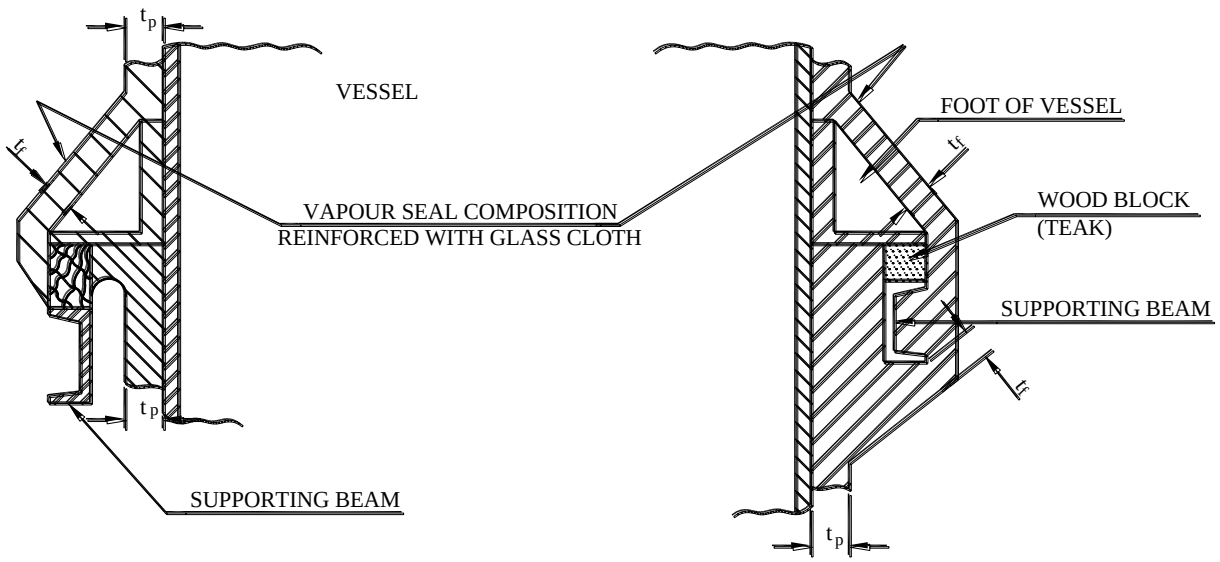
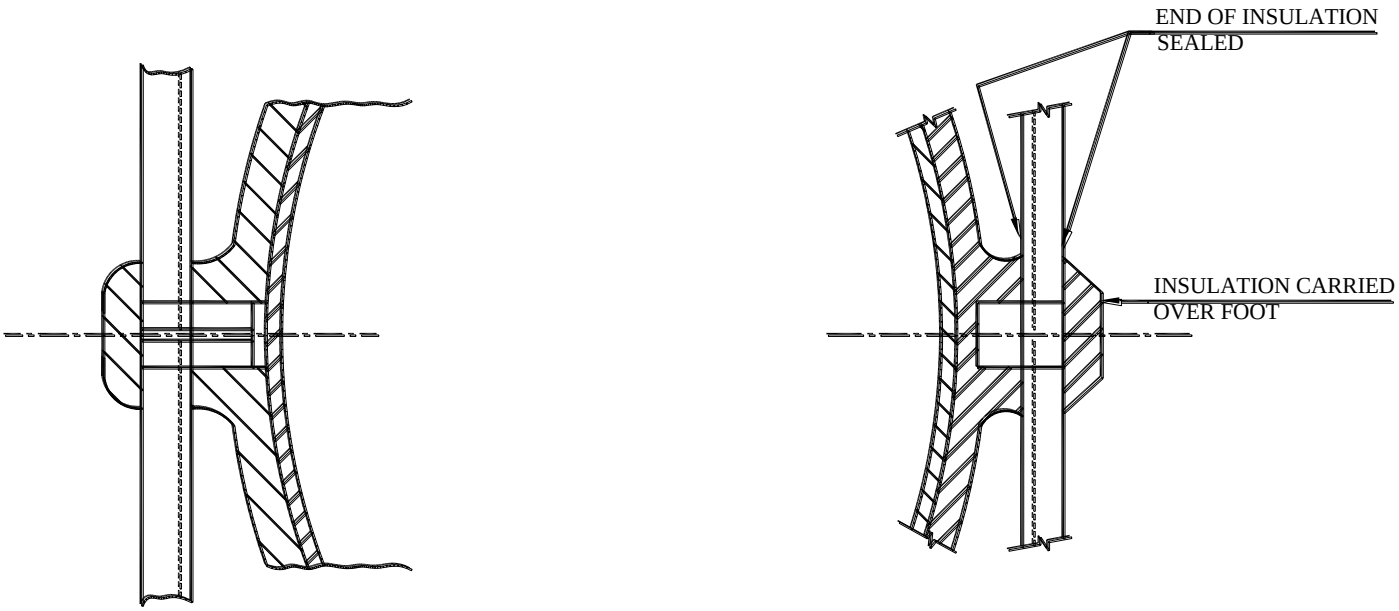


NOTE : ALL CORNERS MUST BE ROUNDED. MINIMUM RADIUS 25 MM.



t_p = THICKNESS OF VESSEL INSULATION
$t_f = t_p$ t_f = 100 MM WHERE t_p IS BETWEEN 100 MM & 125 MM.

METHOD OF INSULATING FEET OF VESSELS

DRAWING NO.-06

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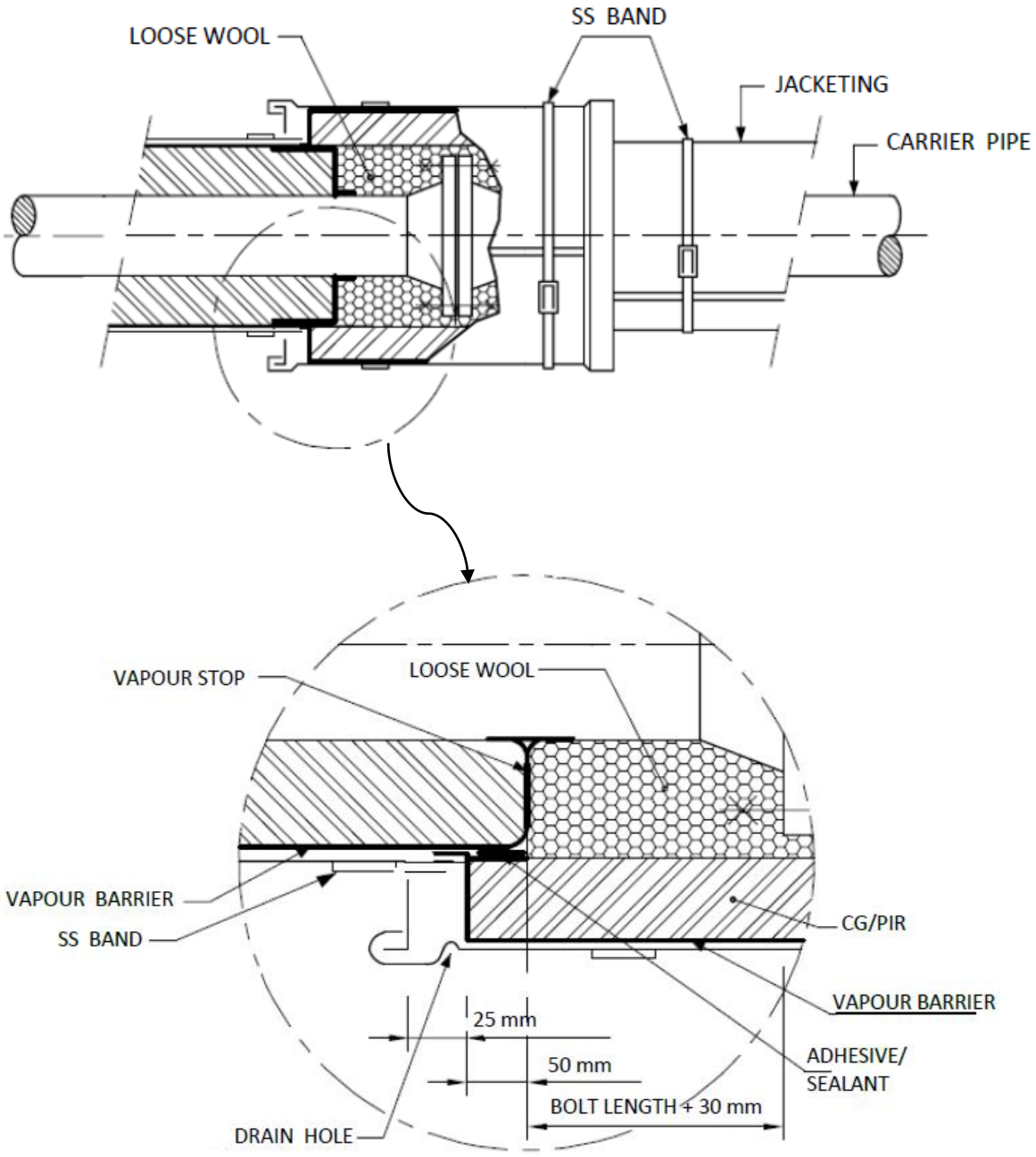

TYPICAL INSULATION DETAILS FOR HORIZONTAL FLANGE BOX

DRAWING NO.-7.1

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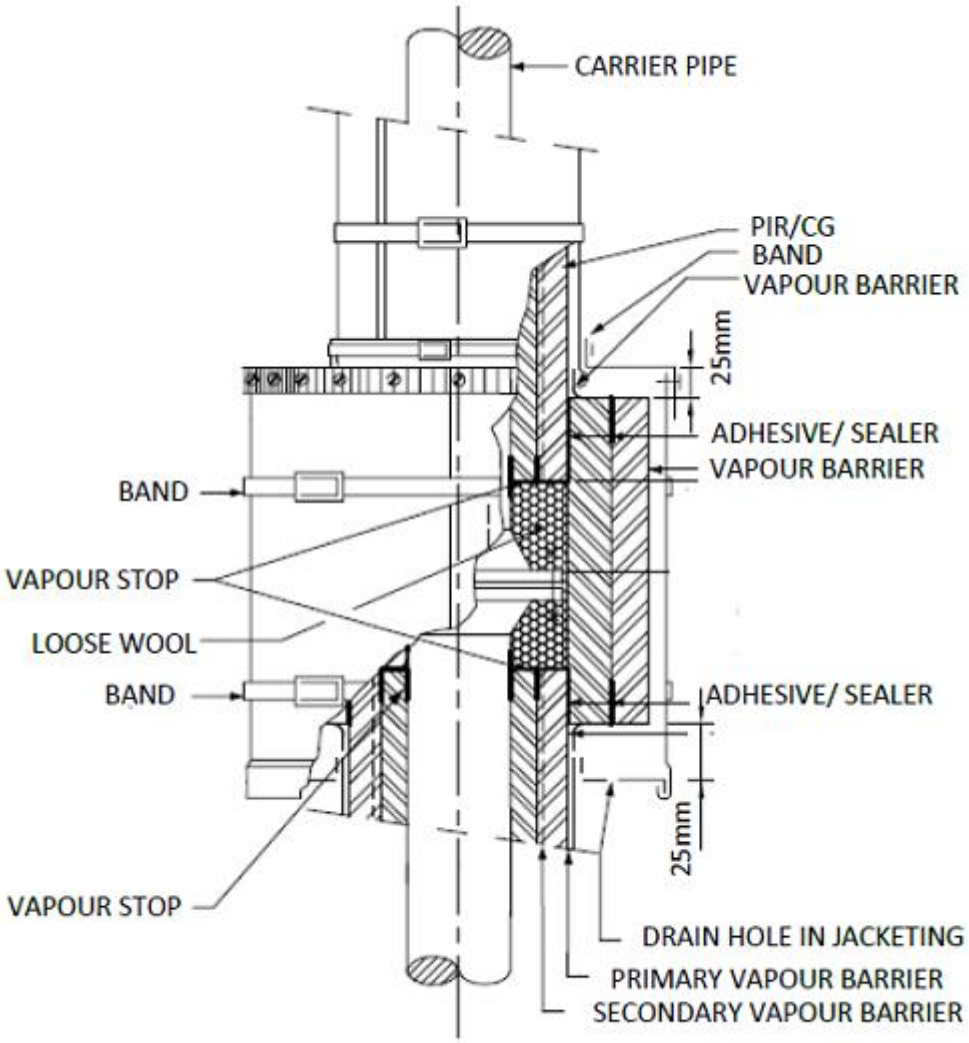

TYPICAL INSULATION DETAILS FOR VERTICAL FLANGE BOX

DRAWING NO.-7.2

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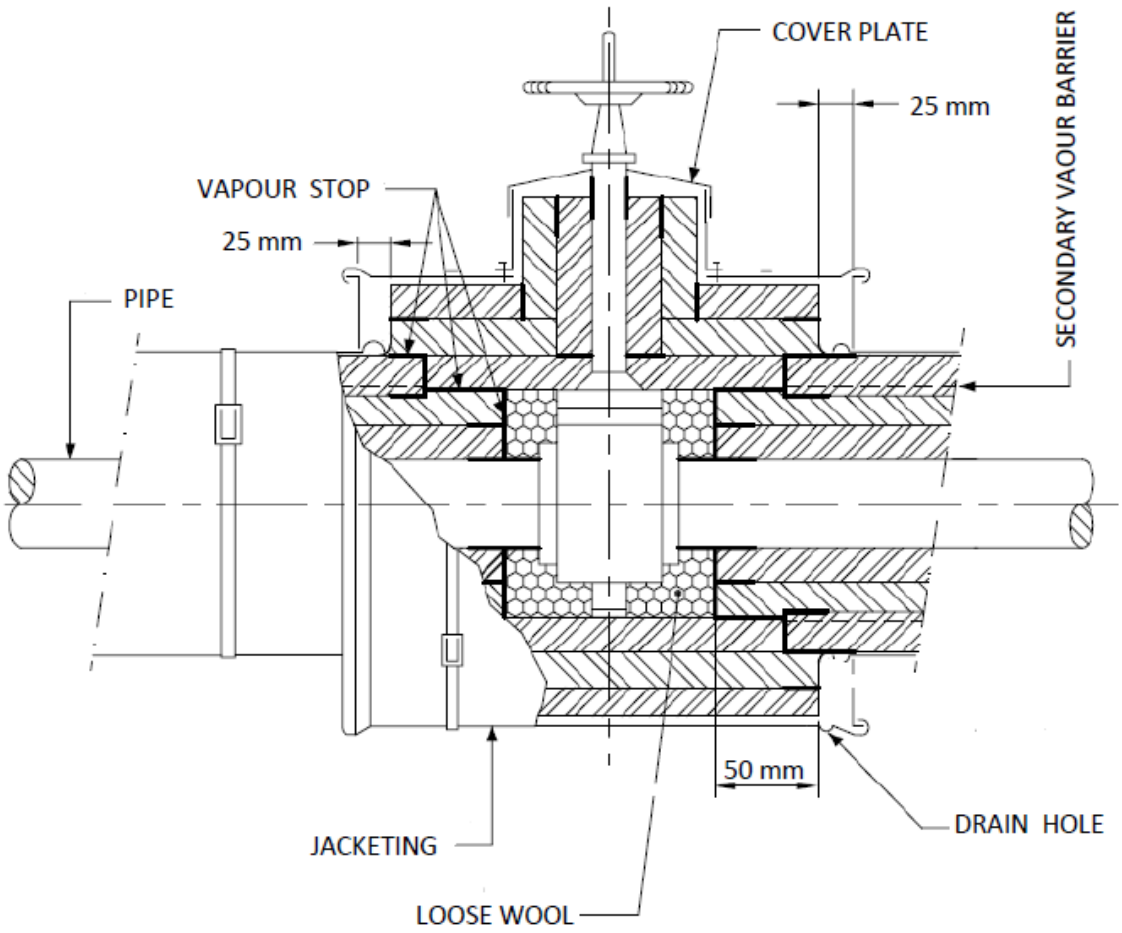

TYPICAL INSULATION DETAILS FOR VALVES BOX (HORIZONTAL)

DRAWING NO.-8.1

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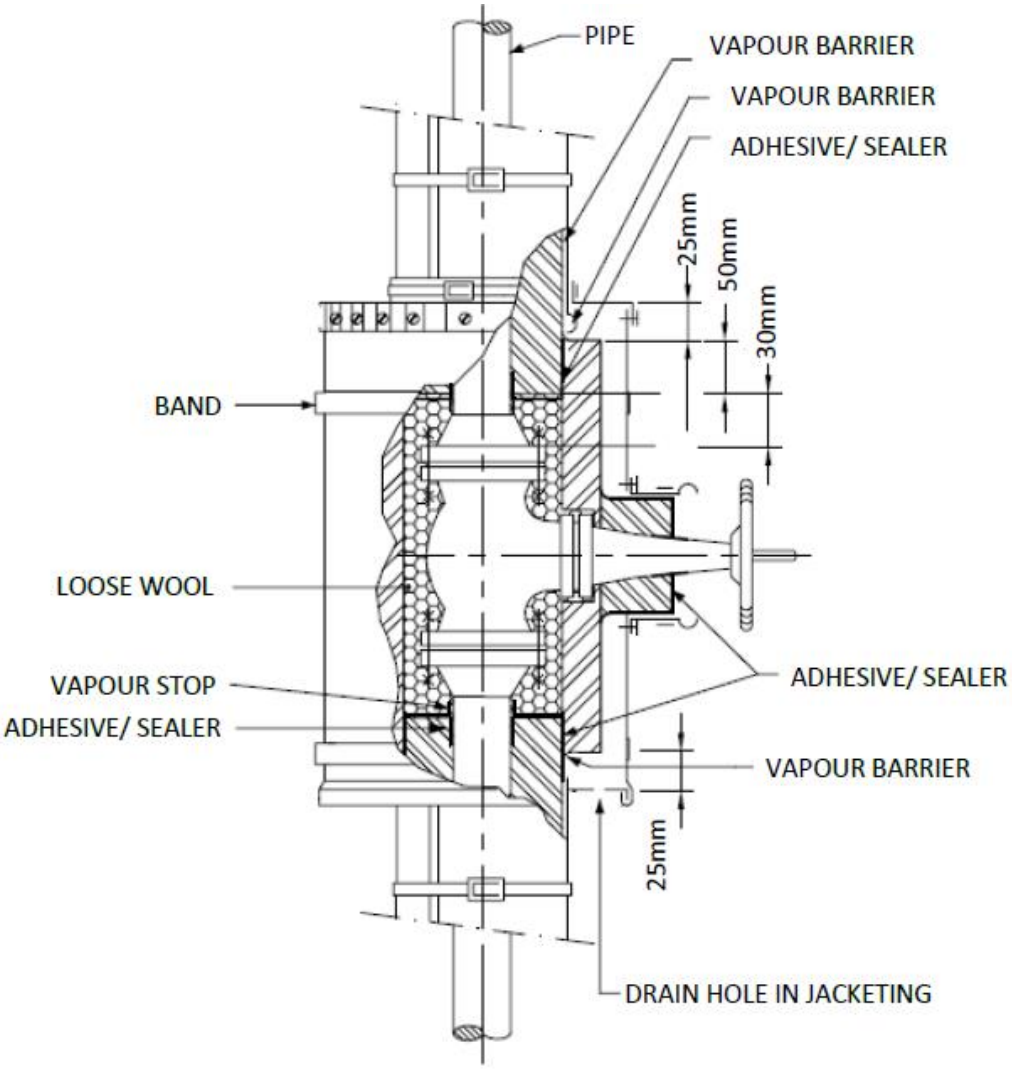

TYPICAL INSULATION DETAILS FOR VALVES BOX (VERTICAL)

DRAWING NO.-8.2

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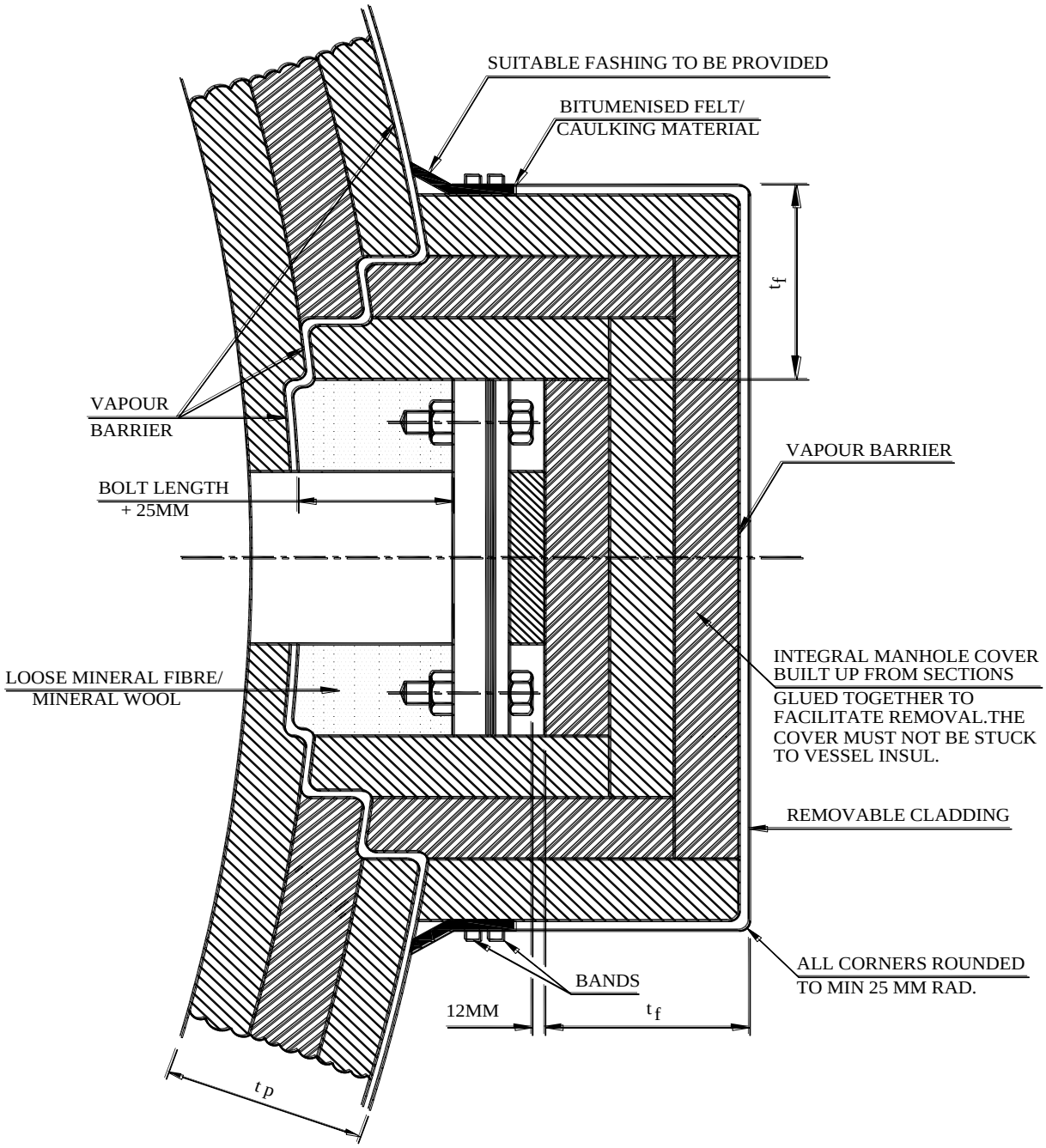

t_p = THICKNESS OF LAGGING IN VESSELS

t_f = THICKNESS OF LAGGING IN FLANGES

t_f = t_p + 25 MM WHERE t_p >125 MM
t_f = 100 MM WHERE t_p IS BETWEEN 100 MM & 125 MM
t_f = t_p WHERE t_p <100 MM

INSULATION DETAILS FOR MANHOLES

DRAWING NO.-09

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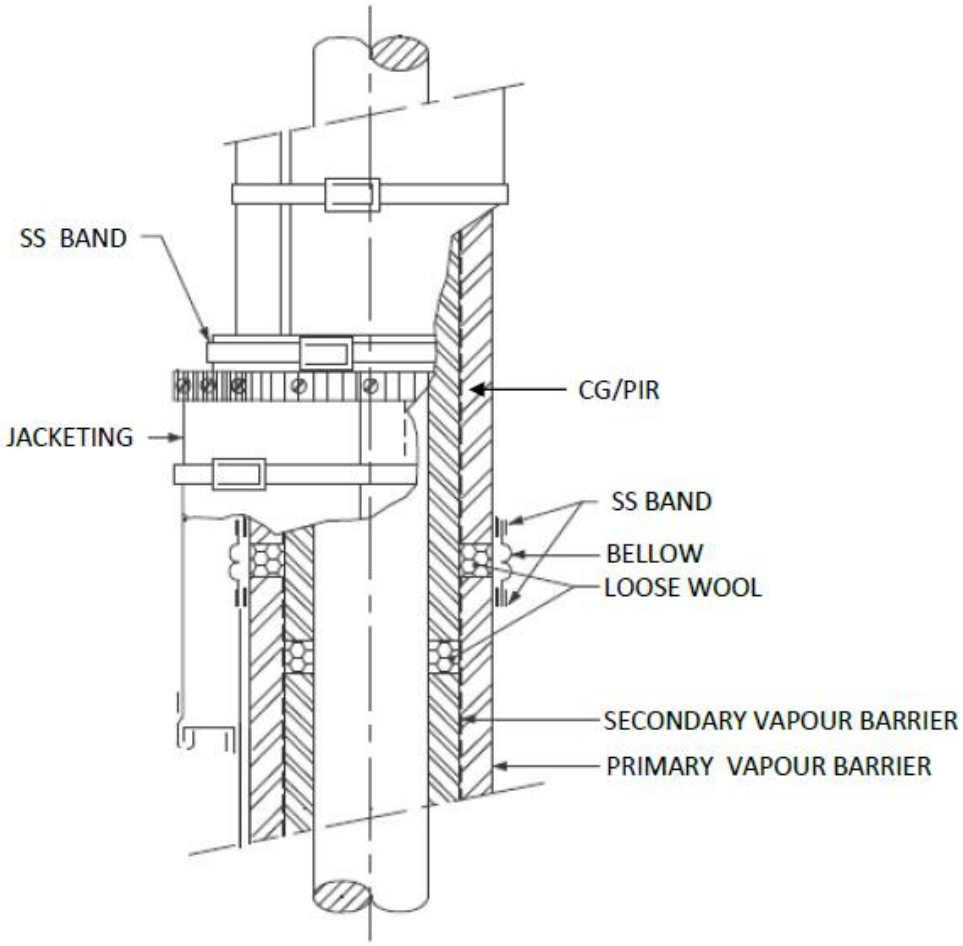

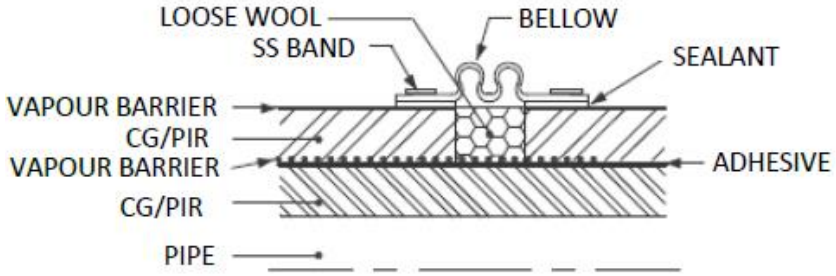

TYPICAL CONTRACTION JOINT DETAILS FOR PIPING

DRAWING NO.-10.1

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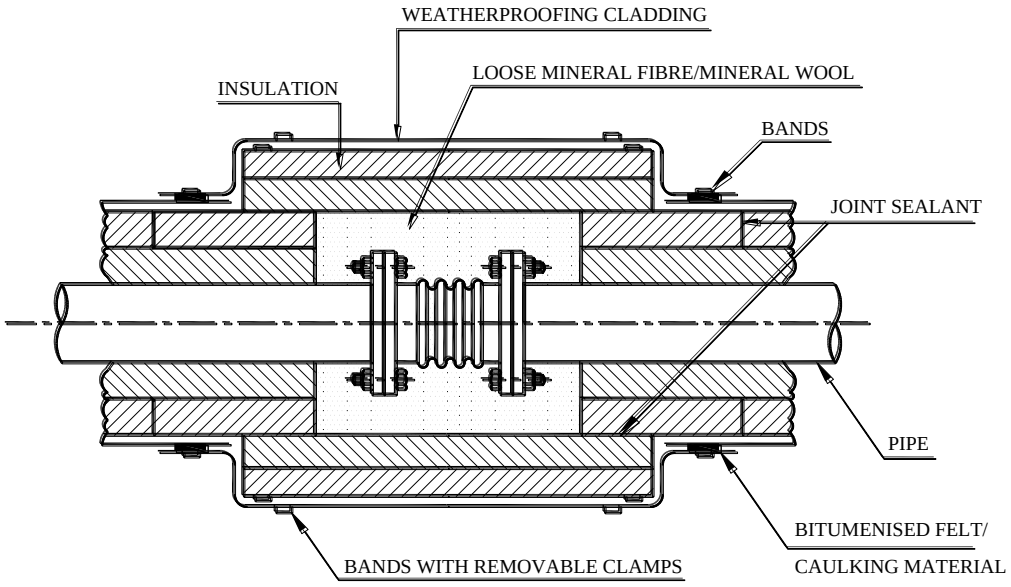
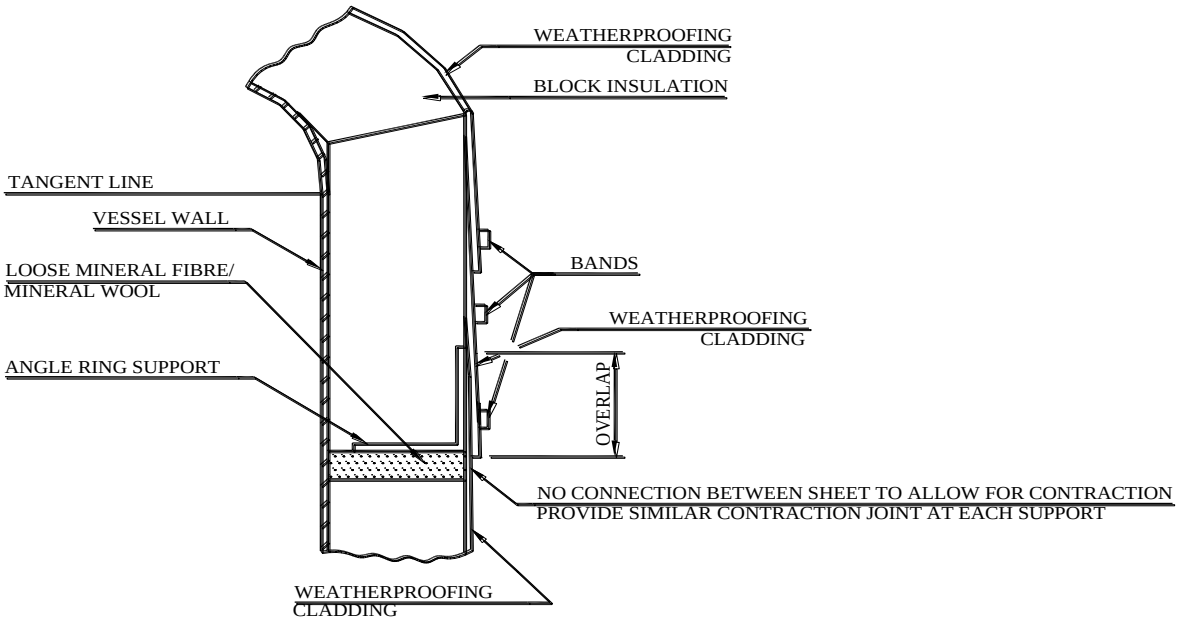


CONTRACTION JOINT – MECHANICAL EXPANSION JOINT

DRAWING NO.-10.2



CONTRACTION JOINT – VERTICAL VESSELS

DRAWING NO.-10.3

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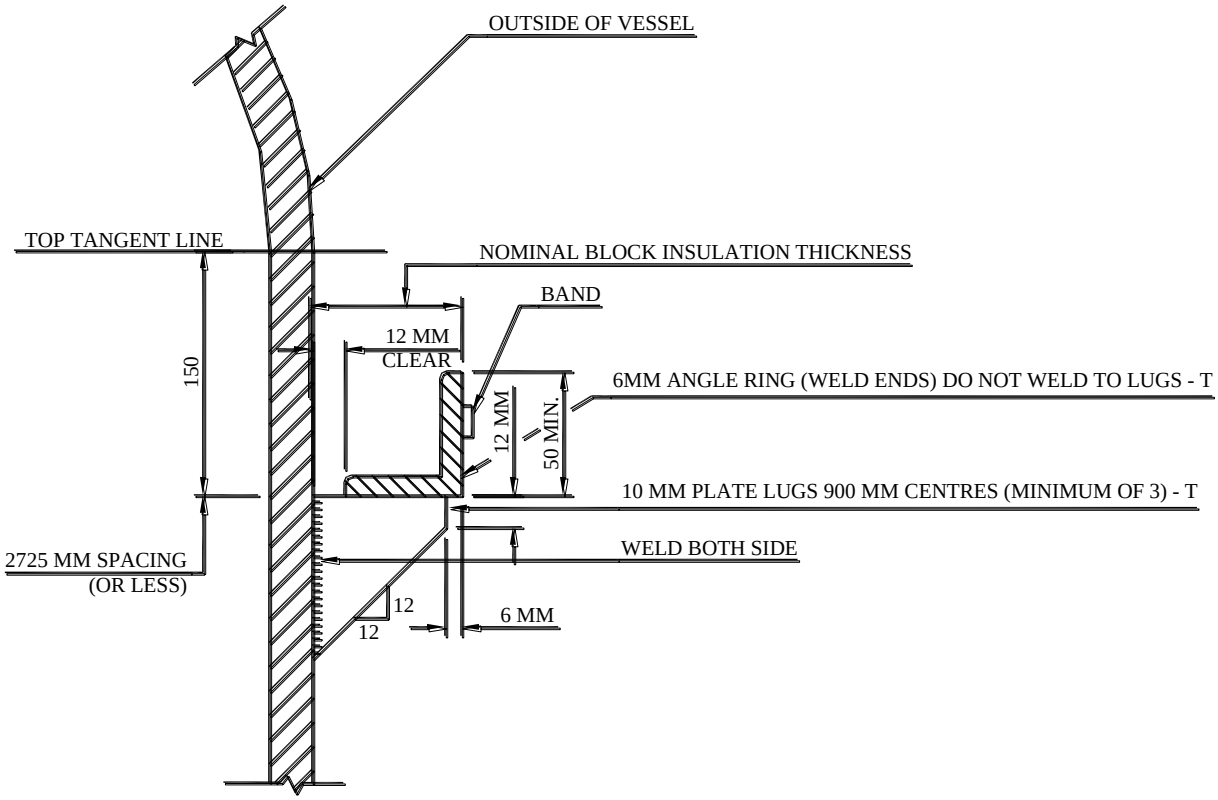
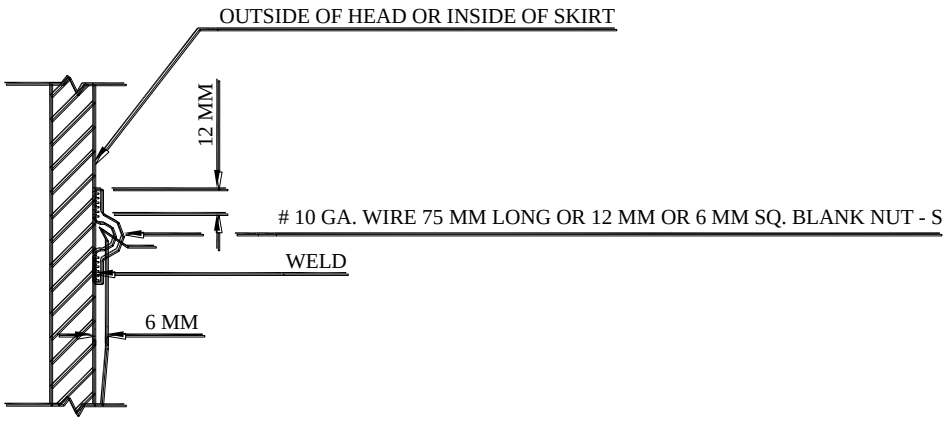


SUPPORTS FOR BLOCK INSULATION

DRAWING NO.-11.1



CLIPS ON HEADS AND INSIDE SKIRT FOR BLOCK INSULATION

DRAWING NO-11.2

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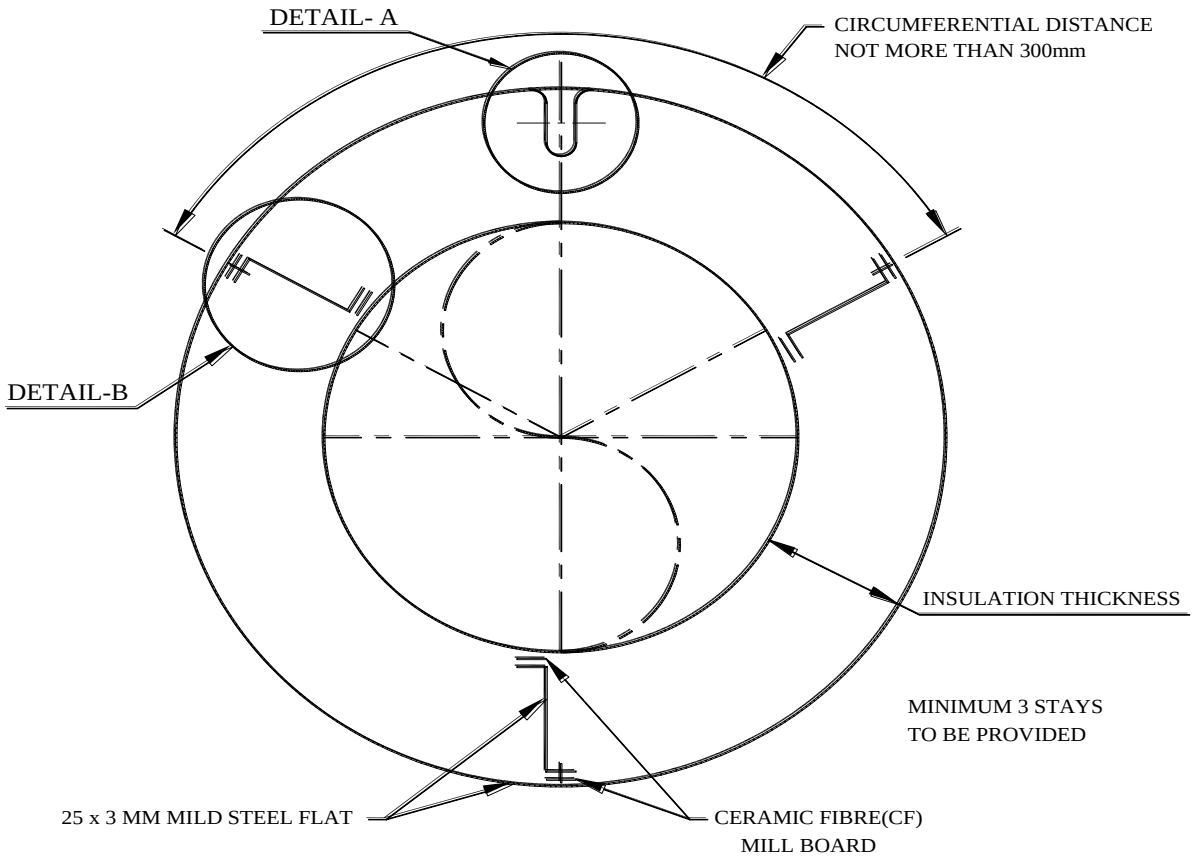

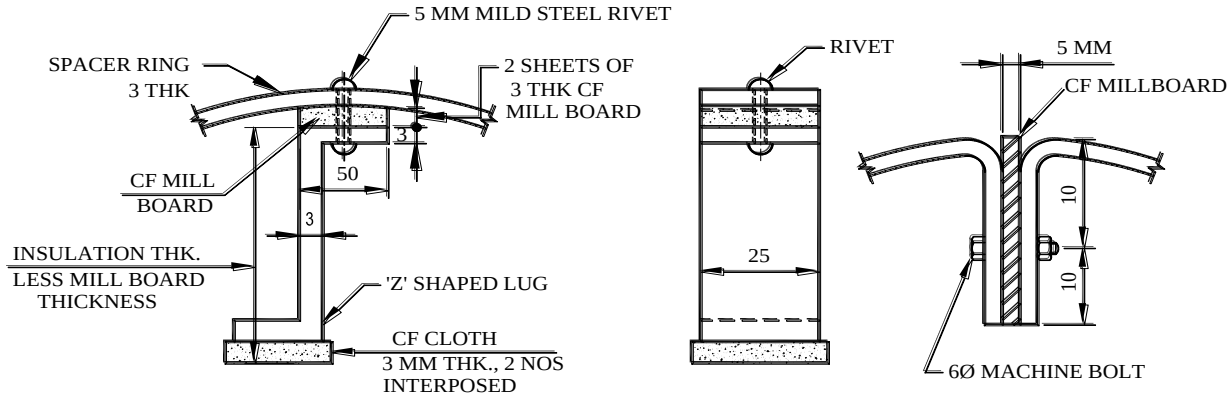

DETAIL OF SPACER RING

DRAWING NO.-12

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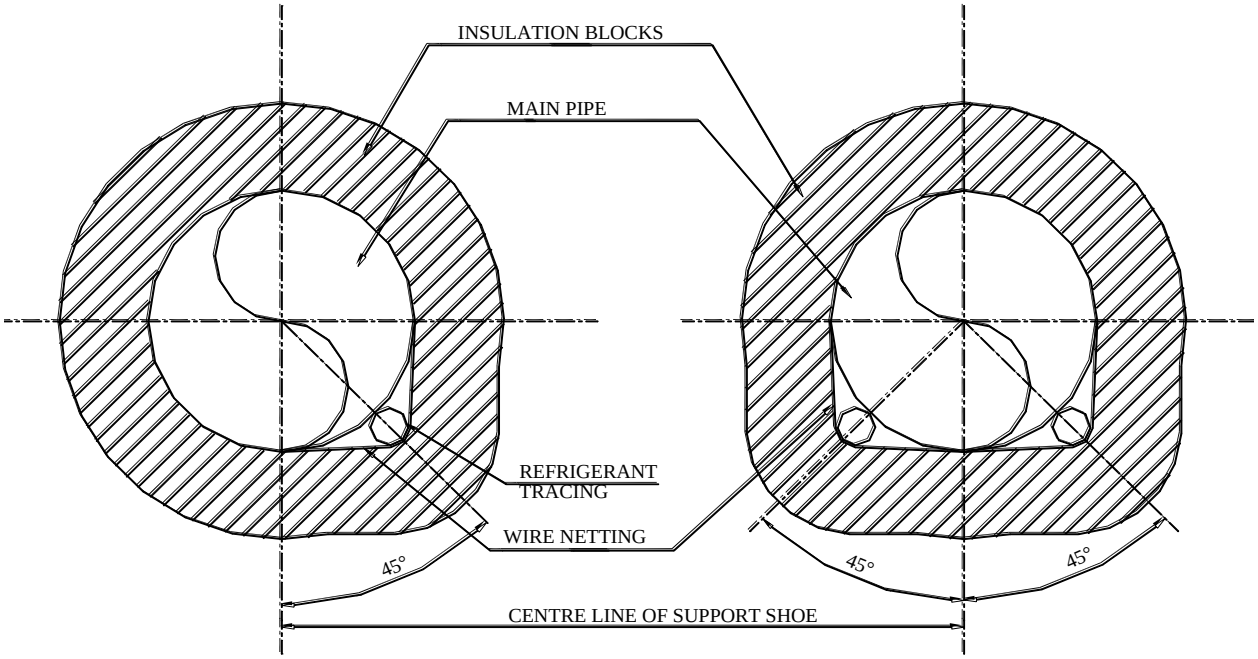
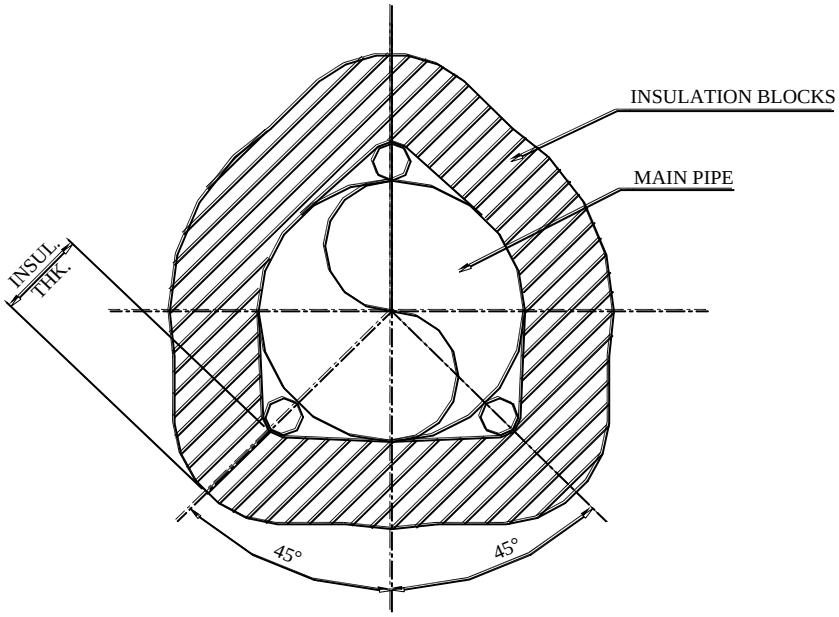


SINGLE TRACER DETAIL

DOUBLE TRACER DETAIL



TRIPLE TRACER DETAIL

REFRIGERANT TRACING INSULATION

DRAWING NO.-13

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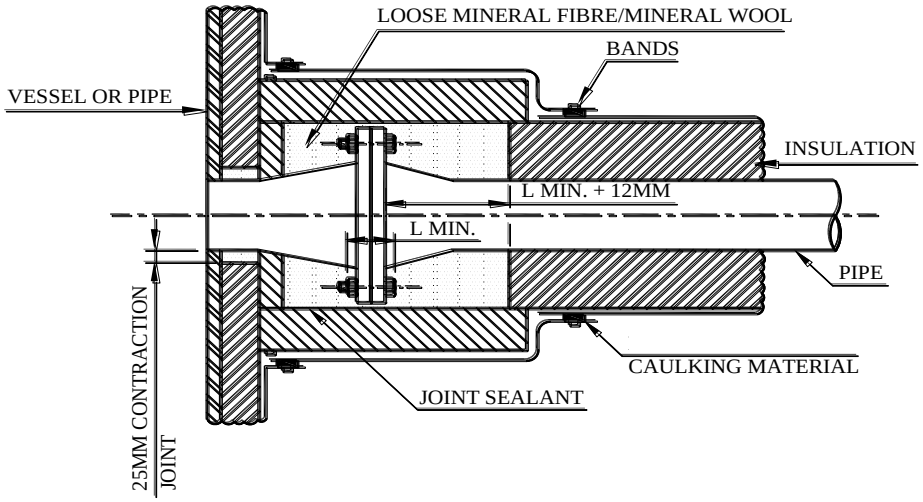

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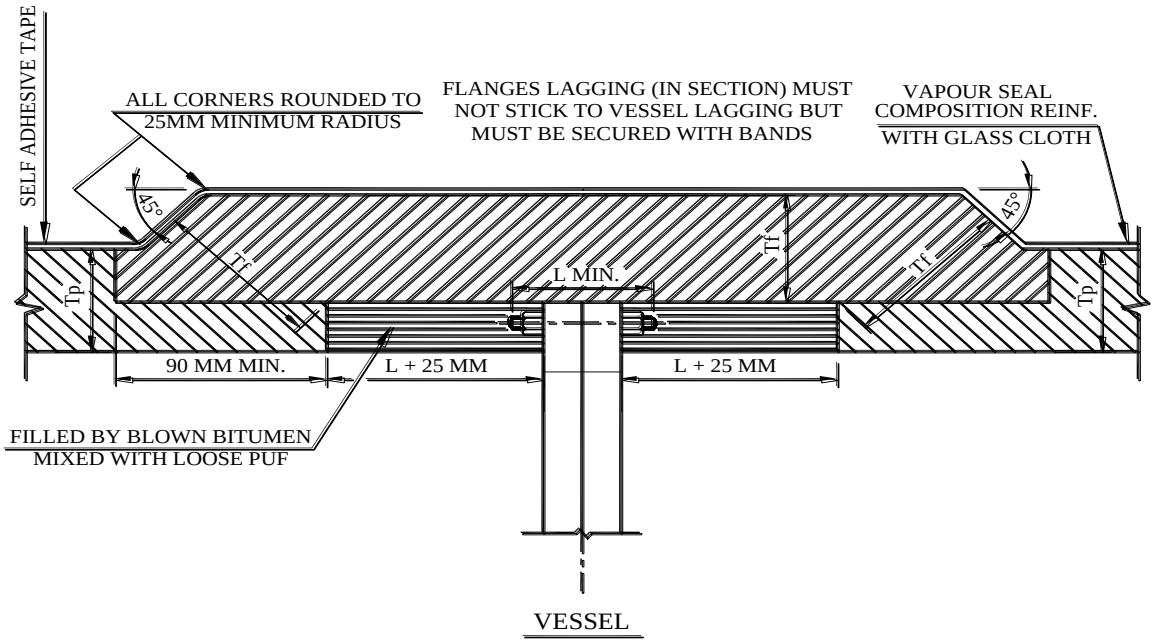

Tp = THICKNESS OF LAGGING ON PIPE OR VESSEL SHELL PLATE AND END PLATE

Tf = THICKNESS OF LAGGING ON PIPE FLANGE OR VESSEL FLANGE

Tf = Tp - 25 MM WHERE Tp>= 125 MM

Tf = 100 MM WHERE Tp IS BETWEEN 100 & 125 MM

Tf = Tp WHERE Tp <=100 MM

DRAWING NO.-14.2

METHOD OF LAGGING FLANGED JOINTS OF VESSEL

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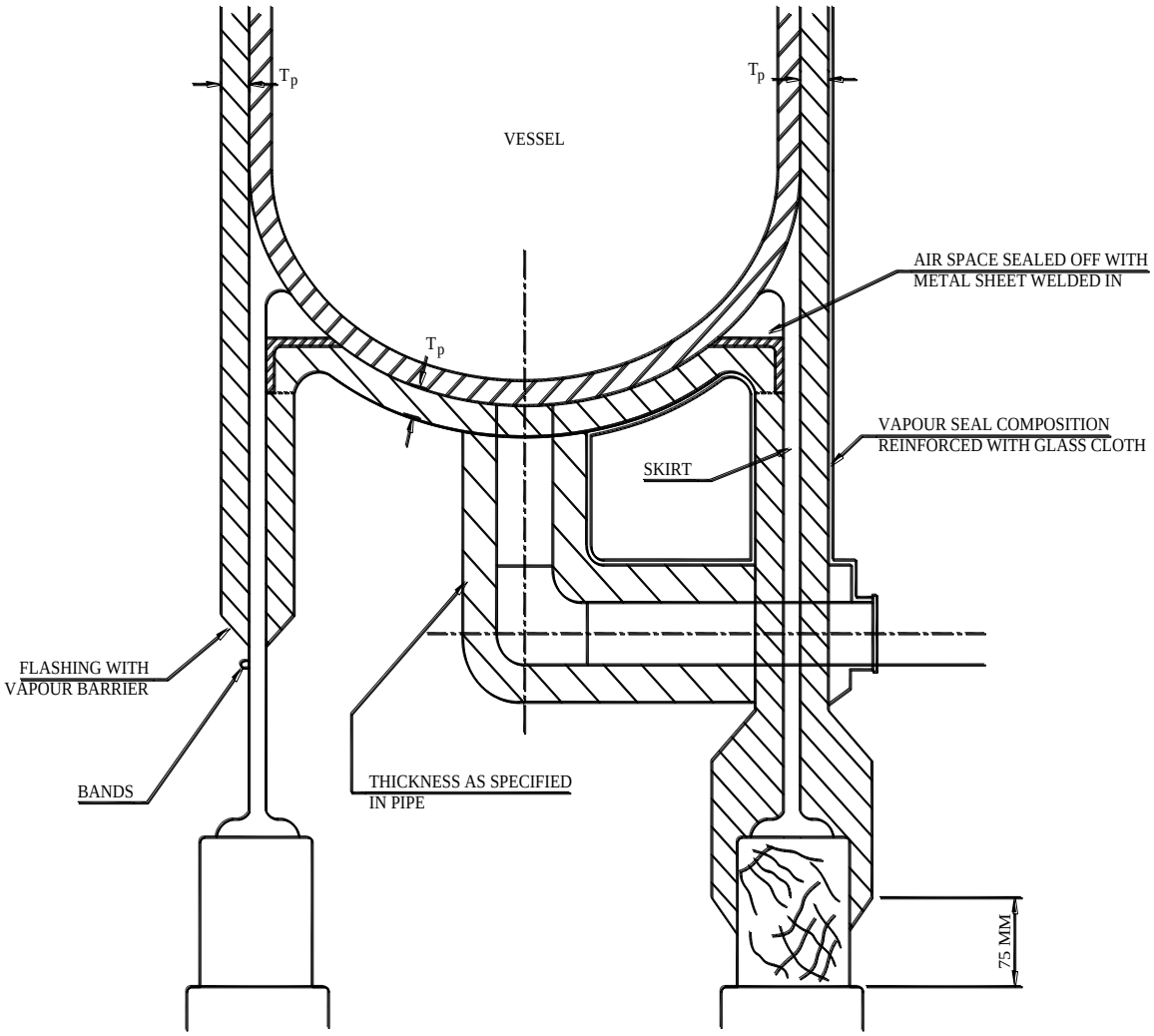

WOOD BLOCKS TO BE COATED ALL OVER WITH ADHESIVE BEFORE ASSEMBLY

T_p = THICKNESS OF VESSEL INSULATION

METHOD OF INSULATING VESSEL SKIRT

(ALTERNATIVE FOR HALF OR FULL INSULATION OF SKIRT)

DRAWING NO.-15

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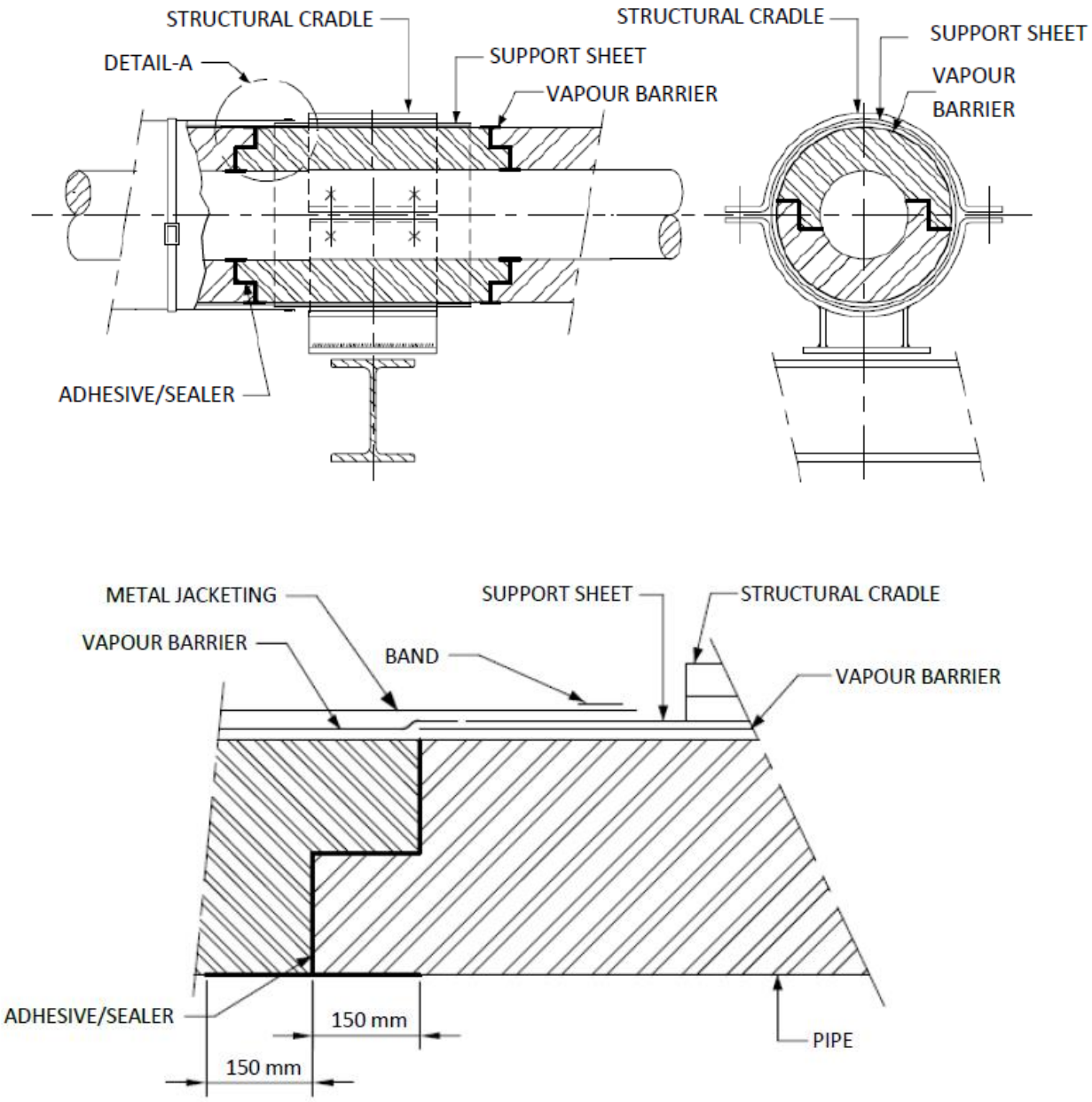

DETAIL-A

TYPICAL INSULATION DETAILS FOR PIPE SUPPORT

DRAWING NO.-16.1

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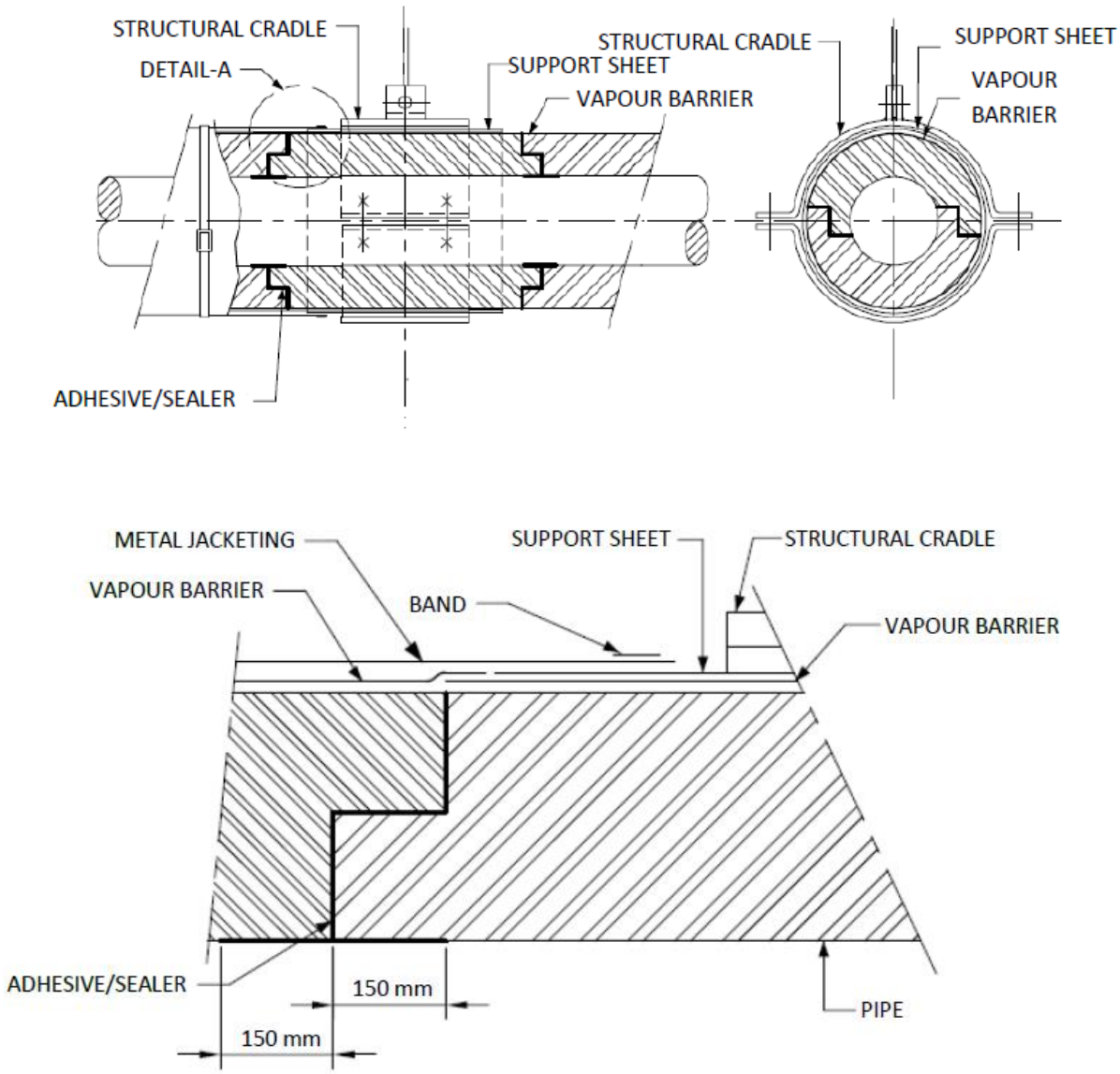

DETAIL-A

TYPICAL INSULATION DETAILS FOR PIPE HANGER SUPPORT

DRAWING NO.-16.2

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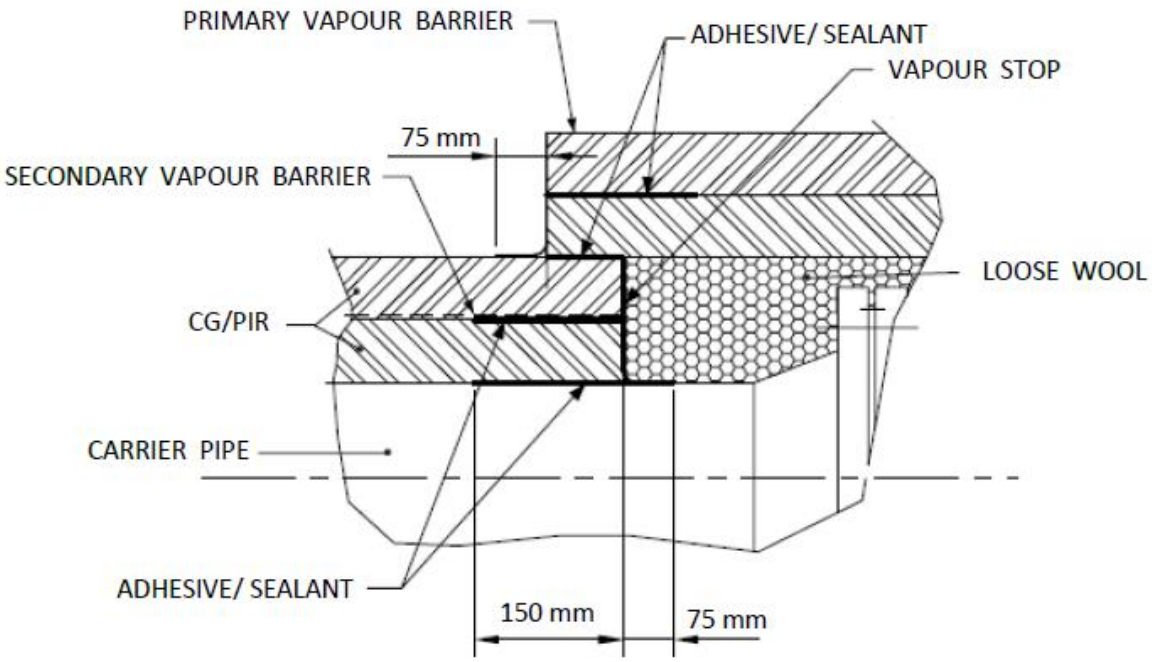
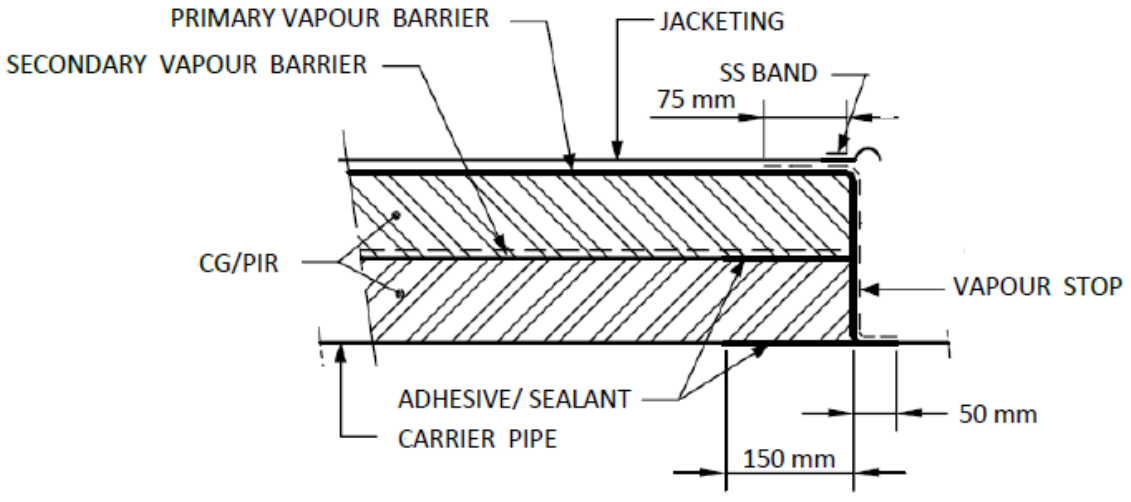


TYPICAL DETAILS FOR VAPOR STOP AT FLANGES AND VALVES

DRAWING NO.-17



TYPICAL DETAILS AT INSULATION TERMINATION

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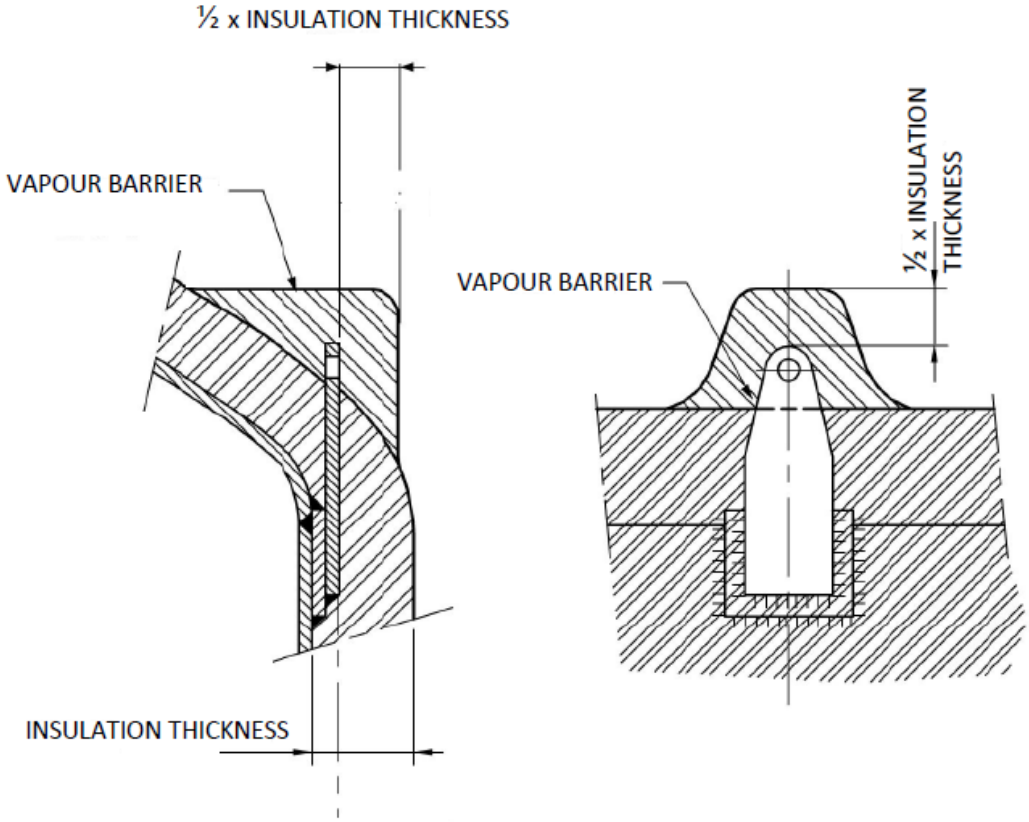

TYPICAL DETAILS FOR VESSEL LIFTING LUGS

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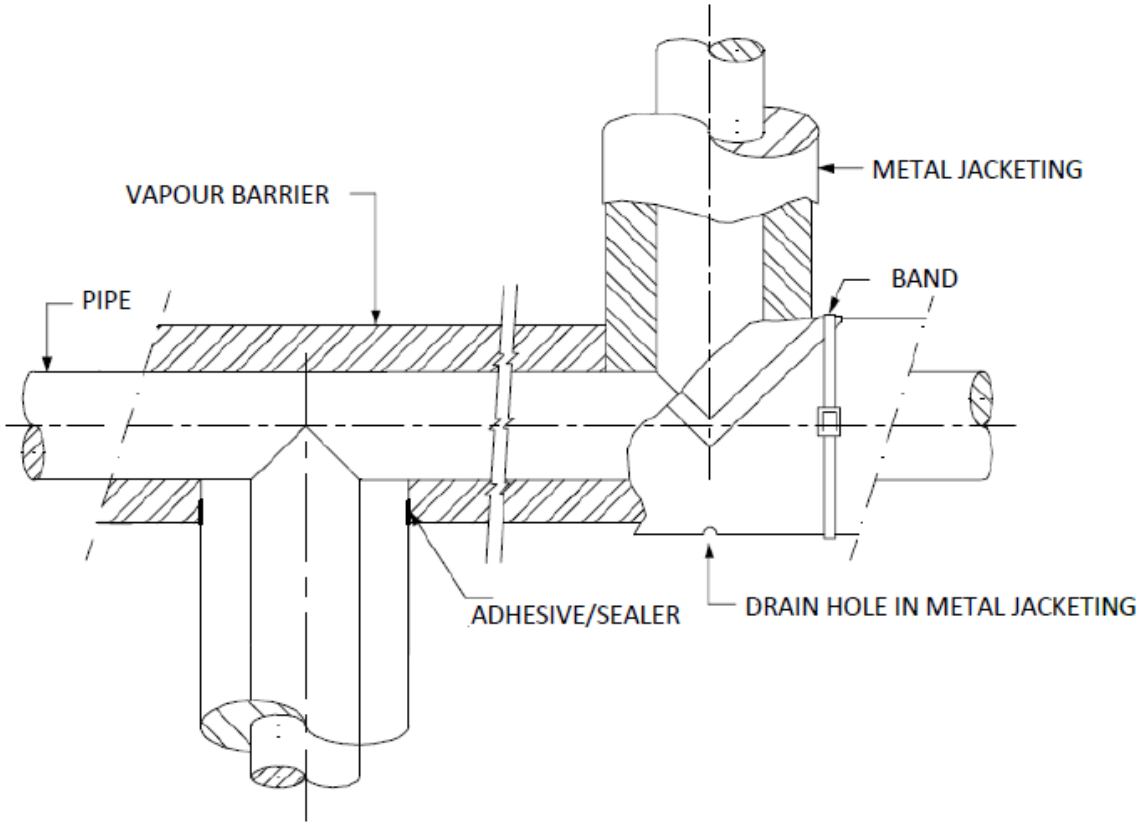

TYPICAL INSULATION DETAILS FOR T-PIECES (SINGLE LAYER)

DRAWING NO.-20.1

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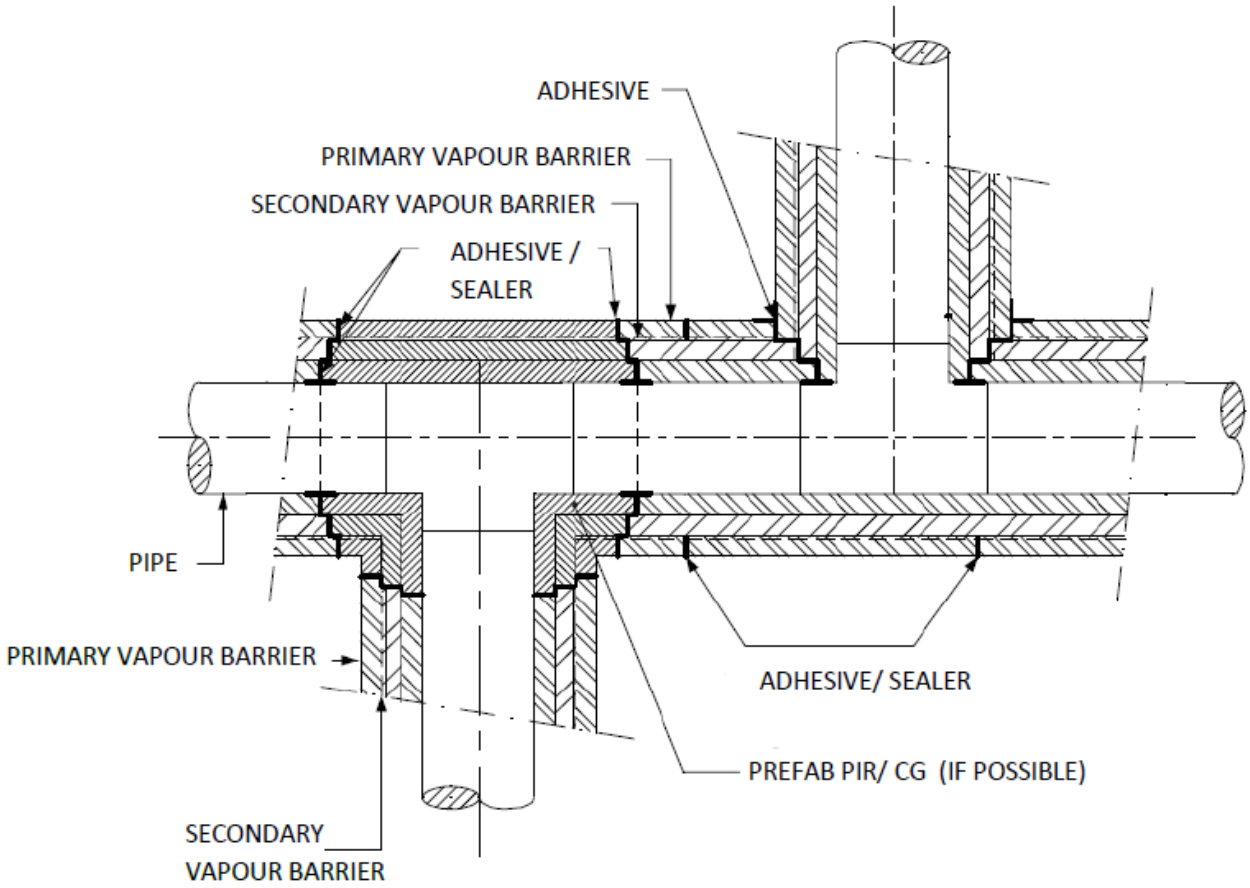

TYPICAL INSULATION DETAILS FOR T-PIECES (MULTIPLE LAYERS)

DRAWING NO.-20.2

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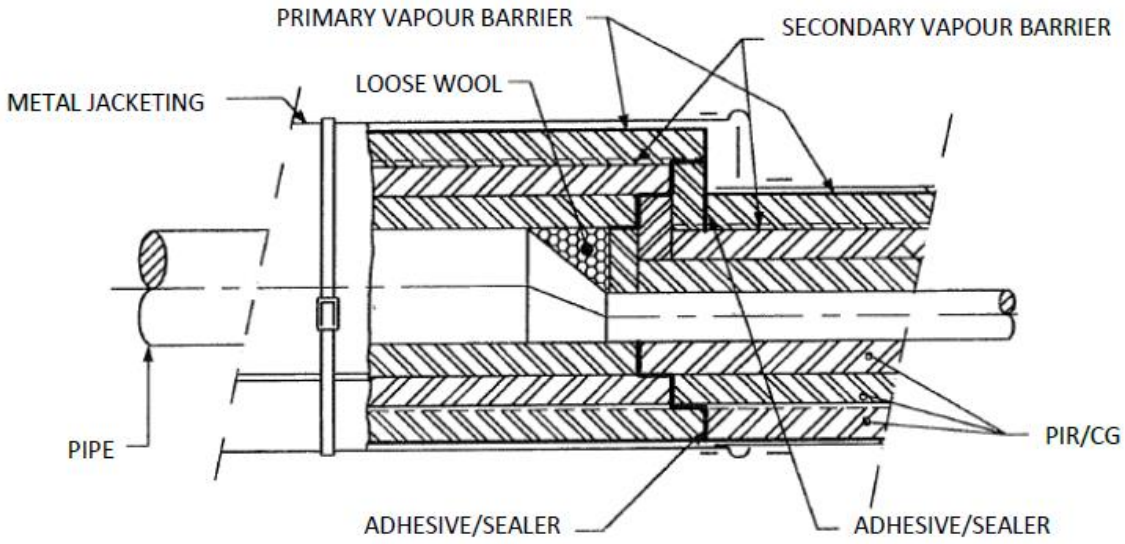
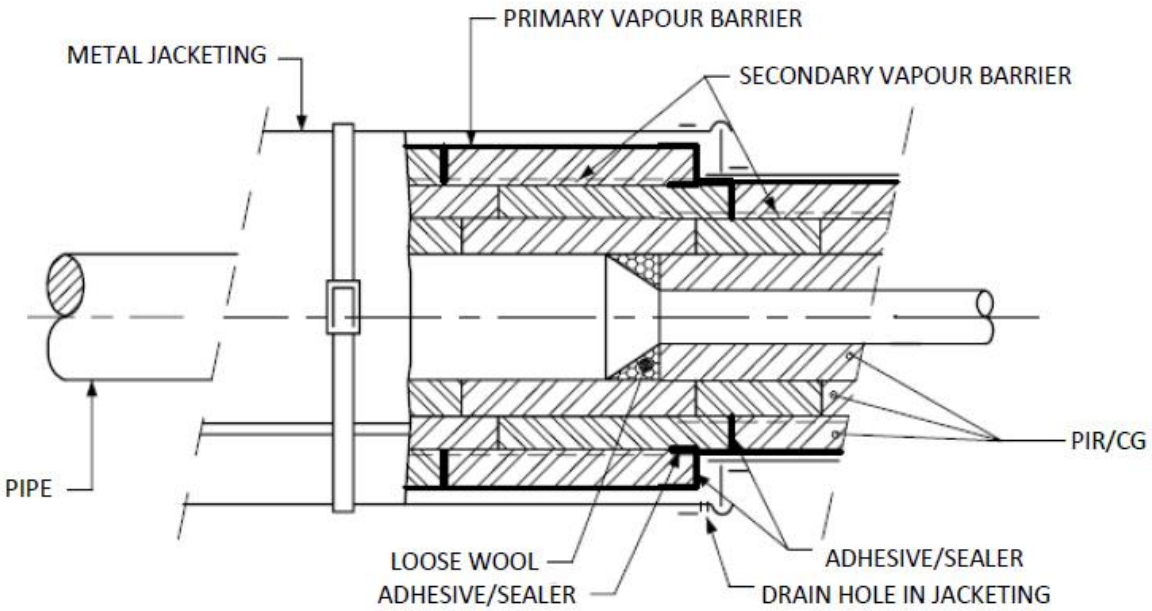


TYPICAL INSULATION DETAILS FOR ECCENTRIC REDUCER

DRAWING NO.-21.1



TYPICAL INSULATION DETAILS FOR CONCENTRIC REDUCER

DRAWING NO.-21.2

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रॉकवूल इन्सुलेशन के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR ROCKWOOL INSULATION

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	31-01-2024	ISSUED AS STANDARD SPEC.	SK	PP	PS	MN

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Abbreviations:

ASTM	:	American Society for Testing and Materials
IS	:	Indian Standard
min	:	shall indicate a minimum limit value
max	:	shall indicate a maximum limit value
SS	:	Stainless Steel
gsm	:	gram per square meter
ITP	:	Inspection Test Plan
IRN	:	Inspection Release Note
TPIA	:	Third party Inspection Agency

Refractory & Insulation Standards Committee

Convenor : Mr Prasenjit Saha

Members :
Mr Biswarup Sarkar
Mr P. Pal
Mr Udayan Chakravarty (Piping)
Mr Prag Goel (Fired Heaters)
Mr Ayush Mathur (Projects)
Mr Tarun Kumar (Equip Div)
Mr Neeraj Mathur (Inspection)
Dr Arijit Roy (Materials & Corrosion)
Mr Neeraj Rai (Pipeline)
Mr Indrajeet Neog (Construction)

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1.0 SCOPE

This standard specification outlines the technical requirements of Rock wool insulation products for external insulation of piping, vessels and equipment operating temperature from 27°C to 550°C for the purpose of heat conservation, personnel protection, fire safe and acoustic requirements.
Maximum use limit temperature referred above is based on EIL standard design practice followed over a period of time and do not refer the service temperature of material mentioned elsewhere in this specification.

2.0 GENERAL REQUIREMENTS

2.1 The term rock wool shall mean fibrous insulation wool made from natural rock and does not refer to products manufactured from slag or glass. Rock wool is a fibrous insulation made from molten rock, bonded with varying degree of resin or suitable binder. Rock wool is generally noncombustible and should not settle or shrink with age.

2.2 Rock wool shall meet the general classification of respective standards as mentioned below:

Rock wool type	Quality standard
Preformed pipe sections	ASTM C547 TYPE-II / IS 9842
Metal –mesh covered blanket	ASTM C592 CLASS-III/ IS 8183
Block and Board	ASTM C612/ IS 8183

2.3 Chemical and Physical test requirements

Rock wool insulation products shall meet the minimum technical requirements below specified in Table-1.

Table-1: Physical and Chemical Requirements of Rock wool Products

CHARACTERISTICS		MATERIAL TYPE		
		PIPE SECTIONS	BLANKET	BOARD & BLOCK
Service temperature (°C)		650	650	760
Nominal Density (kg/m^3), in acc. with ASTM C302 (pipe)/ ASTM C303 (Slab)/ASTM C167 (blankets)/IS 8183/IS 3144		140	128	192-320
Linear Shrinkage (%) at 550°C/ 24 hours as per ASTM- C-356, max.		2	2	2-4
Non fibrous shot (%) as per ASTM C-1335 / 3144, max		15	15	15
Water vapor sorption (%) as per ASTM C1104, max.		5	5	5
Compressive strength at 10% deformation (kPa) as per ASTM C165, min.		-	-	2.4 (Note-1)
Alkalinity, pH as per ASTM C-871		7-10	7-10	7-10
Leachable Chloride as per ASTM C-871, ppm, max.		10 (Note-2,3)	10 (Note-2,3)	10 (Note-2,3)
Test for incombustibility OR fire resistivity	Incombustibility as per 8183/IS 3144	Pass	Pass	Pass

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	OR Flame spread as per ASTM E84	25	25	25
Thermal Conductivity (W/mK) as per IS 3346 /ASTM C-177/ASTM C-518 at mean temperature, max.	(+) 100°C	0.052	0.052	
	(+) 200°C	0.070	0.068	
	(+) 250°C	0.085	0.080	
	(+) 300°C	0.10	0.090	
Note-1: When intended to use over tank roof the minimum compressive strength shall be 50kPa Note-2: Max. 20 ppm allowed for application over carbon steel and low alloy steel Note-3: Supplier shall provide Type test certificate no older than 2 years Note-4: Asbestos shall not be used as an ingredient or component part				

2.4 Additionally the product shall meet the following requirements:

a) For application over austenitic stainless steel, the material shall be zinc free and shall be inhibited with sodium silicate as per ASTM C-795.

b) For operating temperature up to 175°C and / or carbon steel / low alloy steel substrate metal mesh covered blanket shall have galvanized hexagonal shaped (25mm) wire-woven netting (min. 0.73mm dia.) on one side stitched with tie wires (min. 0.41mm dia.). Galvanization shall be minimum 30 gsm.

c) For operating temperature 176°C or above irrespective of the substrate, blanket metal facing shall be stainless steel as per ASTM A167 type SS304 with 25mm mesh and minimum wire diameter 0.8mm, stitched with 0.41mm dia. tie wire.

d) Irrespective of operating temperature for austenitic stainless steel and all Ni-alloys, Cu-Ni alloys and duplex stainless substrate, blanket metal facing shall be stainless steel as per ASTM A167 type SS304 with 25mm mesh and minimum wire diameter 0.8mm, stitched with 0.41mm dia. tie wire.

3.0 DIMENSIONS AND TOLERANCES

Rock wool insulation shall be supplied in the form of board, blankets, and pipe sections. Standard sizes of the board /block and pipe sections or segments shall be as per the respective standard specifications.
The average permissible variations for length, width and thickness shall be as follows:

Table-2: Dimensional tolerances for various Rock wool insulation products

Form of Insulation	Length (mm)	Width (mm)	Thickness	Inside Diameter
Block and Board	± 12.7	± 6.4	(-)1% or (-)2mm whichever is greater and (+) 3 mm	NA
Blankets	+ excess, -0	± 6	(-)1% or (-)2mm whichever is greater and (+) 3 mm	NA
Pipe sections	± 3mm	-	± 5% or ± 3mm whichever is greater	+ 4mm, -0

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4.0 INSPECTION & QUALITY CONTROL

Prior to dispatch, the insulation material shall be inspected by the Inspection Authority (TPIA or any other agency approved for certifying the quality) as per the approved 'Inspection test plan' (ITP). The ITP shall be prepared by the supplier and approved by competent authority (EIL or authorized agency) prior to inspection.

The ITP shall include reference of purchase order number and date, methods of tests followed, frequency of sampling, lot size and acceptance criteria with the permissible tolerances.

4.1 Sampling

a) Unless otherwise specified, the lot shall consist of all insulation material of same type, class, form, size and thickness produced under the same conditions (8 hours production).

b) The lot size for preformed board/block and pipe section shall be equal to the number of shipping packages. The lot size for blanket shall be based on the square-meter basis of material in a shipping packages. The test sample shall be randomly selected from the lot and tested for the conformity to the requirements of the specification. The lot size and sample size for preformed sections and blankets shall be as prescribed in Table-3 and Table-4 respectively.

Table-3: Sampling plan (Preformed Board / Block and Pipe Sections)

Lot Size (Shipping packages)	Sample Size (Shipping packages)
200	5
201-300	6
301-500	7
501-800	8
801-1300	9
1301 & Above	10

Table-4: Sampling plan (Blankets)

Lot Size (m^2)	Sample Size (Shipping packages)
1500 or less	5
1501 to 2500	6
2501 to 5000	8
5001 to 9000	13
9001 to 15000	15
15001 and Above	20

4.2 Inspection Test Plan

From each shipping package in the sample, test specimens necessary for carrying out the various tests specified in this standard for each form of material shall be taken are given in Table-5. The Inspection Authority (TPIA or any other approved agency) shall witness the minimum testing as per the Inspection Test Plan provided below.

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TABLE-5: INSPECTION AND TEST PLAN (ITP) FOR ROCK WOOL INSULATION

INSPECTION BODY		LEGEND		F- FREQUENCY	
1	Manufacturer	**I**- Inspection Point	**TC**-Test Certificate	**1**	Prior to start of Inspection
2	Contractor	**H**-Hold Point	**R**-Document Review	**2**	During Inspection
3	TPIA/EIL/Client	**W**-Witness Point		**3**	End of Inspection

Sl. No	Inspection Activity	Reference Documents	Acceptance Criteria	Extent of Inspection	Inspection responsibility			F
					1	2	3	
1	Document checking	Purchase order	-	-	**H**	-	-	**1**
2	Density	Approved data sheet	Compliance data sheet	5 specimen / Lot	**I, H**	**W**	**W**	**2**
3	Compressive strength (Note-1)	Approved data sheet	Compliance data sheet	5 specimen / Lot	**I, H**	**W**	**W**	**2**
4	Linear Shrinkage	Approved data sheet	Compliance data sheet	5 specimen / Lot	**I, H**	**W**	**W**	**2**
5	Non fibrous shot	Approved data sheet	Compliance data sheet	3 specimen / Lot	**I, H**	**W**	**W**	**2**
6	Water vapor sorption	Approved data sheet	Compliance data sheet	5 specimen / Lot	**I, H**	**W**	**W**	**2**
7	Thermal Conductivity (Note-2)	Approved data sheet	Compliance data sheet	1 specimen / Lot	**I, H TC**	**R**	**R**	**2**
8	Leachable Chloride	Approved data sheet	Compliance data sheet	3 specimen / Lot	**I, H**	**W**	**W**	**2**
9	Alkalinity, pH	Approved data sheet	Compliance data sheet	3 specimen / Lot	**I, H**	**W**	**W**	**2**
10	Incombustibility	Approved data sheet	Compliance data sheet	1 specimen / Lot	**I, H**	**W**	**W**	**2**
11	Flame spread Index (Note-2)	Approved data sheet	Compliance data sheet	1 specimen / Lot	**I, H TC**	**R**	**R**	**2**
12	Dimensional check	Purchase Order	Conformity report	Note-3	**I, H**	**W**	**W**	**2**
13	Quantity Verification	Purchase Order	Conformity report	-	**I, H**	**W**	**W**	**3**
14	Packing Inspection	-	-	Packing protection	**I, H**	**W**	**W**	**3**
15	Issue of Inspection Release Note (IRN)	-	-	-	**I, H**	**I, H TC**	**I, H TC**	**3**

Note-1: Compressive strength is applicable only for Rock wool Board & Block

Note-2: Independent laboratory test certificate no older than 2 years

Note-3: Apart from Physical / Chemical characteristic check, dimension check shall also be performed. The number of dimensional check shall be at the discretion of TPIA / EIL / Client. However, the minimum number of dimensional check shall be 10.

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4.3 Criteria for conformity

The acceptance/rejection criteria for material is determined by average physical and chemical properties for each sample, which shall fully meet the criteria enumerated in compliance datasheet produced by the manufacturer. In the event a sample fails to conform the specified requirements and test results are within 10% of the acceptable values, manufacturer may propose a re-testing program for the non-conformance batch or production run to Purchaser for approval. The retest shall be conducted using a new sample representing the same pallet(s) of the same batch of insulation as the failed sample. Use the same testing facility, testing procedure, and inspection methods. If the retest is unsuccessful, the material represented by the sample(s) shall not be used.

4.4 Certificate of conformity

The supplier shall furnish a 'certificate of compliance' along with the certified material test record after the inspection. The certified material test record should contain the following information as minimum:

- ✓ Name of the manufacturer
- ✓ Certificate number and date of issue
- ✓ Material specification/designation
- ✓ Production batch /code number (Lot, control number)
- ✓ Quantity
- ✓ Purchaser's reference number
- ✓ Test and Inspection results
- ✓ Name, designation and signature of person authorizing the certificate

5.0 PACKING AND MARKING

The Rock wool insulation materials shall be packaged for shipment such as to ensure that the material will not be damaged by weather humidity and normal handling during shipment. The certified material/conforming material shall be clearly marked either on the product or on the label or on the packing with the following information:

- ✓ Product name and other identifying characteristics (grade, dimensions etc.)
- ✓ Purchase order number
- ✓ Quantity
- ✓ Date of manufacturing
- ✓ Manufacturer name, address and telephone number
- ✓ Destination
- ✓ Country of origin

6.0 STORAGE

The material shall be stored in warehouse or dry covered area to avoid water ingress or moisture. Storage shall be on an elevated, ventilated platform. Moisture shall be directed away from the insulation material.

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7.0 REFERENCE CODES & STANDARDS

ASTM Standards and Specifications

ASTM C165	Measuring Compressive Properties of Thermal Insulations
ASTM A167	Specification for Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet and Strip
ASTM C177	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
ASTM C302	Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation
ASTM C303	Standard Test Method for Dimensions and Density of Preformed Block and Board–Type Thermal Insulation
ASTM C356	Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat
ASTM C390	Standard Practice for Sampling and Acceptance of Thermal Insulation Lots
ASTM C518	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C547	Standard Specification for Mineral Fiber Pipe Insulation
ASTM C592	Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C612	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C795	Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C871	Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
ASTM C1104	Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
ASTM C1335	Standard Test Method for Measuring Non-Fibrous Content of Man-Made Rock and Slag Mineral Fiber Insulation
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials

EIL Standards and Specifications

6-79-0022	Standard Specification for Acoustic Insulation
6-79-0026	Standard Specification for Hot Insulation of Vessels, Piping and Equipment

IS Standards and Specifications

IS 3144	Mineral Wool Thermal Insulation Materials-Method of Test
IS 3346	Method for the Determination of Thermal Conductivity of Thermal Insulation Materials (Two Slab, Guarded Hot Plate Method)
IS 8183	Bonded Mineral Wool-Specification
IS 9842	Preformed Fibrous Pipe Insulation Specification

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विक्रेता कार्यशाला में सकारात्मक सामग्री पहचान के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION (PMI) AT SUPPLIER'S WORKS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	23.12.21	REVISED AND RE-ISSUED	HKM	CS	RK	S Majumdar
3	19.09.16.	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
2	20.10.11	REVISED AND RE-ISSUED	RKS	SCG	AKC	DM
1	15.07.08	REVISED AND RE-ISSUED	NKR	SSL	SKP	VC
0	07.12.00	ISSUED AS STANDARD SPECIFICATION	AKC	AKB	AKB	MI

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Abbreviations:

API	:	American Petroleum Institute
AS	:	Alloy Steel
HIC	:	Hydrogen Induced Cracking
LSTK	:	Lump Sum Turn Key
NACE	:	National Association of Corrosion Engineers
PMI	:	Positive Material Identification
RTJ	:	Ring Type Joint
Sch	:	Schedule
SS	:	Stainless Steel
TPI or TPIA	:	Third Party Inspection Agency

Inspection Standards Committee

Convenor: Mr. Rajeev Kumar

Members: Mr. Rajesh Sinha
Mr. Himangshu Pal
Mr. R. Muthuramalingam (RPO Representative)
Mr. Chandrashekhar
Mr. Avdhesh Agrawal
Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal

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1.0 SCOPE

1.1 This specification applies to the requirements for Positive Material Identification (PMI) to be performed at the Supplier's works on Metallic Materials procured either directly by the Owner/EIL/ LSTK contractor or indirectly through the sub-Suppliers.

1.2 This specification covers the procedures and methodology to be adopted to assure that the chemical composition of the material is consistent with the material specifications as specified in purchase documents using 'Alloy Analyzer' at the time of final inspection before dispatch.

1.3 The scope of this specification shall include but shall not be limited to Positive Material Identification (PMI) to be performed on Materials listed below:

1.3.1 For alloy Steel materials as below:

- Alloy Steel Pipes including Clad Pipes
- Alloy Steel Flanges & Forgings
- Alloy Steel Fittings including Clad Fittings
- Alloy Steel Fasteners
- Alloy Cast & Forged steel valves
- Alloy Steel Instrumentation Items (Control Valves, Safety Valves etc.)
- Longitudinal Pipe & Fittings Welds.
- Gaskets (for Ring Type Joints)

1.3.2 For Carbon Steel materials as below:

- All Carbon Steel Piping items under NACE or HIC or H2 or Wet Hydrogen Sulfide (H_2S), Hydrofluoric acid (HF), Sulfuric acid (H_2SO_4) services etc.
- Carbon Steel flanges and valves (Rating 900# and above)
- LTCS items

Following items shall be excluded from scope of PMI examination.

- Gaskets other than for Ring Type Joints
- Internal Components of Valves

1.4 All grades of material supplies including Stainless Steels shall be liable for PMI test at site. In case of any defective materials being found at site, the Supplier shall be responsible to effect replacement of such defective materials at project site without any delays to the satisfaction of EIL site RCM (Resident Construction Manager).

2.0 REFERENCE DOCUMENTS

2.1 API Recommended Practice 578 (Third Edition, Feb 2018) - Material Verification Program for New and Existing Alloy Piping Systems.

3.0 DEFINITIONS

3.1 **Supplier:** Any Supplier or Manufacturer on whom an order is placed for the supply of referred items. This definition shall also include any sub-Supplier or manufacturer on whom a sub-order is placed by the Supplier.

3.2 **Inspection Lot:** A group of items offered for inspection covered under same size, Heat and Heat treatment lot.

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3.3 **Alloy Material:** Any metallic material (including welding filler materials) that contains alloying elements such as Chromium, Nickel, Molybdenum or Vanadium, which are intentionally added to enhance mechanical or physical properties and/or corrosion resistance.

4.0 PMI EXAMINATION

4.1 The Supplier shall submit a procedure of PMI to comply with the requirements of this Specification. Approval of PMI Procedure shall be obtained from Owner / EIL / TPIA prior to commencing manufacture / inspection of product.

4.2 PMI examination of materials is independent of any certification, markings or colour coding that may exist and is aimed at verifying that the alloy used are as per specified grades.

4.3 The Supplier shall identify all incoming alloy materials and maintain full traceability of all alloy
materials, including all off-cuts. Transfer of identification marks shall be undertaken prior to cutting to ensure maintenance of identification on off-cuts.

4.4 The Supplier shall ensure that all alloy materials are segregated and stored in separately identified locations to prevent the mix up of materials of different alloy specifications or alloy material with carbon steel. Non ferro-magnetic materials shall be segregated at all times from ferro-magnetic materials.

4.5 PMI examination is subject to surveillance inspection by Owner / EIL / TPIA.

5.0 ACCEPTABLE METHODS FOR PMI

5.1 The method used for PMI examination shall provide a quantitative determination of the alloying elements like Chromium, Nickel, Molybdenum or Vanadium in Alloy Steel items.

5.2 Instruments or methods used for PMI examination shall be able to provide quantitative, recordable, elemental composition results for positive identification of alloying elements present.

5.3 The acceptable instruments for alloy analyzer shall be either "Portable X-Ray fluorescence" or "Optical Emission" type each capable of verifying the percentage of alloy elements within specified range.

5.4 Chemical spot testing, magnets, alloy sorters and other methods using eddy current or triboelectric testing methods are not acceptable for PMI examination.

5.5 The PMI instrument used shall have the sensitivity to detect the alloying elements in the specified range.

5.6 All PMI instruments shall have been serviced within a 6 month period of the time of use to verify the suitability of batteries, sources etc., and the data of the last service shall be stated on the PMI Report Form (Sample enclosed).

5.7 Each analyzer must be calibrated according to the manufacturer's specification at the beginning and end of each shift. Instrument must be checked against known standard for each alloy type to be inspected during the shift.

5.8 Certified samples, with full traceability, of a known alloy materials shall be available for use as a random spot check on the instrument calibration.

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5.9 The surfaces to be examined shall be prepared by light grinding or abrasive paper and solvent cleaner. Evidence of Arc burn resulting from examination shall be removed by light grinding or abrasive paper. No permanent marks, which are injurious to the usage of product in service, are acceptable.

5.10 Alloy Steel ring type joint Gaskets shall be inspected by using portable X-Ray fluorescence instrument.

5.11 Testing shall be done as per the procedures outlined by the manufactures of alloy analyzer being used. Modification of these procedures if any must be approved by Owner/EIL.

5.12 The persons performing PMI shall demonstrate their capabilities to the satisfaction of Owner/EIL/TPIA visiting engineer. If the Supplier has qualified operator on their rolls, he may perform the examination. Otherwise PMI examination shall be sub-contracted to an independent testing agency approved by EIL.

5.13 Whenever material is identified as not meeting requirements by the visiting engineer a rejection note shall be issued.

6.0 EXTENT OF PMI EXAMINATION

Following sampling plans shall be applicable for PMI examination of various items.

A. Flanges, Fittings Valves, RTJ Gaskets - 100% by Supplier and 10% @ random witness by EIL/TPIA

B. Pipes - 100% (for pipes procured from traders)
2 random samples drawn from each Size/Heat/Lot (for pipes procured directly from mills)

C. Fasteners -

Lot Size	**Sample Size for** EIL/TPIA	Sample size for Supplier
Upto 100	2% (Min 2)	Min 10%
101 to 500	1% (Min 3)	Min 10%
501 and above	0.5% (Min 5)	Min 10%

Note:

a. For Welded Pipes and Fittings and flanges like Fig 8, Spacer and blinds etc. PMI shall be performed on Base Metal as well as weldments.

7.0 ACCEPTANCE CRITERIA

7.1 Base Metal

PMI test results showing presence of characteristic elements upto 10% less than the minimum specified value in the material specification and upto 10% more than the maximum specified value in the material specification shall be acceptable.

7.2 Deposited Weld Metal

For deposited weld metal using welding consumables matching with base metals, the recorded presence of characteristic elements upto 12.5% less than the minimum specified value in the

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welding consumable specification and upto 12.5% more than the maximum specified value in the welding consumable specification shall be acceptable.

8.0 REJECTION CRITERIA

8.1 If PMI test results fall outside the acceptable range as specified in 7.0 above, the supplier shall obtain a quantitative check analysis performed by a laboratory acceptable to Owner / EIL / TPIA for a complete chemical analysis. Alternatively, the item can be tested with a spark analyser for verification. Results of this analysis shall be submitted to Owner / EIL / TPIA for final decision.

Decision of Owner / EIL / TPIA shall be final in this regard.

8.2 If any sample drawn to PMI test on the basis of percentage selection as per 6.0 above, fails to meet specification requirements, 100% of items of lot shall be tested for PMI by supplier. Any failure thereafter during sample check shall mean rejection of whole lot.

9.0 RECORDING AND DOCUMENTATION

The results of PMI examination shall be recorded in a Report Format as enclosed with this specification.

10.0 MARKING

10.1 All alloy materials tested by PMI shall be identified using either of the following methods by indicating "PMI OK"

a) Bar Code/Hologram Sticker
b) A low stress stamp marking

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	POSITIVE MATERIAL IDENTIFICATION REPORT BULK MATERIALS								Page of
Project:			Client						Job No.
PMI Report No.			Supplier/Sub-Supplier						
Purchase Order No.			Testing Agency						
Purchase Requisition No:			PMI Location						
Bulk Item Type (as per Requisition)									
Material Specification/Grade Number of items in Lot									
Requisition Item No./ Description			Major content, Weight Percent						Remarks Accept/Reject
Element	Cr	Ni	Mo	V	Ti *	Cb/ Nb **	Mn ***		
Specified Range									
Actual observations 1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
Instrument Type / ID Last Service Date		Inspection Agency							Witnessed By

* To be reported in case of SS321 Material
** To be reported in case of SS347 Material
*** To be reported in case of LTCS Material

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निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
WELDED PIPES

Rev. No.	Date	Purpose	Prepared By	Checked By	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	23.12.2021	REVISED AND RE-ISSUED	HKM	CS	RK	S Mazumdar
5	19.09.2016	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
4	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
3	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
2	30.06.2010	REVISED AND RE-ISSUED	RKB	VKJ	SKP	ND

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. P V Satyanarayana (Engg. Representative)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements for Welded Pipes.

2.0 REFERENCE DOCUMENTS

PO/PR/Standards referred therein/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	Hydrostatic Test, Heat Treatment, NDT and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS,PQR & WPQ (Approved under EIL/Reputed TPIA)	Welding Parameters & Qualification Record	100%	WPS,PQR &WPQ	-	H	W- New R- Existing (Qualified under reputed TPIA)
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Review of MTC for Chemical & Mechanical Properties	100%	Test Certificates	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	**In Process Inspection**						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Heat Treatment	Stress Relieving, Normalizing, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart	-	H	R
3.3	Ferrite Check of SS Pipes (as Applicable) Before HT	% Ferrite Check	Random On Weld	Inspection Report	-	H	R
3.4	UT / RT As applicable	Surface & Internal Imperfections	PR / Purchase Specification	RT Films, Reports & UT Reports	-	H	R (Film review for RT)
3.5	TPM (Identification of Test Samples)	Product analysis, Tensile, Hardness, Impact, IGC and Other test as applicable	Lot as per specification.	Test Reports	-	H	H
3.6	Product Analysis	Chemical Composition	PR / Purchase Specification	Test Reports	-	H	R
3.7	Destructive Testing	Tensile (0.2 Offset/0.5% extension under load), Hardness, Impact, IGC and Other test as applicable	Lot as per specification.	Test Reports	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.8	Galvanizing (If Applicable)	Integrity Of Galvanized Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic Testing	Leak Check	100%	Test Report	-	H	RW (Min.5%)
4.2	Visual and Dimensional Inspection (VDI)	Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Profile Thickness, Length, End Finish, Marking etc	100%	Inspection Report	-	H	RW (Min.5%)
4.3	Weight Checking as applicable	Weight	100%	Inspection Report	-	H	-
4.4	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW
4.5	Final Stamping	Stamping of Accepted Pipes	Stamping of Pipes which are witnessed by EIL/TPIA.	Inspection Report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Rust Preventive Coating & Color Coding (As applicable)	Visual & Color Coding as applicable	100%	Inspection Report	-	H	-
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Manufacturer TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.
3. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN10204 type 3.2 certification from EIL approved suppliers.

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निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
SEAMLESS PIPES

Rev. No.	Date	Purpose	Prepared By	Checked By	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
6	23.12.2021	REVISED AND RE-ISSUED	HKM	CS	RK	S Majumdar
5	19.09..2016	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
4	17.06..2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
3	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
2	30.06.2010	REVISED AND RE-ISSUED	RK	VKJ	SKP	ND

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R. Muthuramalingam (RPO Representative)
Mr. Chandrashekhar	Mr. Avdhesh Agrawal	Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Seamless Pipes.

2.0 REFERENCE DOCUMENTS

PO/PR/Standards referred therein/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
1.0	**Procedure**						
1.1	Hydrostatic Test, Heat Treatment, NDT and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Review of MTC for Chemical, Mechanical Properties, size & steel making process, etc.	100%	Test Certificates	-	H	R
3.0	**In Process Inspection**						

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
3.1	Heat Treatment	Normalizing, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart	-	H	R
3.2	NDT As applicable	Surface & Internal Imperfections	PR / Purchase Specification	NDT Reports	-	H	R
3.3	TPM (Identification of Test Samples)	Product analysis, Tensile ((0.2 Offset/0.5% extension under load),), Hardness, Impact, IGC and Other test as applicable	Lot as per specification	Test Reports	-	H	H (Note-1)
3.4	Product Analysis	Chemical Composition	Lot as per specification	Test Reports	-	H	R
3.5	Destructive Testing	Tensile, Hardness, Impact, IGC and Other test as applicable	Lot as per specification	Test Reports	-	H	H (Note-1)
3.6	Galvanizing (If Applicable)	Integrity of Galvanised Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic Testing	Leak Check	100%	Test Report	-	H	RW (Note 1)

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
4.2	Visual and Dimensional Inspection (VDI)	Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking, End Caps etc	100%	Inspection Report	-	H	RW (Note 1)
4.3	Weight Checking as applicable	Weight	100% By Supplier	Inspection Report	-	H	-
4.4	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW
4.5	Final Stamping	Stamping of Accepted Pipes	Stamping of Pipes which are witnessed by EIL/TPIA..Other pipes to have suppliers identification	Inspection Report	-	H	H

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
5.0	**Painting**						
5.1	Rust Preventive Coating & Color Coding (As applicable)	Visual & Color Coding as applicable	100%	Inspection Report	-	W	-
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate(IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. Carbon Steel Pipes (Other than LTCS & Pipes for special services like NACE, H2, HIC, etc.) up to size 12" will be accepted on review of Supplier Test Certificates. Supplier Test Certificate to be reviewed by EIL/TPIA.
2. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable (Unless otherwise agreed upon).
3. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.
4. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN10204 type 3.2 certification from EIL approved suppliers.

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निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
VALVES

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	08.05..2023	REVISED AND RE-ISSUED	NK	AK	RK	SM
6	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
5	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
4	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
3	30.06.2010	REVISED AND RE-ISSUED	RKB	VKJ	SKP	ND
2	31.01.2008	REVISED AND RE-ISSUED	CS	SS	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Ms Sulakshna Hundekari (Piping)	

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Valves.

2.0 REFERENCE DOCUMENTS

PO/PR/Standards referred therein/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	Hydrostatic Test, Heat Treatment, NDT, Helium Leak Test, Fugitive Emission Test, Internal/ External Coating Procedures & Other Procedures (Wherever applicable as per MR/ PR)	NDT Level III Approved Documented Procedures	100%	NDT Level III Approved Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ and NDT operator Qualification Record	Welding Parameters & Qualification Record	100%	WPS, PQR &WPQ	-	H	W- New R- Existing

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.3	Pre-Qualification Tests	Fire safe, Cryogenic, Fugitive Emission Test, Internal Epoxy Coating, Glass Lined Coating & Other Test as applicable	As per PR / Purchase Specification	Acceptance Report	-	H	H (If new)
2.0	**Material Inspection**						
2.1	Castings & Forgings (Body, Bonnet, Disc, Stem, Body ring)	Chemical, Mechanical (Tensile, Hardness, Impact Test etc.), Heat Treatment, NDT, IGC & Other Properties as applicable	100%	Test Certificates	H	R	R
2.2	Castings & Forgings (Body, Bonnet, Disc, Stem, Body ring)	Visual & Dimension	100%	Inspection Report	H	H	-
2.3	Body and Bonnet Castings	Radiography Examination after Heat Treatment	As per PR / Purchase Specification	RT Films and NDT reports	H	R	R
2.4	Bars for Trim material	Chemical Analysis	Each Heat	Test Certificates & Lab Report	H	R	-

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.5	Gaskets, Gear units, Fasteners, Gland, Packings, etc.	Physical / Chemical Properties	100%	Test Certificates & Lab Report	H	R	-
2.6	Actuators as applicable	Performance, Statutory Certificates etc. As per EIL ITP. 6-81-1091	100%	Test Certificates, Inspection report	H	H	R
3.0	**In Process Inspection**						
3.1	Welding, Weld Overlay, Stelliting, Hardfacing (As applicable)	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Machining of components	Visual / Dimension	100%	Inspection Reports	-	H	-
3.3	DP Test for all weld joints, Bevel Ends & Bypass (as applicable)	Dye Penetrant Test	100%	NDT Report	-	H	RW
3.4	Hardness Check	Heat Treat Castings, Weld Joints, Grove Joints etc.	100%	Inspection Reports	-	H	R
4.0	**Final Inspection**						

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	a. Shell Hydrotest b. Seat Hydro Test (Both Sides) c. Backseat Hydrotest (Gate & Globe Valves) d. Seat Pneumatic/ Air Test	Leak Check	100%	Pressure Test Report, Water quality Report		H	RW (Note 1)
4.2	Helium Leak test / Vacuum Test (as applicable)	Leak Check	As per PR / Purchase Specification	Test Report	-	H	RW (Note 1)
4.3	Visual & Dimensional Check	Surface Verification & Dimension Measurement	100%	Test Report	-	H	RW (Note 1)
4.4	Functional Test for Motor/ Actuator Operated Valves	Satisfactory Performance	100%	Test Report	-	H	RW
4.5	Marking Verification	Verification of Marking, Valve Tagging & Name Plate Checking	100%	Marking & Tagging Report		H	RW (Note-1)
4.6	PMI Check	Chemical Check	As per EIL Spec. 6-81-0001	PMI Report	-	H	RW

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.7	Strip Check (As applicable)	Verify Components for wear, damage , harmful defects & Differential hardness as applicable	As per PR / Purchase Specification	Inspection Report	-	H	RW (Note-1)
4.8	Final Stamping	Stamping of Accepted Valves	Stamping of Valves which are witnessed by EIL/TPIA.	Inspection Report	-	H	H (Note-1)
5.0	**Painting**						
5.1	Painting/ Pickling & Passivation and Color coding as applicable	Visual / DFT Check	100%	Inspection Report	-	H	-
6.0	**PACKING & PROTECTION**						
6.1	Packing & Protection	Dispatch Instructions as per Technical Notes for Valves	100%	Compliance Report with photographs		H	RW
7.0	**Documentation & Inspection Certificate**						

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
7.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. Non NACE & Non Hydrogen service Carbon Steel Cast Valves up to size 12"-300ANSI Class and Carbon Steel Forged Valves up to size 1.5"- 800 ANSI Class will be accepted on review of Supplier Test Certificates.
   Supplier Test Certificate along with back up reports to be reviewed by EIL/TPIA.
2. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon)
3. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.

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फ्लैंजो, स्पैक्टेकल ब्लांइडों एवं ड्रिप रिंगों के लिये निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR FLANGES, SPECTACLE BLINDS & DRIP RINGS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	22.02.2024	REVISED AND RE-ISSUED	BBK	PW	RK	MN
5	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
4	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
3	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM

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DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
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ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor: Mr. Rajeev Kumar

Members:

Mr. Chandrashekar	Mr. G Suresh	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Ms. Sulakshna Hundekari (Engg.)	Mr. Anil Kumar

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Flanges, Spectacle Blinds & Drip Rings.

2.0 REFERENCE DOCUMENTS

PO/PR/Standards referred therein/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	Heat Treatment, NDT, PMI , IGC, Mechanical, Chemical testing and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W- New R- Existing
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Chemical & Mechanical Properties	100%	Test Certificates	-	H	R

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	**In Process Inspection**						
3.1	Welding / Forging	Forging /Welding Parameters	100%	Inspection Reports	-	H	-
3.2	Heat Treatment	Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment etc., as applicable	100%	HT chart	-	H	R
3.3	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC (Per heat/ Heat Treatment lot) and Other tests, as applicable	100%	Test Reports	-	H	H
3.4	Product Analysis (As applicable)	Chemical Composition	As per PR/Purchase Specification	Test Reports	-	H	R
3.5	Destructive Testing	Mechanical, Impact, IGC and Other tests, as applicable	100%	Test Reports	-	H	H
3.6	NDT as applicable	Surface & Internal Imperfections	As per PR/Purchase Specification	NDT Reports	-	H	R

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.7	Galvanizing (If Applicable)	Integrity of Galvanised Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Final Inspection	1. Visual 2. Dimensions 3. Hardness 4. Marking etc.,	100%	Inspection Report	-	H	H (Note-1,2)
4.2	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW
4.3	Review of Calibration Records	Summary of Calibration Reports of all Equipments, tools and instruments used during inspection and testing	100%	Calibration Reports	-	H	R
4.4	NDE Operator Qualification records	ASNT / ISNT Level I/II/III certifications	100%	Summery	H	H	R
4.5	Final Stamping	Stamping of Accepted Items	Stamping of Items which are witnessed by EIL/TPIA.	Inspection Report	-	H	H (Note-1,2)

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Rust Preventive Coating & Color Coding	Visual & Color Coding as applicable	100%	Inspection Report	-	H	-
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. Non-NACE/HIC, Non-Hydrogen service & Non-LTCS, Carbon Steel (CS) Flanges, Spectacle Blinds and drip Rings up to size 24"-300 ANSI Class will be accepted based on the review of the Manufacturer's Test Certificates. Manufacturer's Test Certificate shall be as per EN 10204 Type 3.1. MTC along with backup reports to be reviewed by EIL/TPIA.

2. For cases apart from Note-1, Manufacturer's Test Certificate shall be as per EN 10204 Type 3.2 Certification, unless otherwise specified.

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3. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon)

4. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.

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निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
BOLTING MATERIAL

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
5	23.12.2021	REVISED AND RE-ISSUED	HKM	CS	RK	S Mazumdar
4	19.09.2016	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
3	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
1	28.09.2007	REVISED AND RE-ISSUED	PD	RB	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R. Muthuramalingam (RPO Representative)
Mr. Chandrashekhar	Mr. Avdhesh Agrawal	Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Bolting Material.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred therein/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	Heat Treatment & NDT Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Chemical, Mechanical properties, Steel making process, Macro Etch, etc.	100% one no. per heat per size	Mill Test Certificates/ Lab Reports	H	H	R
3.0	**In Process Inspection**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.1	Thread Rolling, Hot forging of Nuts/Bolt Heads, Machining	Process Parameters	100%	Inspection Report	-	H	-
3.2	Heat Treatment	Normalising & Tempering, Quenching & Tempering Solution Annealing, Stabilization Heat Treatment, Strain Hardening, Nitriding etc. as applicable	100%	Heat treatment process records /charts	-	H	R
3.3	NDT (as applicable)	Defects detection	100%	Test Reports	-	H	R
3.4	TPM Identification of Test Samples	Product Analysis, Proof Load Test , Stress Rupture, Tensile, Hardness, Impact, and Other test as applicable	Lot as per specification.	Test Reports	-	H	H
3.5	Chemical Testing	Chemical analysis	Lot as per specification.	Test Reports		H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.6	Mechanical Testing	Mechanical (0.2 Offset/0.5% extension under load), Hardness, Proof Load Test for Nuts (as applicable) , Stress Rupture (As Applicable), Impact and Other test as applicable	Lot as per specification.	Test Reports	-	H	H
3.7	Galvanizing (If Applicable)	Integrity of Galvanised Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Visual & Dimension	Visual Marking & Dimensions	100% by supplier & Random by EIL/ TPIA	Inspection Report	-	H	RW (Note-3)
4.2	Final Stamping	Stamping of Accepted Bolting Material	Stamping of bolting material which are witnessed by EIL/TPIA. Others to have supplier's identification.	Inspection Report	-	H	RW (Note 3)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.3	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW (Note 3)
5.0	**Painting**						
5.1	Rust Preventive & Color Coding (as applicable)	Visual & Color Coding as applicable	100%	Inspection Report	-	H	-
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness {As specified or NOTE 3), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

Notes (as applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable (unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.
3. Final visual and dimension And PMI Check shall be checked as per below sampling plan:

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Lot Size (Nos.)	Sample Size (Minimum) for EIL/TPIA	Sample size (Min) for Supplier
Upto 100	2% (Min. 2 Nos.)	10%
101 to 500	1% (Min. 3 Nos.)	10%
501 and above	0.5% (Min. 5Nos.)	10%

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INSPECTION AND TEST PLAN
FOR
GASKETS

Rev. No.	Date	Purpose	Prepared By	Checked By	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	28.09.2022	REVISED AND RE-ISSUED	TKK	PTM	RK	SM
4	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
3	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
1	02.01.2008	REVISED AND RE-ISSUED	AM	SS	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Chandrashekhar	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Miss Sulakshana Hundekari	

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Gaskets.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	HT & Test Procedures, as applicable	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Chemical, Physical and other properties as per applicable material specification	100%	Test Certificates	H	H	-
3.0	**In Process Inspection**						
3.1	Punching & Finishing	Finish & Dimension	100%	Inspection Report	-	H	-

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.2	Heat Treatment for RTJ Gaskets (As applicable)	Time & Temperature	100%	HT Chart		H	R
3.3	Marking	Size, Rating, Material, Color Coding etc., as applicable	100%	Test Record	-	H	-
4.0	**Final Inspection**						
	Final Visual, Dimension & Testing	• Visual checks including marking check • Dimension check	100%	Inspection Report	-	H	R
4.1	Hardness test for RTJ Gaskets	Ring Hardness	10% (Per size/Rating/Heat /Heat treatment lot)	Test report	-	H	R
	Compressibility, Recovery, Sealability tests for Spiral Wound Gaskets	Compressibility, Recovery, Sealability	One per size/rating/lot	Test report	-	H	R

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	PMI Check (as applicable)	Chemical Check	As per EIL Spec: 6-81-001	Inspection Report	-	H	R
4.3	Submission of Documents/ Certificate	Performance Qualification Test (applicable for Spiral wound Gaskets)	As per ASME B16.20	Type test report	-	H	R (Note-3)
5.0	**Painting**						
5.1	Rust Preventive & Color Coding as applicable	Visual & Color Coding as applicable	100%	Inspection Report	-	H	-
6.0	**Documentation & IC**						
6.1	Documentation & IC	Review of test reports, Inspection documents & Issue of IC	100%	Supplier Records / IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

Notes (as applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.
3. Performance qualification test of Spiral wound gaskets shall be carried out under reputed Third Party Inspection Agency(TPIA) arranged by the supplier

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INSPECTION AND TEST PLAN
FOR
HEAT EXCHANGERS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	14.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
3	09.09.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	REVISED AND RE-ISSUED	HP	SCG	AKC	DM
1	25.10.2005	GENERAL REVISION	TSSR	PRV	SY	VC
0	01.11.02	ISSUED FOR IMPLEMENTATION	NKN	SPS	AKB	GRR

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Abbreviations:

AS/CS/SS	:	Alloy Steel/Carbon Steel/Stainless Steel	MTC	:	Material Test Certificate
CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	PWHT	:	Post Weld Heat Treatment
HIC	:	Hydrogen Induced Cracking	RT	:	Radiography Testing
ITP	:	Inspection and Test Plan	SSCC	:	Sulphide Stress Corrosion Cracking
IP	:	Ingress Protection	TC	:	Test Certificate
IHT	:	Intermediate Heat Treatment	TPI or TPIA	:	Third Party Inspection Agency
IC	:	Inspection Certificate	UT	:	Ultrasonic Testing
IGC	:	Inter Granular Corrosion	VDR	:	Vendor Data Requirement
MPT/MT	:	Magnetic Particle Testing	WPS	:	Welding Procedure Specification
			WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convener: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R. Muthuramalingam (RPO- Representative)
Mr. Chandrasekhar	Mr. Avdhesh Agrawal	Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal		

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1.0 SCOPE

This Inspection and test plan covers the minimum testing requirements of Heat exchanger

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**						
1.1	Hydro test, heat treatment, NDT, hot forming and other Procedures	Documented procedures.	100%	Procedure documents	-	H	R
1.2	Weld Plan & NDT Plan	As per PR/ Purchase Specification/ Applicable codes	100%	Procedure documents	-	H	R – CS A-AS/SS/ CLAD
1.3	WPS/ PQR /WPQ/Mock up	Documented procedures.	100%	Procedure documents	-	H	R-Existing W-New
2.0	**Materials Procurement**						
2.1	Plates, pipes, Forgings, Expansion Bellows, Anodes, Fittings, Fasteners, Gaskets, etc (As applicable) (Note – 3)	As per PR/Purchase Specification	100%	Mill TC	H	H	R
2.2	Tube sheets, Tubes & Non standard flanges (Note-3)	As per PR/Purchase Specification	100%	Mill TC / TPIA'S IRN	H	H	R-CS W-AS/SS
3.0	**In process inspection**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.1	Materials identification of pressure parts	Review of test certificates, markings visual & dimensional inspection, identity correlation & transfer of identity	100%	Material clearance record	-	H	H
3.2	Non Pressure Parts	Review of test certificates	100%	Material test certificate	W	R	R
3.3	Inspection of formed components	NDT of weld seam as applicable	100%	NDT Reports / RT Films	H	H	R
		NDT on knuckle portion (both inside and outside) and weld overlay, as applicable	100%	Inspection report	H	H	R
		HT chart review as applicable	100%	HT Chart	W	W	R
		Test coupon as applicable	100%	Inspection report	W	W	W
		Visual & dimensional (min. thickness, profile, ovality etc) inspection	100%	Inspection report	H	H	W
		UT for lack of bond (after final heat treatment, if any) formed from clad plates as applicable	100%	Inspection report	H	H	R
3.4	Welding consumable	Chemical , mechanical properties & IGC as applicable	100%	Batch test certificates	H	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.5	Weld edge preparation & Set up of pressure Parts	Visual & dimensional inspection, weld edge, root gap, offset, alignment, cleanliness etc.	100%	Inspection check list	-	W	-
		NDT of weld edges as applicable	100%	Inspection check list	-	W	-
3.6	Intermediate Inspection of Welding	Visual, welding parameters/ DPT (as applicable)	100%	Inspection report	-	W	R
		Heat treatment as applicable	100%	HT chart		H	R
3.7	Inspection of tube sheet	Hole diameter, drift, layout, groove depth, ligament, tube hole surface finish etc.	100%	Inspection report	H	H	H
3.8	Inspection of Baffles	Hole diameter, drift, layout, etc	100%	Inspection report	W	W	-
3.9	Skeleton of tube bundle before tube insertion	Visual, dimensions, Completeness of assembly	100%	Insp Report	-	H	-
3.10	Tube bundle assembly	Visual, dimensions, Completeness of assembly	100%	Insp Report	-	H	H
3.11	Floating head assembly (as applicable)	Visual & Dimensions	100%	Insp Report	-	H	R
		NDT, as applicable	100%	Inspection Report	-	W	-
		Heat treatment, as applicable	100%	HT chart		H	R
3.12	Pull through test of shell	Passing of Gauge	100%	Insp Report	-	H	R
3.13	Tube to tube sheet joint (welding/expansion)	% thinning, Length of expansion, weld visual and DP as applicable	100%	Insp. report	-	H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.14	Pneumatic Test of RF Pads & Tube to Tube sheet joints (after root run & final)	Leak Test	100%	Inspection Report	H	H	R- RF Pads W-TTJ
4.0	**Final inspection**						
4.1	Visual and dimensional inspection (internals & externals) including welds of shell, channel shell, shell cover etc. (before PWHT as applicable)	Visual, dimensions, completeness of assembly and weld visual for reinforcement, undercuts, Surface defects, etc.	100%	Inspection report	-	H	H
4.2	PMI, as applicable	Chemical check	Each component and weld	Inspection report	-	H	RW
4.3	Inspection of completed welds	PWHT as applicable	100%	HT chart		H	R
		NDT as applicable	Spot/100%	NDT report / RT films	-	H	R
		Production test coupon testing as applicable	as per specification / drawing	Inspection report	-	H	H
		Sample selection for weld overlay chemistry, as applicable	as per specification / drawing	Inspection report	-	H	W
		Weld chemical results for undiluted chemistry, as applicable	as per specification / drawing	Inspection report	-	H	R
		Hardness for weld /HAZ, as applicable	As per spec.	Inspection report		H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.4	Pressure Test (Hydrostatic, Pneumatic, Helium etc. as applicable)	Leak check	100%	Inspection report	-	H	H
4.5	Pickling/ passivation, drying of equipment (as applicable)	Visual inspection for cleanliness	100%	Inspection report	-	W	R
4.6	Ferroxyl test (as applicable)	Fe pick-up check	100%	Inspection report	-	W	RW
4.7	Drying and Nitrogen -Purging	Visual, Gas pressure	100%	Inspection report	-	W	-
5.0	**Painting**						
5.1	Final painting (as applicable)	Visual inspection (after surface preparation and final painting for workmanship, uniformity) DFT check	100%	Inspection report	-	H	-
6.0	**Documentation and IC**						
6.1	Final stamping, review of inspection documents and issue of IC	Verifying stamping details and review of inspection documents	100%	IC / Inspection reports	-	H	H
6.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

Legend: A-Approval, H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

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NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Third Party Certifications shall be as per EN 10204 Type 3.2 for Clad Plates, CS Plates (NACE/H2/HIC), Anodes, Tubes, Tube sheets, Non-standard Flanges, Forgings, Fittings and Expansion Bellows; and TPIA shall be arranged by supplier. Certifications shall be as per EN 10204 Type 3.1 for Pipes, CS Plates (non-NACE/H2/HIC), Gaskets and Fasteners.
4. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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कार्बन स्टील प्रैशर वेसल / कॉलम के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR PRESSURE VESSELS/ COLUMNS CARBON STEEL

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
4	14.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
3	09.09.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	REVISED AND RE-ISSUED	HP	SCG	AKC	DM
1	28.09.2007	REVISED AND RE-ISSUED	PD	RB	MVKK	VC
0	10.12.2002	ISSUED FOR IMLEMENTATION	NKN	SPS	AKB	GRR

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Abbreviations:

AS / CS / SS		Alloy Steel / Carbon Steel / Stainless Steel	MRT	:	Mechanical Run Test
CEIL	:	Certification Engineers International Limited	NDT	:	Non Destructive Testing
CIMFR	:	Central Institute of Mining & Fuel Research	NPSH	:	Net Positive Suction Head
CE	:	Carbon Equivalent	PO	:	Purchase Order
DFT	:	Dry Film Thickness	PESO	:	Petroleum Explosive Safety Organization
DPT	:	Dye Penetrant Testing	PQR	:	Procedure Qualification Record
DHT	:	De-hydrogen Heat Treatment	PR	:	Purchase Requisition
ERTL	:	Electronics Regional Test Laboratory	PMI	:	Positive Material Identification
FCRI	:	Fluid Control Research Institute	PWHT	:	Post Weld Heat Treatment
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			
				:	

Inspection Standards Committee

Convenor : Mr. R K Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. P V Satyanarayana (Engg. Representative)

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1.0 SCOPE

This Inspection and test plan covers the minimum testing requirements of Pressure vessels/ Columns carbon steel

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**						
1.1	Hydro test, heat treatment, NDT, hot forming and other Procedures	Documented procedures.	100%	Procedure documents	-	H	R
1.2	Weld Plan & NDT Plan	As per PR/ Purchase Specification/ Applicable codes	100%	Procedure documents	-	H	R
1.3	WPS/ PQR /WPQ	Documented procedures.	100%	Procedure documents	-	H	R-Existing W-New
2.0	**Materials Procurement**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Plates, pipes, Forgings, Expansion Bellows, Fittings, Fasteners, Gaskets, etc (As applicable) (Note-3)	As per PR/Purchase Specification	100%	Mill TC	H	H	R
2.2	Internals like Demister, Johnson screen, support grid etc (As applicable) (Note-4)	As per PR/Purchase Specification	100%	Mill TC	H	H	R
3.0	**In process inspection**						
3.1	Materials identification for plates, pipes (pressure parts)	Review of test certificates, markings visual & dimensional inspection, identity correlation & transfer of identity	100%	Material clearance record	-	H	H
3.2	Material identification _for forgings, fittings, fasteners, gaskets (pressure parts)	Review of test certificates, markings Identity correlation.	100%	Material clearance record	-	H	R
3.3	Non pressure parts (including internals, supports etc.)	Review of test certificates	100%	Material test certificate	W	R	R
3.4	Inspection of formed components (cold or hot formed)	NDT of weld seam as applicable	100%	NDT Reports / Films	H	H	R
		NDT (dished ends and tori-cone) on inside & outside surfaces in knuckle zone and edges.	100%	Inspection report	H	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		HT chart review as applicable	100%	HT Chart	W	W	R
		Test coupon as applicable	100%	Inspection report	H	H	W
		Visual & dimensional (min. thickness, profile, ovality etc) inspection	100%	Inspection report	H	H	H
3.5	Welding consumable	Chemical & mechanical properties	100%	Batch test certificates	W	R	R
3.6	Weld edge preparation & set up of pressure parts	Visual & dimensional inspection, weld edge, root gap, offset, alignment, cleanliness etc	100%	Inspection check list	-	W	-
		NDT of weld edges, as applicable	100%	NDT Reports	-	W	R
3.7	Intermediate inspection of welds	Visual, Welding Parameters, NDT	100%	Inspection report	-	W	-
4.0	**Final inspection**						
4.1	Visual and dimensional inspection (internals & externals) including welds (before PWHT as applicable)	Visual, dimensions, completeness of assembly and weld visual for reinforcement, undercuts, Surface defects, etc.	100%	Inspection report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	PMI (AS/SS components)	Chemical check	Each component	Inspection report		W	RW
4.3	Pneumatic test of RF pads	Leak check	100%	Test report	-	W	R
4.4	Trial assembly of internals and column/vessel sections as applicable	Dimensions, completeness of assembly and alignment	100%	Inspection report	-	H	W
4.5	Inspection of completed welds	PWHT as applicable	100%	HT chart		W	R
		NDT as applicable	100%	NDT Reports / RT Films	-	W	R
4.6	Hardness check on all welds, HAZ as applicable	Hardness	100%	Inspection report	-	W	RW
4.7	Production test coupon as applicable	Production test coupon testing	As per spec/drg.	Inspection report	-	H	H
4.8	Hydrostatic test	Leak check	100%	Test report	-	H	H
5.0	**Template Inspection**						
5.1	Foundation Template & Gauge plate inspection	Visual & Dimensions, Orientation markings	100%	Inspection report	-	H	H
6.0	**Painting**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.1	Final painting	Visual inspection (after surface preparation and final painting for workmanship, uniformity) DFT check	100%	Inspection report	-	H	-
7.0	**Documentation and IC**						
7.1	Final stamping, review of inspection documents and issue of IC	Verifying stamping details and review of inspection documents	100%	IC / Inspection reports	-	H	H
7.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Third Party Certifications shall be as per EN 10204 Type 3.2 for CS Plates (NACE/H2/HIC), Forgings, Fittings and Expansion Bellows and TPIA shall be arranged by supplier. Certifications shall be as per EN 10204 Type 3.1 for Pipes, CS Plates (non-NACE/H2/HIC), Gaskets and Fasteners.
4. Inspection of Internals shall be as per EIL Std ITP no. 6-81-0060.
5. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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INSPECTION AND TEST PLAN FOR LOW ALLOY STEEL PRESSURE VESSELS / COLUMNS/REACTORS

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
4	14.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
3	09.09.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	Revised and Re-Issued	HP	SCG	AKC	DM
1	28.09.2007	Revised and Re-Issued	PD	RB	MVK	VC
0	19.07.2002	Issued For Implementation	NKN	SPS	AKB	SB

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Abbreviations:

AS/CS/SS	:	Alloy Steel/Carbon Steel/Stainless Steel	MRT	:	Mechanical Run Test
CEIL	:	Certification Engineers International Limited	NDT	:	Non Destructive Testing
CIMFR	:	Central Institute of Mining & Fuel Research	NPSH	:	Net Positive Suction Head
CE	:	Carbon Equivalent	PO	:	Purchase Order
DFT	:	Dry Film Thickness	PESO	:	Petroleum Explosive Safety Organization
DPT	:	Dye Penetrant Testing	PQR	:	Procedure Qualification Record
DHT	:	De-hydrogen Heat Treatment	PR	:	Purchase Requisition
ERTL	:	Electronics Regional Test Laboratory	PMI	:	Positive Material Identification
FCRI	:	Fluid Control Research Institute	PWHT	:	Post Weld Heat Treatment
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO-Representative)
Mr. P V Satyanarayana (Engg. Representative)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Pressure vessels/ Columns/Reactors low alloy steel

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**						
1.1	Hydro test, heat treatment, NDT, hot forming, and other Procedures	Documented procedures.	100%	Procedure Documents	-	H	R
1.2	Weld Plan & NDT Plan	As per PR/ Purchase Specification/ Applicable codes	100%	Procedure documents	-	H	A
1.3	WPS/ PQR /WPQ	Documented procedures.	100%	Procedure documents	-	H	R-Existing W-New
2.0	**Materials Procurement**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Plates, pipes, forging, fittings, Expansion Bellows, Fasteners, Gaskets etc (as applicable) (NOTE – 3)	As per PR / Purchase Specification	100%	Mill Test Certificates and TPI reports	H	H	R
2.2	Internals like Demisters, Johnson screens, support grids, Diffusers etc. (as applicable) (NOTE – 4)	As per PR/Purchase Specification	100%	Mill TC and TPI reports	H	H	R
3.0	**In process inspection**						
3.1	Materials identification for plates, pipes (pressure parts)	Review of test certificates, markings visual & dimensional inspection, identity, correlation & transfer of identity	100%	Material clearance record	-	H	H
3.2	Material identification for forgings, fittings, fasteners, gaskets (pressure parts)	Review of test certificates, markings Identity correlation.	100%	Material clearance record	-	H	R
3.3	Non pressure parts (including internals, supports etc.)	Review of test certificates	100%	Material test certificate	W	R	R
3.4	Inspection of formed components	NDT of weld seam as applicable	100%	NDT report/ RT Films	H	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		NDT (dished ends and tori-cone) on inside & outside surfaces in knuckle zone and edges.	100%	NDT report	H	H	R
		HT chart review as applicable	100%	HT Chart	W	W	R
		Test coupon as applicable	100%	Inspection report	H	H	W
		Visual & dimensional (min. thickness, profile, ovality etc) inspection	100%	Inspection report	H	H	H
3.5	Welding consumable	Chemical & mechanical properties	100%	Batch test certificates	W	R	R
3.6	Weld edge preparation & set up of pressure parts	Visual & dimensional inspection, weld edge, root gap, offset, alignment, cleanliness etc	100%	Inspection check list	-	W	R
		NDT of weld edges as applicable for cracks, laminations or segregations	100%	NDT report	-	W	R
3.7	Intermediate inspection of welds	Visual, Welding parameters, NDT (as applicable)	100%	Inspection report	-	W	R
		Heat treatment as applicable during welding	100%	HT chart	-	H	R
3.8	Intermediate Stress Relieving / De-Hydrogen Treatment	Heat treatment cycle	100%	HT Chart	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Visual and dimensional inspection (internals & externals) including welds (before PWHT as applicable)	Visual, dimensions, completeness of assembly and weld visual for reinforcement, undercuts, surface defects, etc.	100%	Inspection report	-	H	H
4.2	PMI	Chemical check	All components and weld	Inspection report	-	W	RW
4.3	Pneumatic test of RF pads	Leak check	100%	Test report	-	W	R
4.4	Trial assembly of internals and column/vessel sections as applicable	Dimensions, completeness of assembly and alignment	100%	Inspection report	-	H	H
4.5	Inspection of completed welds	PWHT as applicable	100%	HT chart		W	R
		NDT, as applicable	/100%	NDT Reports / Films	-	W	R
		Production test coupon Testing as applicable	As per spec/drg.	Inspection report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.6	Hardness Checking of welds after PWHT	Hardness	100%	Inspection report	-	W	RW
4.7	Hydrostatic test	Leak check	100%	Hydro test report	-	H	H
4.8	NDT of all weld surfaces (external and internal) after hydro test as applicable	Check for cracks	100%	NDT Reports	-	W	R
4.9	Drying and Nitrogen Purging (as applicable)	Visual, Gas Pressure	100%	Inspection report	-	W	-
5.0	**Template Inspection**						
5.1	Foundation Template and Gauge plate	Visual & Dimensions, Orientation markings	100%	Inspection report	-	H	H
6.0	**Painting**						
6.1	Final painting (As applicable)	Visual inspection (after surface preparation and final painting for workmanship, uniformity) , DFT check	100%	Inspection report	-	H	-
7.0	**Documentation and IC**						
7.1	Final stamping , review of inspection documents and issue of IC	Verifying stamping details and review of inspection documents	100%	IC / Inspection reports	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
7.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

Legend: A-Approval, H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Third Party Certifications shall be as per EN 10204 Type 3.2 for Plates, Pipes, Forgings, Fittings, Fasteners and Expansion Bellows; and TPIA shall be arranged by supplier. Certifications shall be as per EN 10204 Type 3.1 for Gaskets.
4. Inspection of Internals shall be as per relevant EIL Std ITP's attached with PR; if not attached with PR, separate ITP's shall be submitted for EIL approval.
5. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
STAINLESS STEEL PRESSURE VESSELS / COLUMNS

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
4	14.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
3	09.09-2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	REVISED AND RE-ISSUED	HP	SCG	AKC	DM
1	15.07.08	REVISED AND RE-ISSUED	NKR	SSL	SKP	VC
0	19.07.02	ISSUED FOR IMPLEMENTATION	NKN	SPS	AKB	GRR

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Abbreviations:

AS/CS/SS	:	Alloy Steel / Carbon Steel / Stainless Steel	MRT	:	Mechanical Run Test
CEIL	:	Certification Engineers International Limited	NDT	:	Non Destructive Testing
CIMFR	:	Central Institute of Mining & Fuel Research	NPSH	:	Net Positive Suction Head
CE	:	Carbon Equivalent	PO	:	Purchase Order
DFT	:	Dry Film Thickness	PESO	:	Petroleum Explosive Safety Organization
DPT	:	Dye Penetrant Testing	PQR	:	Procedure Qualification Record
DHT	:	De-hydrogen Heat Treatment	PR	:	Purchase Requisition
ERTL	:	Electronics Regional Test Laboratory	PMI	:	Positive Material Identification
FCRI	:	Fluid Control Research Institute	PWHT	:	Post Weld Heat Treatment
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members:

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Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. P V Satyanarayana (Engg. Representative)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Pressure vessels/ Columns stainless steel

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**						
1.1	Hydro test, heat treatment, NDT, hot forming, and other Procedures	Documented procedures.	100%	Procedure Documents	-	H	R
1.2	Weld Plan & NDT Plan	As per PR/ Purchase Specification/ Applicable codes	100%	Procedure documents	-	H	R
1.3	WPS/ PQR /WPQ	Documented procedures.	100%	Procedure documents	-	H	R-Existing W-New
2.0	**Materials Procurement**						
2.1	Plates, pipes, Forging, Fittings, Expansion Bellow, Fasteners, Gaskets etc. (as applicable) (Note-3)	As per PR / Purchase specification	100%	Mill test certificates and TPI reports	H	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.2	Internals like Demisters, Johnson screens, support grids, Diffusers etc. (as applicable) (Note 4)	As per PR/Purchase Specification	100%	Mill TC and TPI reports	H	H	R
3.0	**In process inspection**						
3.1	Materials identification for plates, pipes (pressure parts)	Review of test certificates, markings visual & dimensional inspection, identity correlation & transfer of identity	100%	Material clearance record	-	H	H
3.2	Material identification for forgings, fittings, fasteners, gaskets (pressure parts)	Review of test certificates, markings identity correlation	100%	Material clearance record	-	H	R
3.3	Non pressure parts (including internals, supports etc.)	Review of test certificates	100%	Material test certificate	W	R	R
3.4	Inspection of formed components (Cold or hot formed)	NDT of weld seam as applicable	100%	NDT report/RT films	W	W	R
		NDT (dished ends and tori-cone) on inside & outside surfaces in knuckle zone and edges	100%	Inspection report	W	W	R
		Solution Annealing, as applicable	100%	HT chart	W	W	R
		Hardness check, as applicable	As per requirement	Inspection report	W	W	R
		Test coupon Tensile, IGC, Micro etching as applicable	100%	Inspection report	W	W	W

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		Visual & dimensional (min. thickness, profile, ovality etc) inspection	100%	Inspection report	H	H	H
3.5	Welding consumable	Chemical & mechanical properties including IGC	100%	Batch test certificates	W	R	R
3.6	Weld edge preparation & set up of pressure parts	Visual & dimensional inspection, weld edge, root gap, offset, alignment, cleanliness etc	100%	Inspection check list	-	W	R
		DPT of weld edges as applicable for cracks, laminations or segregations	100%	Inspection check list	-	W	R
3.7	Intermediate Inspection of Welds	Visual, Welding parameters, NDT	100%	Inspection report	-	W	R
4.0	**Final inspection**						
4.1	Visual and dimensional inspection (internals & externals) including welds	Visual, dimensions, completeness of assembly and weld visual for reinforcement, undercuts, surface defects etc.	100%	Inspection report	-	H	H
4.2	PMI	Chemical check	Each component and weld	Inspection report	-	W	RW
4.3	Pneumatic test of RF pads	Leak check	100%	Test report	-	W	R
4.4	Trial assembly of internals and column/vessel sections as applicable	Dimensions, completeness of assembly and alignment	100%	Inspection report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.5	Inspection of completed welds	PWHT as applicable	100%	HT chart	-	W	R
		Hardness test as applicable	100%	Inspection report	-	W	R
		Production test coupon testing including IGC and micro etching as applicable	100%	Inspection report	-	H	H
		NDT as applicable	100%	NDT report/RT films	-	W	R
4.6	Water Quality Check	Chloride Content	100%	Inspection report	-	H	R
4.7	Hydrostatic test	Leak check	100%	Test report	-	H	H
4.8	Pickling/ passivation (inside and outside surface) , drying of equipment	Visual inspection for cleanliness	100%	Inspection report	-	W	R
4.9	Ferroxyl test/ Copper Sulphate Test, as applicable	Fe pick up check	100%	Inspection report	-	W	RW
4.10	Drying and Nitrogen Purging (as applicable)	Visual, Gas Pressure	100%	Inspection report	-	W	-
5.0	**Template Inspection**						
5.1	Foundation Template and Gauge plate, as applicable	Visual & Dimensions, Orientation markings	100%	Inspection report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.0	**Painting**						
6.1	Final painting (As applicable)	Visual inspection (after surface preparation and final painting for workmanship, uniformity) DFT check	100%	Inspection report	-	H	-
7.0	**Documentation and IC**						
7.1	Final stamping, review of inspection documents and issue of IC	Verifying stamping details and review of inspection documents	100%	Name plate/ rub-off and inspection reports	-	H	H
7.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Q.C. dossier	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (as applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable.(unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Third Party Certifications shall be as per EN 10204 Type 3.2 for Plates, Forgings, Fittings and Expansion Bellows; and TPIA shall be arranged by supplier. Certifications shall be as per EN 10204 Type 3.1 for Pipes, CS Plates, Gaskets and Fasteners.
4. Inspection of Internals shall be as per relevant EIL Std ITP's attached with PR; if not attached with PR, separate ITP's shall be submitted for EIL approval.
5. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
CHAIN PULLEY BLOCK / WINCH

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
4	14.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
3	09.09.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	10.04.12	REVISED AND RE-ISSUED	SK	SCG	AKC	DM
1	31.01.08	REVISED AND RE-ISSUED	CS	RB	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	SKT	NKN	AKB	GRR

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Abbreviations:

BIS	:	Bureau of Indian Standards	MTC	:	Material Test Certificate
CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convenor: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. Shishupal Choudhary (Engg. Representative)

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1.0 SCOPE:

This Inspection Test Plan covers the minimum testing requirements of Chain Pulley Block / Winch

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Material Procurement**						
1.1	Trolley & Chain Pulley Block Plates	Chemical & Physical	One Sample Per Lot/Heat	Test Certificates	H	R	R
1.2	Wire rope	Strand configuration, size & tensile strength	Per drum / length	Manufacturer's Test Certificate	H	R	R
1.3	Hook	Load & Proof load test, Chemical, Physical, HT & NDT	100%	Manufacturer's Test Certificate	H	R	R
1.4	Gears/Ratchet Pawl/ Wheel	Chemical Composition	One Sample Per Lot/Heat	Manufacturer's Test Certificates	H	R	R
2.0	**In-process Inspection**						

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S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Hooks	Proof load	100%	Manufacturer's Test Certificates	-	H	-
2.2	Load Chain / Wire Rope	Proof load	100%	Manufacturer's Test Certificates	-	H	-
2.3	Ratchet Pawl	Hardness	100%	Inspection Report	-	H	-
3.0	**Final Inspection**						
3.1	Complete Assembly	Load & Proof Load test	100%	Inspection Report	-	H	RW
		Operational Effort	100%	Inspection Report	-	H	RW
		Lift	100%	Inspection Report	-	H	RW
		Statutory certification / BIS License, if any	100%	Test Certificate/ License	-	R	R
4.0	**Painting**						
4.1	Panting (As applicable)	Visual & Dry Film Thickness	100%	Inspection Report	-	W	-
5.0	**Documentation and IC**						

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S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.1	Final stamping, review of inspection documents and issue of IC	Verifying stamping details and review of inspection documents	100%	IC / Inspection reports	-	H	H
5.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (as applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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INSPECTION AND TEST PLAN
FOR
STRAINERS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	14.02.2024	REVISED AND RE-ISSUED	NK	AK	RK	MN
3	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
2	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
1	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
0	28.09.2007	ISSUED FOR IMPLEMENTATION	PD	RB	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Suresh G	Mr. Avdhesh Agrawal	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Anil Kumar	Mr. Mahendra Mittal	Ms. Sulakshana Hundaikari (Engg)	Mr. Chandrashakhar

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Strainers.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	NDT (DPT, MT, RT), Hydro test, Heat treatment (Normalizing, Nor & Temp, Solution Annealing, Stabilizing as applicable), Picking, Shot blasting & Painting procedure	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	Weld Plan (WPS/ PQR/WPQ) & NDE Plan	Applicability of welding process (welding parameters) & NDE methods	100%	Weld & NDE Plan	-	H	W- New R- Existing
2.0	**Material Inspection**						

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Raw Material Inspection	Chemical , Mechanical, Impact, IGC, Heat Treatment, NDT, Hardness and other properties as applicable	100%	Test Certificates	H	H	R
3.0	**In Process Inspection**						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Heat Treatment	PWHT as applicable	100%	HT chart	-	H	R
3.3	Radiography as Applicable	Weld Defects	100%	RT films & Reports	-	H	R
3.4	NDT As applicable	Surface & Internal Imperfections	100%	Test Reports	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic Testing	Neither pressure drop nor leakage	100%	Test Report	-	H	RW (Note-1)
4.2	Visual and Dimensional Inspection (VDI)	Filter element fitment, Surface Condition & Dimensions	100%	Inspection Report	-	H	RW (Note-1)
4.3	PMI Check (External body, fasteners, internal filter element etc)	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection Report	-	H	RW (Note-1)

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.4	Final Stamping	Stamping of Accepted Strainers	Stamping of Strainers which are witnessed by EIL/TPIA.	Inspection Report	-	H	H (Note-1)
5.0	**Picking passivation and Painting**						
5.1	Final shot blasting, surface preparation & painting (As applicable)	Visual inspection (after surface preparation and final painting for workmanship, uniformity) DFT check, color coding	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation (SS strainers) as applicable	As per procedure	100%	Inspection Report	H	H	R
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. For Non-NACE & Non-Hydrogen service Strainers up to size 6" 300# ANSI will be accepted on review of Supplier Test Certificates duly reviewed by EIL/TPIA.

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2. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (unless otherwise agreed upon)
3. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.

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INSPECTION AND TEST PLAN
FOR
STEAM TRAPS

Abbreviations:

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	14.02.2024	REVISED AND RE-ISSUED	NK	AK	RK	MN
3	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
2	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
1	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
0	28.09.2007	Issued for implementation	PD	RB	MVKK	VC

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CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Suresh G	Mr. Avdhesh Agrawal	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Anil Kumar	Mr. Mahendra Mittal	Ms. Sulakshana Hundaikari (Engg)	Mr. Chandrashakhar

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of steam traps.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	NDT (DPT, MT, RT), Hydro test, Heat treatment (as applicable), Shot blasting & Painting procedure	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	Weld Plan (WPS/ PQR/WPQ) & NDE Plan	Applicability of welding process (welding parameters) & NDE methods	100%	Weld & NDE Plan	-	H	R
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Chemical, Mechanical, Impact, IGC, Heat Treatment, NDT, Hardness and other properties as applicable	100%	Test Certificates	H	H	R

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	**In Process Inspection**						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Heat Treatment	PWHT as applicable	100%	HT chart	-	H	R
3.3	Radiography as Applicable	Weld Defects	PR / Purchase Specification	RT films & Reports	-	H	R
3.4	NDT (PT, MT, UT) As applicable	Surface & Internal Imperfections	PR / Purchase Specification	Test Reports	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic Testing / Functional Testing as applicable	Neither pressure drop nor leakage	100%	Test Report	-	H	RW
4.2	Visual and Dimensional Inspection (VDI)	Surface Condition & Dimensions	100%	Inspection Report	-	H	RW
4.3	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW
4.4	Final Stamping	Stamping Of Accepted traps (witnessed by EIL /TPIA)	100%	Inspection Report	-	H	H

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Surface preparation, Painting & Color Coding	Visual, DFT & Color Coding as applicable	100%	Inspection Report	-	H	-
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.

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के लिए
निरक्षण एवं परीक्षणयोजना

INSPECTION AND TEST PLAN
FOR
HOSE PIPES AND COUPLING

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	11.12.2023	REVISED AND RE-ISSUED	SS	CS	RK	
3	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
2	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
1	13.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
0	28.09.2007	Issued for implementation	PD	RB	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited
CIMFR	:	Central Institute of Mining & Fuel Research
CE	:	Carbon Equivalent
DFT	:	Dry Film Thickness
DPT	:	Dye Penetrant Testing
DHT	:	De-hydrogen Heat Treatment
ERTL	:	Electronics Regional Test Laboratory
FCRI	:	Fluid Control Research Institute
HT	:	Heat Treatment
HIC	:	Hydrogen Induced Cracking
ITP	:	Inspection and Test Plan
IP	:	Ingress Protection
IHT	:	Intermediate Heat Treatment
IC	:	Inspection Certificate
IGC	:	Inter Granular Corrosion
MPT/MT	:	Magnetic Particle Testing
MTC	:	Material Test Certificate
MRT	:	Mechanical Run Test
NDT	:	Non Destructive Testing
NPSH	:	Net Positive Suction Head
PO	:	Purchase Order
PESO	:	Petroleum Explosive Safety Organization
PQR	:	Procedure Qualification Record
PR	:	Purchase Requisition
PMI	:	Positive Material Identification
RT	:	Radiography Testing
SSCC	:	Sulphide Stress Corrosion Cracking
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
UT	:	Ultrasonic Testing
VDR	:	Vendor Data Requirement
WPS	:	Welding Procedure Specification
WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Chandrashekhar	Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Mr. Shishupal Chaudhary (Engg)	

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Hose pipes and Couplings

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	NDT and other Procedures.	Documented Procedures	100%	Procedure Documents	-	H	R
1.1 (a)	NDT Plan with operator qualification	Requirement of NDT stages (PT, MT, UT, RT etc) & operator certificates	100%	NDT reports and Plan with Qualification records	-	H	R
1.2	Weld plan with WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	Weld plan with WPS, PQR & WPQ	-	H	R- Existing W-For New
2.0	**Material Inspection**						

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Incoming materials (Rubber hose/ SS pipe/SS wire braiding/ Flanges/ coupling)	Chemical & Mechanical Properties. & IGC (For SS Items if applicable.)	100%	Test certificates	H	H	R
3.0	**In Process Inspection**						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	R
3.2	NDT as applicable	Weld soundness	100%	Test Reports	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic/Pneumatic Testing	Leak Check	100%	Test Report	-	H	R
4.2	Vacuum test, Steam Resistance, Electrical Continuity and other tests as applicable	Leak & Soundness Check	100%	Test Report	-	H	R
4.3	Visual and Dimensional Inspection	Surface Condition & Dimensions	100%	Inspection Report	-	H	R
4.4	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	R
4.5	Final Stamping	Stamping of Accepted Items	100%	Inspection Report	-	H	R

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting & Color Coding	Visual, DFT & Color Coding as applicable	100%	Inspection Report	-	H	R- For Record only
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.

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फ़िक्स्ड CO_2 अग्नि शमन प्रणाली के लिए निरीक्षण और परीक्षण योजना

INSPECTION AND TEST PLAN FOR FIXED CO_2 FIRE EXTINGUISHING SYSTEM

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	30-03-2021	Issued for implementation	AA	CS	RKS	S Mazumdar

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Abbreviations:

AS/CS/SS	:	Alloy Steel/Carbon steel/Stainless steel
DT	:	Destructive Testing
IRN	:	Inspection Release Note
MOC	:	Material of Construction
MTC	:	Material Test Certificate
NDT	:	Non Destructive Testing
PESO	:	Petroleum Explosive Safety Organization
PO	:	Purchase Order
PQR	:	Procedure qualification record
TPI	:	Third Party Inspection
WPS	:	Welding procedure specification

Inspection Standards Committee

Convenor : Mr. R K Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R. Muthuramalingam (RPO Representative)
Mr. Chandrashekhar	Mr. Avdhesh Agrawal	Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of for fixed CO_2 fire extinguishing system.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**						
1.1	WPS/PQR	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	**Shop Supply - Material Inspection/ In process Inspection (TPI Certification required, Refer note-1)**						
2.1	CO_2 cylinder assembly a. Visual, Dimensional, Marking b. Hydro test c. test certificate / statutory certifications and approvals	Surface & Dimension Check, Leak test, review of test certificate / statutory certifications and approvals like ATEX/BASEEFA/UL & PESO	100%	Test Certificate/ Mill TC/ statutory report	H	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
	Fitting of valve and filling of CO_2.	Verification of valve and gas, review of test certificate	100%	MTC	H	H	R
2.2	Hose	Visual, Dimension, Marking, Review of test certificates	100%	MTC	H	H	R
2.3	Valve	Visual, Dimension, Hydro test, Marking, Review of test certificates	100%	MTC	H	H	R
2.4	Directional valve with actuator	Visual, Dimension, Marking, Review of test certificates	100%	MTC	H	H	R
2.5	Pipes (Note-2)	Testing, Visual, Dimension, Marking, Review of test certificates	100%	MTC	H	H	R
2.6	Fitting (Note-2)	Testing, Visual, Dimension, Marking, Review of test certificates	100%	MTC	H	H	R
2.7	Flange (Note-2)	Testing, Visual, Dimension, Marking, Review of test certificates	100%	MTC	H	H	R
2.8	Gasket and fasteners (Note-2)	Testing, Visual, Dimension, Marking, Review of test certificates	100%	MTC	H	H	R
2.9	Nozzle	Testing, Visual, Dimension, Marking, Review of test certificates	100%	MTC	H	H	R
2.10	Pressure Switch	Visual, Dimension, Marking, Review of test certificates	100%	MTC	H	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.11	Gas release Panel	Visual, Dimension, Marking, Review of test certificates, Functional test, Review of deg. of protection certificate	100%	**MTC**	H	H	R
2.12	Online weighing System	Visual, Dimension, Marking, Review of test certificates, Functional test, Review of calibration certificate	100%	**MTC**	H	H	R
2.13	Cables	Routine tests as per relevant IS/IEC standards	100%	**MTC**	H	H	R
3.0	**Final Inspection**						
3.1	Verification of all items as per PR	Review of test certificates, TPI IRN, Statutory certificates (as applicable)	100%	Inspection Report	-	H	H
4.0	**Documentation and IC**						
4.1	Documentation and Inspection Certificate(IC) for shop supply	Review of Stage Inspection Reports/Test Reports, Final test reports ,Statutory test report & Issue of IC	100%	Supplier TC & Inspection Certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), R-Review, RW-Random witness (As specified or 10% (min.1 no of each size & type of bulk item)), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES (as applicable):

1. TPI certifications are required for materials for note-2.TPI shall be appointed by supplier for material inspection at sub vendor works.
2. Pipe, flange, fitting and valves with CS MOC up to size 12'' 300# (including forge fitting up to 1.5'' 3000 # and forge valves up to 1.5'' 800#) and Gasket/fasteners can be accepted based on review of MTC of supplier. (To be decided by EIL-HO)
3. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable (Unless otherwise agreed upon).
4. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
5. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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एपॉक्सी लेपित प्लांट पाइपिंग सामग्री (फ्लांगेस, फिटिंग एंव वालवेस) के लिए निरीक्षण और परीक्षण योजना

INSPECTION AND TEST PLAN FOR EPOXY COATED PLANT PIPING MATERIALS (FLANGES, FITTINGS AND VALVES)

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by	
					Standards Committee Convener	Standards Bureau Chairman
1	10.06.2024	ISSUED FOR IMPLEMENTATION	SK	CS	RK	MN

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Abbreviations:

CEIL	:	Certification Engineers International Ltd.	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	PO	:	Purchase Order
DFT	:	Dry Film Thickness	PQR	:	Procedure Qualification Record
DPT	:	Dye Penetrant Testing	PR	:	Purchase Requisition
DHT	:	De-hydrogen Heat Treatment	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. G. Suresh
Mr. Avdhesh Agrawal
Mr. Himangshu Pal
Mr. Mahendra Mittal
Mr. R. Muthuramalingam
Ms. Sulakshna Hundekari (Engg. Representative)
Mr. Chandrashekhar
Mr. Anil Kumar

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of epoxy coated plant piping including buried flanges, fittings and valves.

2.0 REFERENCE DOCUMENTS

PO/PR/Standards referred therein/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**						
1.1	Painting/Coating application procedure	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	**Pre-Qualification Testing (PQT)**						
2.1	Pre-Qualification Testing	All testing as per PR/ specification	100%	Inspection/ test Reports	-	H	R- Existing H-New
3.0	**Material Inspection**						
3.1	Painting/Coating Materials	Properties as per PR/ Specification	100%	Manufacturer's test certificate	H	R	R
4.0	**Painting/ Coating**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Surface Preparation for Painting/Coating application	Ambient Temp. (DBT), Degree of Cleanliness, Roughness, Surface profile, Dew Point Temperature, Relative Humidity, Salt contamination, Pre-heating temperature, Surface Imperfections & Chemical Treatment (as applicable)	100%	Inspection Report	-	H	RW
4.2	Mixing of Painting/Coating Material before application	Proportions of each component (Epoxy Resin & Curing agent), Preheating (if required) & Homogeneous mixing	100%	Inspection Report	-	H	R
4.3	Inspection of applied coating	• Holiday detection, • Adhesion test -resistance to removal/ Cross-cut test, • Adhesion test -Pull off method • Impact Test • Any other test specified in PR/ standards	As per PR/ specification	Test Reports	-	H	H
		• Visual check, • DFT, • Cut-back at the ends	As per PR/ specification	Test Reports	-	H	RW
4.4	Color Coding (as applicable)	Color and shade of paint/ coating, as applicable	100%	Inspection Report	-	H	W
4.5	Final Stamping	Stamping of accepted materials	Stamping of items, which are witnessed by EIL/TPIA	Inspection Report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Packing**						
5.1	Verification of packing as per packing list	List of PO item including spare as per PO/PR, marking	100%	Inspection report/ Certification of packing list	-	H	W
6.0	**Documentation & IRN**						
6.1	Documentation & Inspection Release Note (IRN)	Review of Stage Inspection Reports / Test Reports & Issue of IRN	100%	Supplier TC & IRN	-	H	H

Legend:- H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):-

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.

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निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
HV SWITCHBOARDS
UP TO 33KV

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	14 01 2020	Revised and Reissued	MM	RS	RKS	RKT
3	21 11 2013	Revised and Reissued	MJ	RS	SCG	SC
2	15 07 2011	Revised and Reissued	GS	SA	AKC	DM
1	28 09 2007	Revised and Reissued	AKG	PPM	MVKK	VC
0	30 04 2002	Issued for implementation	RG	AKC	AK	GRR

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Abbreviations:

BIS	:	Bureau of Indian Standard	PO	:	Purchase Order
CIMFR	:	Central Institute of Mining & Fuel Research	PESO	:	Petroleum Explosive Safety Organization
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FM	:	Factory Mutual	PVC	:	Poly Vinyl Chloride
FLP	:	Flame Proof	QC	:	Quality Control
FRLS	:	Flame retardant low smoke	SF6	:	Sulpher Hexa Floride
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IC	:	Inspection Certification	UL	:	Under writer Laboratories
IEC	:	International Electro technical Commission	VDR	:	Vendor Data Requirement
JEC	:	Japanese Electro technical Committee	XLPE	:	Cross Linked Poly Ethylene
MTC	:	Material Test Certificate			
NEMA	:	National Electrical Manufacturers Association			

Inspection Standards Committee

Convenor : Mr. RK Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrasekhar	Mr R Muthuramalingam (RPO representative)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Mr. Deepak Gupta (Project)	

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of indoor, draw out type High Voltage Switchboards up to and including 33 KV.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents/Relevant BIS/IEC Standards.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	----	--	--	--
2.0	**Material Inspection**						
2.1	Incoming major Material like Bus Bars, sheet metal, Cable wire (FRLS), instrument transformers, Relays, Breakers, Vacuum Bottles, etc	Visual, Dimensional, Operational checks (as applicable)	100%	MTC's/ Inspection & Test records / Lab Test Records/ Manufacturer's Test Certificates	H	H	R
3.0	**In process Inspection**						
3.1	Breaker Assembly	• Mechanical Operation including spring charging mechanism & time, Breaker opening / closing at normal and worst voltage conditions, Opening / closing time and	100% by Supplier and random by EIL/TPIA	Test Records / Inspection Witness Record	-	H	W #

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		simultaneous closing of all poles, Contact resistance measurement, Gas leakage check (for SF6 breakers), Power Frequency Test.					
3.2	Wiring checks	Size, termination, ferruling, continuity, color coding, make, type	100%	Suppliers Test Records	--	H	----
4.0	**Final Inspection**						
4.1	Switchgear Assembly (Routine test)	• Visual check including layout, Tag plates, Paint shade, Bus marking and sleeving, Joint shrouding, Identification and location of components, safety shutter operation check, verification of partition type, earthing arrangement, wiring checks etc • Dimension check including operational height, Bus bar size, Clearances, Creepage distances, termination height, Compartmentalization; cable gland size, Paint shade, thickness & adhesion check etc.	100%	Test Records / Inspection Witness Record	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
	Switchgear Assembly (Contd.)	• Verification of Bus bar support arrangement with respect to GA drawing and type tested panel drawings and provision for external cable termination. • Bill of material check. • Rack-in and Rack-out of breakers * • Mechanical and electrical interlock checks on test and service position of circuit breaker * • Interchangeability of Truck assembly in identical feeders.* • Pressure switches operation for SF6 breaker. *(as applicable) • Operation check for auxiliary equipment circuits and auxiliary contacts * • Operation checks for all control functions and interlocks as per schematic diagrams in Service position	100%	Test Records / Inspection Witness Record	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• Logics and interlock checks on incomers and bus coupler sections as per job specification and approved documents • Relay operation check through primary / secondary injection.* • Measurement of resistance of main circuit. • Communication check between relays and Ethernet switches /Data concentrator / HMI (if applicable)* • HMI operation and functional checks as per separate agreed ITP/FAT(if applicable) • Insulation resistance of main, auxiliary and control circuits before and after High Voltage Test. • Power Frequency voltage withstand test on main, auxiliary and control circuits.					
4.2	Switchgear Assembly (Type Test) %	• Short time current withstand test	On each Type/Rating	Test Agency Reports	-	R/H**	R/H**

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• Impulse and Power Frequency withstand Test • Temperature Rise test • Internal Arc test (in AFLR Condition) • Check for Themography window (if specified) • Operating sequence test (Duty cycle test) for breaker & endurance test • Degree of protection for panels					
5.0	**Painting**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage, as per contract.	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports • IC issuance.	100%	Supplier's Test Records / Inspection Certificate	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.2	Final Document submission	Compilation of Inspection reports, drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

* Quantum of check is 100% by Supplier & random basis by EIL/TPIA(as applicable)
** Witness if called for in job specifications. In such cases specified Type test will be considered as part of routine test.
# Breaker assembly test can be witnessed during final inspection.
% Sequence of type testing shall be as per latest IEC.

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
3. Supplier has to submit the internal test report for the offered switchboard before the scheduled inspection date.

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अग्निरोधक नियंत्रण स्टेशनों के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR FLAMEPROOF CONTROL STATIONS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5.	28.08.2024	Revised and Reissued	RP	GS	RK	MN
4.	14.01.2020	Revised and Reissued	MM	RS	RKS	RKT
3.	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
2	29.06.2012	Revised and Reissued	AB	HVJ	AKC	DM
1	28.09.2007	Revised and Re-issued	AKG	PPM	MVKK	VC
0	30.04.2002	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations

BIS	:	Bureau of Indian Standard
CIMFR	:	Central Institute of Mining & Fuel Research
DFT	:	Dry Film Thickness
ERTL	:	Electronics Regional Test Laboratory
FM	:	Factory Mutual
FLP	:	Flame Proof
IL	:	Indicating Lamps
ITP	:	Inspection and Test Plan
IP	:	Ingress Protection
IC	:	Inspection Certification
IS	:	Indian Standard
IEC	:	International Electro technical Commission
JEC	:	Japanese Electro technical Committee
MTC	:	Material Test Certificate
NEMA	:	National Electrical Manufacturers Association
PB	:	Push Button
PO	:	Purchase Order
PESO	:	Petroleum Explosive Safety Organization
PR	:	Purchase Requisition
PVC	:	Poly Vinyl Chloride
QC	:	Quality Control
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
VDR	:	Vendor Data Requirement
XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. R K Singh

Members:

Mr. G Suresh	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. R Muthu Ramalingam
Mr. Mahendra Mittal	Mr. Avdesh Agrawal	Mr. Anil Kumar	Mr. Arvind NP Singh (Engg)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Flameproof Control Stations.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents/Relevant IS/IEC Standards.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming material like castings, glass, meters, PBs, ILs, Fasteners etc	Visual, Dimensional, Chemical, Physical and Operational checks, (as applicable)	100%	MTC / Lab test records	H	H	R
3.0	**In process Inspection**						
3.1	Machining, Joints, Sealing methods	As per Test Lab Certified Drawings for Hazardous Area Applications	100%	Test Certificates	-	H	-
3.2	Assembly and Wiring Checks	Visual, Dimensional, Bill of Material, Rating of Components, Tightness of wiring terminations, Size, Type (FR/FRLS), continuity, color coding.	100%	Test Certificates	-	H	-

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.3	Flameproof enclosure without components	Routine Over-Pressure test	100%	Test Certificates	-	H	R
4.0	**Final Inspection**						
4.1	Flameproof Control Station (Routine tests)	• Visual/Dimensional/BOM Checks • Nameplate and Tag Number checks • Adherence of panels to Hazardous Area Certification conditions including Flame Path, Flame Gap, Thread Check, Thickness of Enclosure, No. of Cable Entries, Rating of mounted components, Maximum number of door/ cover mounted components, Joints, Sealing etc. • Wiring Checks/Electrical/ Functional Checks • High voltage test • IR test before and after High voltage Test • Paint Shade, Thickness and Adhesion check.	100% by Supplier 10% by EIL/TPIA	Test Records / Inspection Witness Record	-	H	H
4.2	Submission of Certificates & Documents	• Test Certificate of testing agency (CIMFR/ KLPL etc) for suitability of model to intended Hazardous area classification as per latest IS/IEC standards. • Certificate of Statutory authority (PESO). • Valid BIS License.	For each Type/Model	Certificates from test agencies	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting and Packing	• Visual checks for compliance to Painting requirements as per contract. • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage, as per contract.	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports & MTC • IC Issuance	100%	Supplier's Test Records / Inspection Certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), Random 10% , R-Review, RW-Random witness, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents/ Hazardous Area certifications.
3. Supplier has to furnish internal test reports before scheduled inspection date.

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अग्निरोधक लाइटिंग एवं पावर पैनलों के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR FLAMEPROOF LIGHTING AND POWER PANELS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
4.	28.08.2024	Revised and Reissued	RP	GS	RK	MN
3.	14.01.2020	Revised and Reissued	MM	RS	RKS	RKT
2.	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
1	15.07.2011	Revised and Reissued	GS	SA	AKC	DM
0	07.10.2008	Issued for implementation	SA	SKD	SKP	VC

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Abbreviations

BIS	:	Bureau of Indian Standard
CIMFR	:	Central Institute of Mining & Fuel Research
DFT	:	Dry Film Thickness
ERTL	:	Electronics Regional Test Laboratory
FM	:	Factory Mutual
FLP	:	Flame Proof
FRLS	:	Flame retardant low smoke
ITP	:	Inspection and Test Plan
IP	:	Ingress Protection
IS	:	Indian Standard
IC	:	Inspection Certification
IEC	:	International Electro technical Commission
JEC	:	Japanese Electro technical Committee
MTC	:	Material Test Certificate
NEMA	:	National Electrical Manufacturers Association
PO	:	Purchase Order
PESO	:	Petroleum Explosive Safety Organization
PQR	:	Procedure Qualification Record
PR	:	Purchase Requisition
PVC	:	Poly Vinyl Chloride
QC	:	Quality Control
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
VDR	:	Vendor Data Requirement
XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. G Suresh	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. R Muthu Ramalingam
Mr. Mahendra Mittal	Mr. Avdesh Agrawal	Mr. Anil Kumar	Mr. Arvind NP Singh (Engg)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for Flameproof Lighting And Power panels.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents/Relevant IS/IEC Standards.

3.0 INSPECTION AND TEST REQUIREMENT:

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	---	---	---	---	---	---
2.0	**Material Inspection**						
2.1	Incoming Materials like Castings, Glass, Meters, Wires/ Cables, Bus-Bars, Gaskets, Isolators, MCBs, MCCBs, RCCBs, CTs/ PTs etc (As applicable)	Visual, Dimensional, Physical, chemical & functional checks (as applicable)	100%	Material test certificates / Manufacturer's Test records/	H	H	R
3.0	**In process Inspection**						
3.1	Machining, Joints, Sealing methods	As per Test Lab Certified Drawings for Hazardous Area Applications	100%	Test records	-	H	---
3.2	Panel assembly	Visual, Dimensional, Bill of Material, Rating of Components.	100%	Test Records	-	H	---
3.3	Wiring Checks	Size, type (FR/FRLS), make, termination tightness, ferruling, continuity, color coding	100%	Test Records	-	H	----
3.4	Pressure Check	Over Pressure test on individual enclosures as per relevant standard	100%	Test Records	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Final Inspection	• Visual and Dimensional check • Adherence of panels to Hazardous Area Certification conditions including Flame Path, Flame Gap, Thread Check, Thickness of Enclosure, No. of Cable Entries, Rating of mounted components, Maximum number of door/ cover mounted components, Joints, Sealing etc. • Bill of material. • Wiring checks • Paint shade, adhesion and thickness. • Verification of mechanical and electrical operations • Dielectric test (High Voltage) • Insulation check before & after High Voltage • Correctness of nameplate • Annunciation/ Indication Checks	100%	Test Records	-	H	H
4.2	Submission of Certificates & Documents	• Test Certificate of testing agency (CIMFR/ KLPL etc) for suitability of model to intended Hazardous area classification as per latest IS/IEC standards. • Certificate of Statutory authority (PESO). • Valid BIS License.	For each Type/Model	Certificates from Test Labs/ Agencies	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting and Packing	• Visual checks for compliance to Painting requirements as per contract. • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage as per contract.	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports & MTC • IC Issuance	100%	Supplier's Test Records / Inspection Certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), Random -10%, R-Review, RW-Random witness, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents/ Hazardous Area certifications.
3. Supplier has to furnish internal test reports before scheduled inspection date.

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औद्योगिक नियंत्रण स्टेशनो
के लिए
निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
INDUSTRIAL TYPE CONTROL STATIONS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	18.05.2020	Revised and Re-issued	NP	RS	RKS	SKS
3	30.01.2014	Revised and Re-issued	MJ	RS	SCG	SC
2	03.10.2012	Revised and Re-issued	RKP	HVJ	AKC	DM
1	28.09.2007	Revised and Re-issued	AKG	PPM	MVKK	VC
0	30.04.2002	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations

BIS	:	Bureau of Indian Standards	MTC	:	Material Test Certificates
BOM	:	Bill of Material	MFR	:	Manufacturer
CEIL	:	Certification Engineers International Limited	NO.	:	Number
CT	:	Current Transformer	NEMA	:	National Electrical Manufacturers Association
EPC	:	Engineering Procurement Construction	PO	:	Purchase Order
HV	:	High Voltage	PR	:	Purchase Requisition
IC	:	Inspection Certification	PT	:	Potential Transformer/Voltage Transformer
IEC	:	International Electro technical Commission	PVC	:	Poly Vinyl Chloride
IP	:	Ingress Protection	QC	:	Quality Control
IRN	:	Inspection Release Note	TC	:	Test Certificate
ITP	:	Inspection and Test Plan	TPI or TPIA	:	Third Party Inspection Agency
Lab.	:	Third Party Laboratory	UL	:	Under writer Laboratories
MOC	:	Material of Construction	VDR	:	Vendor Data Requirement

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members :

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar
Mr. R. Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Mahendra Mittal
Ms. Arvind NP Singh (Engg.)		

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1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Industrial type control stations.

2.0 REFERENCE DOCUMENTS:

PO/PR & Standards referred there in /Job specifications / Approved documents

3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedure**	-	-	-	-	-	-
2.0	**Material Inspection**						
2.1	Incoming material : Sheet steel, Circuit Breaker, CT/PT, Ammeter, Voltmeter as applicable	Physical & Chemical Properties for Sheet Steel. Make, Model, Rating, Serial, Accuracy etc. as applicable	100%/	MTC / Mfr's TC / Lab. TC	H	H	R
3.0	**Inprocess Inspection**						
3.1	Fabrication of Enclosure and painting /Powder Coating (as applicable)	Visual, Dimension and Routine tests	100%	Supplier's Test Records	H	H	-
3.2	Assembly/Wiring work	Wiring Check & Routine electrical Tests	100%	Supplier's Test Records	H	H	-

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Acceptance Tests	• Visual Check • BOM Verification. • Dimensional Verification. • Electrical Check/Test : a. Wire Continuity, b. Functional Check of Components and Control Schemes, c. HV Test d. IR Test (before & after HV) • Paint Thickness & Paint Shade	100%	Inspection witness Test Records	-	H	RW
4.2	Submission of Certificates	• Certificate of testing agency for suitability of degree of protection (as specified)	Samples / Prototype	Type Test Certificates	-	H	R
5.0	**Painting and Packing**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation.	100%	Test records	-	H	-

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.0	**Documentation**						
6.1	Documentation and IC/IRN	• Review of Internal Test Report • Issuance of IC/IRN	100%	Supplier's Test Records / IC/IRN	-	H	H
6.2	Final Document submission (if applicable)	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval,R-Review, RW-Random witness (As specified or 10 %-Samples must include minimum 1 No. of each type) , W-Witness (Give due notice, work may proceed after scheduled date).

NOTES :

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents
3. For EPC Jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

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एम वी स्विचबोर्डो
के लिए
निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
M.V.SWITCHBOARDS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	15.05.2020	Revised and Reissued	YVT	VR	RKS	SKS
3	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
2	15.07.2011	Revised and Reissued	GS	SA	AKC	DM
1	28.09.2007	Revised and Reissued	AKG	PPM	MVKK	VC
0	30.04.2002	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations

BIS/IS	:	Bureau of Indian Standards
CT	:	Current Transformer
EPC	:	Engineering Procurement Construction
IC	:	Inspection Certificate
IEC	:	International Electrotechnical Commission
HMI	:	Human Machine Interface
MCCB	:	Molded Case Circuit Breaker
MV	:	Medium Voltage
PO	:	Purchase Order
PR	:	Purchase Requisition
QC	:	Quality Control
RPO	:	Regional Procurement Office
SFU	:	Switch Fuse Unit
SAS	:	Substation Automation System
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
VDR	:	Vendor Data Requirement

Inspection Standards Committee

Convenor: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrasekhar	Ms. Arvind NP Singh (Electrical)
Mr. R Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of fixed / draw out type MV Switchboards.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	As per applicable BIS/IEC Standards	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Material like Insulators, Bus Bars, Fabricated items, Bus bar supports, Instrument Transformers, Relays, Indicating Instruments, Breakers, MCCBs, Isolator, etc.	Chemical, Mechanical properties, Visual, Dimensional, operational checks, Manufacturer's test certificates etc., as applicable.	100%	Material Test Certificates / Test Records	H	H	R
3.0	**Inprocess Inspection**						
3.1	Panel Assembly, Wiring checks, Relay checks	Visual, Dimensions, Clearances, Bus bar tightness, Rack in rack out operation of modules/breakers etc., as applicable. Wiring Size, termination, ferruling, continuity. Relay logic, parameterization	100%	Test Records	--	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Switchgear Assembly (Acceptance Test)	• Visual check including layout, Tag plates, Paint shade, Bus marking and sleeving, joint shrouding, form of separation, Identification and location of components etc. • Dimension check including operational height, Bus bar size, Clearances, Creepage distances, paint thickness, gland size, provision for external cable termination and Bus Duct flange Dimensions (if applicable). • Physical verification of Bus bar arrangement, Bus bar support arrangement with respect to type tested panel drawings, reports (Short circuit, Temperature rise). • Physical verification of Enclosure/Compartment design including ventilation, pressure release arrangement with respect to type tested panel drawings, reports (Short circuit, Temperature rise, Degree of Protection, Internal Arc, as applicable), as per BIS/IEC standards. • Bill of material / Make of Components check. • Auto/manual/Independent modes or Castle lock interlocks/scheme verification for Incomers, bus couplers, as applicable • Operation check for control and auxiliary equipment circuits and auxiliary contacts. • Operation checks for all control functions and interlocks as per schematic diagrams in Test and service position including mechanical interlocks, continuity check for remote terminals, as applicable.	100%	Supplier's Test Records / Inspection Witness Record	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
	Switchgear Assembly (Acceptance Test) (contd.)	• Interchangeability of identical modules / feeders (if applicable).* • Manual and electrical operation check of Breakers, Relays etc. under normal and worst voltage conditions.* • CT functional check through primary injection test* • Relay operation check through primary/secondary injection.* • Communication check between relays and Data concentrator / Ethernet Switch/HMI (if applicable).* • SAS/HMI operation and functional checks as per separate agreed ITP/FAT(if applicable). • Insulation resistance of main, auxiliary and control circuits before and after High Voltage tests. • Power Frequency voltage withstand test on main, auxiliary and control circuits.	100%	Supplier's Test Records / Inspection Witness Record	-	H	H
4.2	Switchgear Assembly (Type tests)	Temperature Rise test	Sample basis/Rating	Supplier's Test Records / Inspection Witness Record	-	H**	H**
5.0	**Painting**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage.	100%	Packing list / Supplier's Records	-	H	-

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal/Witnessed Test Reports. • IC issuance	100%	Supplier's Test Records / Inspection Certificate (IC)	-	H	H
6.2	Final Document submission	Compilation of Inspection reports, Inspection Certificates, drawings, etc., as per VDR / PR	100%	Final Document, Final Document Completeness Certificate	-	H	H

* Quantum of check is 100% by Supplier & random basis by EIL/TPIA.

** Witness if called for in job specifications/data sheet. In such cases specified Type test will be considered as part of Acceptance Tests.

Legends: H- Hold (Do not proceed without approval), Random -10%, R-Review, RW-Random witness, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
3. For EPC Jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

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अग्निरोधक प्लगों, साकेटों तथा हैंडलैम्पों के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR FLAMEPROOF PLUGS, SOCKETS AND HAND LAMPS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
3	22.05.2020	Revised and reissued	NP	RS	RKS	SKS
2	21.11.2013	Revised and reissued	MJ	RS	SCG	SC
1	29.06.2012	Revised and reissued	AB	HVJ	AKC	DM
0	01.12.2008	Issued for implementation	RB	SKD	SKP	VC

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Abbreviations

ATEX	:	Atmosphère Explosibles	IS	:	India Standard
BASEEFA	:	British Approval Service for Electrical Equipment in Flammable Atmospheres	IRN	:	Inspection Release Note
			MTC	:	Material Test Certificates
BIS	:	Bureau of Indian Standards	ITP	:	Inspection and Test Plan
BOM	:	Bill of Material	Lab.	:	Third Party Laboratory
CEIL	:	Certification Engineers International Limited	Mfr	:	Manufacturer
CT	:	Current Transformers	MOC	:	Material of Construction
CIMFR	:	Central Institute of Mining & Fuel Research	No.	:	Number
DFT	:	Dry Film Thickness	NEMA	:	National Electrical Manufacturers Association
DGMS	:	Directorate General of Mines Safety	PESO	:	Petroleum Explosive Safety Organization
DT	:	Destructive Testing	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PR	:	Purchase Requisition
ERTL	:	Electronics Regional Test Laboratory	PT	:	Voltage Transformers
FM	:	Factory Mutual	PVC	:	Poly Vinyl Chloride
HV	:	High Voltage	QC	:	Quality Control
IC	:	Inspection Certification	TC	:	Test Certificate
IEC	:	International Electrotechnical Commission	TPI or TPIA	:	Third Party Inspection Agency
IECEx	:	International Electrotechnical Commission Explosive	UL	:	Under writer Laboratories
IP	:	Ingress Protection	VDR	:	Vendor Data Requirement

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members :

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar
Mr. R. Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Mahendra Mittal
Ms. Arvind NP Singh(Engg.)		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for Flameproof Plugs, Sockets and Hand Lamps .

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTU M OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	---	---	---	---	---	---
2.0	**Material Inspection**						
2.1	Incoming Material like casting, etc	Physical, chemical & electrical properties as applicable	100%	MTC / Lab. TC	H	H	R
3.0	**In process Inspection**						
3.1	Flameproof plugs Sockets and Hand Lamps assembly	• Visual Check • Dimensional Check • Bill of Material Verification • Routine Press Test on Castings as per latest IS/IEC	100%	Test Records	-	H	R
4.0	**Final Inspection**						
4.1	Final Inspection	• Visual Check • Dimensional (flame path/gap/clearances etc.) • Bill of Material checks. • Compatibility of cable glands with cable sizes/cable entry . • Verification of mechanical and electrical operation.	100%	Test Records	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTU M OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• HV test /Insulation Resistance test before and after HV Test • Colour of metal enclosures.					
4.2	Submission of Certificates & Documents	• Type tests (if specified) • For Electrically Hazardous Area Item: a. Indigenous : Certificates from CIMFR / ERTL / Karandikar Lab, Valid PESO and BIS License for the corresponding Gas Group and Type of Protection as specified. b. Imported: ATEX/ IECex Certification from recognized test authorities and valid PESO approval for the specified gas group and type of protection . c. For use in Projects related to Mines, DGMS approval is required. • Degree of protection certificate (IP) for Instruments housing.	Proto-type from each Model	Certificates from test agencies / Statutory Bodies	-	H	R
5.0	**Painting**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage.	100%	Packing list / Supplier's Records	-	H	-

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTU M OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.0	**Documentation**						
6.1	Documentation and IC/IRN	• Review of Internal Test Reports • Issuance of IC/IRN	100%	Supplier Test Records / IC/IRN	-	H	H
6.2	Final Document submission (if applicable)	Compilation of Inspection reports , Drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No. of each type), W-Witness (Give due notice, work may proceed after scheduled date).

NOTES :

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents
3. For EPC Jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

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हाई मास्ट प्रकाश व्यवस्था के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR HIGH MAST LIGHTING SYSTEM

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by: Standards Committee Convener	Approved by: Standards Bureau Chairman
3	17.10.2024	Revised and Re-issued	NP	GS	RK	MN
2	09.06.2020	Revised and Re-issued	SA	RS	RKS	SKS
1	30.01.2014	Revised and Re-issued	MJ	RS	SCG	SC
0	08.12.2008	Issued for implementation	RB	SKD	SKP	VC

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Abbreviations

AS	:	Alloy Steel
BASEEFA	:	British Approval Service for Electrical Equipment in Flammable Atmospheres
BIS	:	Bureau of Indian Standards
CCE or CCOE	:	Chief Controller of Explosives
CEIL	:	Certification Engineers International Limited
CIMFR	:	Central Institute of Mining & Fuel Research
CE	:	Carbon Equivalent
DFT	:	Dry Film Thickness
DT	:	Destructive Testing
DPT/DPE	:	Dye Penetrant Testing/ Dye Penetrant Examination
ERTL	:	Electronics Regional Test Laboratory
FCRI	:	Fluid Control Research Institute
FM	:	Factory Mutual
FLP	:	Flame Proof
HIC	:	Hydrogen Induced Cracking
ITP	:	Inspection and Test Plan
IP	:	Ingress Protection
IC/IRN	:	Inspection Certification/Inspection Release Note
IGC	:	Inter Granular Corrosion
IEC	:	International Electro technical Commission
JEC	:	Japanese Electro technical Committee
LPT/LPE	:	Liquid Penetrant Testing/ Liquid Penetrant Examination
MRT	:	Mechanical Run Test
MFR	:	Manufacturer
MTC	:	Material Test Certificate
MOC	:	Material of Construction
NPSH	:	Net Positive Suction Head
NDT	:	Non Destructive Testing
NEMA	:	National Electrical Manufacturers Association
PO	:	Purchase Order
PESO	:	Petroleum Explosive Safety Organization
PQR	:	Procedure Qualification Record
PR	:	Purchase Requisition
PMI	:	Positive Material Identification
PVC	:	Poly Vinyl Chloride
QC	:	Quality Control
RT	:	Radiography Testing
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
UT	:	Ultrasonic Testing
UL	:	Under writer Laboratories
VDR	:	Vendor Data Requirement
WPS	:	Welding Procedure Specification
WPQ	:	Welders Performance Qualification
XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Himangshu Pal
Mr. Chandrasekhar
Mr. Anil Kumar
Mr. G.Suresh
Mr. Avdhesh Agarwal
Mr. Mahendra Mittal
Mrs. Arvind NP Singh (Electrical)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for High Mast Lighting System.
Supplier shall perform all the tests listed under their scope, meeting all the requirement of job PR & EIL standard specification 6-51-0039.
Inspection call to be issued only after satisfactory internal test results.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred therein /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Material Inspection**						
1.1	Incoming Material such as: Plates for Mast, Stiffener Plates, Base Plates, Base flange Gaskets, Anchor-bolts with Hex Nuts., Lantern Carriage with fixtures, Aviation obstruction light, Head Frame with lightning rods, Winch Assembly with power tools, Stainless Steel Wire Rope, Local Control Station, Feeder pillar box, Earthing Materials, Cables, Cable Glands etc. (as applicable)	• Visual, Dimensional, Material Identification, Chemical & Physical Properties. • Bought-out Components: Manufacturer's Routine & Operational check as applicable. • Materials for Earthing arrangements in compliance to IS-3043/ relevant STD or Code of Practice.	100%	•Raw Material: MTC/Lab. TC /Dimensional. •Routine and Operational Test reports for Bought-out items	H	R	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**In process Inspection**						
2.1	**Mast Fabrication:** (Refer Note-4)	• Fabrication compliance as per approved Drawings. • Weld Quality (Visual and DPT/LPT). • Dimensional verification.	100%	MFR's Test Reports	H	R	R
2.2	**Hot Dip Galvanization:** (Shall be done Internally and externally as per IS-4759) on: • Entire fabricated mast. • Lantern carriage. • Fasteners (Anchor bolts/studs/bolts/nuts). • Any other component, as applicable.	Tests/Checks shall be done as per IS-4759 and relevant standards mentioned in it. • Visual check Finish (uniform, adherent, • Smoothness and free from imperfections such as flux, ash bare patches, black spots, pimples, lumpiness, runs, rust stains, bulky white deposits and blisters.) • Determination of Uniformity of Galvanizing Coating. • Adhesion of Galvanized Coating. • Mass of Galvanized Coating.	As per relevant IS/ Code of Practice		H	R	R
2.3	**Assembling Stages**	Visual, Dimensional, Bill of Materials	100%	Supplier's records	-	H	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	**Final Inspection**						
3.1	Final Inspection on High Mast Lighting System	• Visual and Dimensional • Bill of Material • Functional and electrical test on feeder pillars/control cubicles • Functional & electrical test for power tools & fixtures • Load carrying capacity test by simulation on Winch Assembly.	100%	Supplier's Test Records and Inspection Witness Record	-	H	H
					-	H	RW
		• **Galvanization test as per IS-4759 and relevant standards mentioned in it.** a. Visual check Finish (uniform, adherent, Smoothness and free from imperfections such as flux, ash bare patches, black spots, pimples, lumpiness, runs, rust stains, bulky white deposits and blisters.) b. Determination of Uniformity of Galvanizing Coating. c. Adhesion of Galvanized Coating. d. Mass of Galvanized Coating.	As per relevant Code	Inspection Records/ Reports	--	H	RW

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.2	**Type Test and Statutory Certifications**	• Degree of protection (IP) certificate as applicable. • Type test certificates for High Mast Lighting Systems equipment. • Certifications for Electrical Hazardous Area usage: PESO certification, BIS License and CIMFR/Karandikar Lab./Equivalent Lab Test Reports for Winch Motor and Feeder Pillar, as applicable. • Test certificate for power tool, Steel wire rope. • Manufacturer's Internal test report for Operation of winch for Over Speed, Time to Raise / Lower.	Prototype for each model	Statutory Approval Certificates / Type Test Certificates	-	R	R
4.0	**Painting**						
4.1	Painting and Packing	• Visual • Proper packing to prevent any damage during transportation • Suitable packing for outdoor storage areas with heavy rains/high ambient temperature unless otherwise agreed	100%	Packing list / Supplier's Records	-	W	-

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Documentation and IC/IRN**						
5.1	Documentation and IC/IRN.	• Review of Internal Test Reports, MTC for various Stages mentioned under Clause. 2.1 to 2.3 • Type Test and Statutory Certifications as per Clause. 3.2 • Issuance of IC/IRN.	100%	Supplier's Test Records / MTC/ Type & Statutory Certification and IC/IRN	-	H	H
5.2	Final Document submission	Compilation of Inspection reports, drawings, etc. as per VDR / PR	100%	Final Data Folder / Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval, R- Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
3. For EPC jobs scope of inspection shall be under TPIA, unless specified otherwise.
4. Supplier/Sub-supplier to ensure availability of Internal Fabrication Procedure prior to starting of fabrication.

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शुष्क किस्म के लाईटिंग ट्रांसफॉर्मर के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR DRY TYPE LIGHTING TRANSFORMER

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	22 01 2020	Revised and Re-issued	MM	RS	RKS	RKT
2	21 11 2013	Revised and Re-issued	MJ	RS	SCG	SC
1	29 06 2012	Revised and Re-issued	RKP	RJD	AKC	DM
0	08 12 2008	Issued for implementation	RB	SKD	SKP	VC

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Abbreviations

BIS	:	Bureau of Indian Standard
CBIP	:	Central Board of Irrigation and Power
ERTL	:	Electronics Regional Test Laboratory
FM	:	Factory Mutual
FLP	:	Flame Proof
FRLS	:	Flame Retardant Low Smoke
HV	:	High Voltage
ITP	:	Inspection and Test Plan
IP	:	Ingress Protection
IC	:	Inspection Certification
IEC	:	International Electro technical Commission
JEC	:	Japanese Electro technical Committee
MTC	:	Material Test Certificate
PO	:	Purchase Order
PESO	:	Petroleum Explosive Safety Organization
PR	:	Purchase Requisition
PVC	:	Poly Vinyl Chloride
QC	:	Quality Control
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
VDR	:	Vendor Data Requirement

Inspection Standards Committee

Convenor : Mr. RK Singh

Members:

Mr Rajesh Sinha	Mr. Himangshu Pal	Mr Chandrasekhar
Mr R Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Deepak Gupta (Project)
Mr. Mahendra Mittal		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing & inspection requirements of Dry Type Lighting Transformer.

2.0 REFERENCE DOCUMENTS

PO/PR & Standards referred there in /Job specifications / Approved documents/ Relevant BIS/IEC/CBIP

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Raw Material like Copper Conductor, Lamination, enclosure, Marshalling box, cables(FRLS), , copper flexible, insulators, dials, Scanners and gauges etc.	• Dimensional and Operational checks • Physical, Chemical, Electrical properties (as applicable) • Calibration checks (as applicable)	100%	Material Test Certificates / Test records	H	H	R
3.0	**In process Inspection**						
3.1	Transformer Assembly	Visual, Dimensions, Bill of materials.	100%	Test Records	-	H	-

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Transformer (Routine Tests)	• Physical and dimensional check. • Measurement of winding resistance • Measurement of voltage ratio and check of voltage vector relationship • Magnetic balance test • Measurement of impedance voltage, short-circuit impedance and load loss • Measurement of no-load loss and current at 90%,100% and 110 % of Nominal voltage • Separate –source voltage withstand test (HV test) • Measurement of Insulation Resistance before and after HV test. • Polarization Index • Induced over voltage withstand test • Noise Level Test	100%	Inspection test records	-	H	R
4.2	Transformer (Special Test)	• Temperature rise	One sample from each type/rating	Inspection test records	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.3	Transformer (Type Test)	• Short circuit test • Impulse Withstand Test. • Degree of Protection of Enclosure.	One sample from each type/rating	Inspection test records	-	H	R
5.0	**Painting**						
5.1	Painting and Packing	• Visual, Packing list. • Proper packing to avoid any damage during transportation.	100%	Supplier's records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports. • IC issuance	100%	Supplier's Test Records / Inspection Certificate (IC)	-	H	H
6.2	Final Document submission	Compilation of Inspection reports, drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

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NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents
3. Supplier to furnish internal test report before scheduled inspection date.

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नेऊतरल ग्रौंडिंग रेसिस्टर
के लिए
निरीक्षण ब परीक्षण योगोना

INSPECTION AND TEST PLAN
FOR
NEUTRAL GROUNDING RESISTOR

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	31.07.23	Revised and Re-issued	DB	RJD	RK	S MAZUMDAR
4	22.01.20	Revised and Re-issued	MM	RS	RKS	RKT
3	30.01.14	Revised and Re-issued	MJ	RS	SCG	SC
2	29.06.12	Revised and Re-issued	RKP	RJD	AKC	DM
1	28.09.07	Revised and Re-issued	AKG	PPM	MVKK	VC
0	25.07.02	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations

AS	:	Alloy Steel
BIS	:	Bureau of Indian Standard
CIMFR	:	Central Institute of Mining & Fuel Research
ERTL	:	Electronics Regional Test Laboratory
FM	:	Factory Mutual
FLP	:	Flame Proof
HT	:	Heat Tension
ITP	:	Inspection and Test Plan
IP	:	Ingress Protection
IC	:	Inspection Certification
IEC	:	International Electro technical Commission
JEC	:	Japanese Electro technical Committee
MTC	:	Material Test Certificate
NEMA	:	National Electrical Manufacturers Association
PO	:	Purchase Order
PESO	:	Petroleum Explosive Safety Organization
PR	:	Purchase Requisition
PVC	:	Poly Vinyl Chloride
QC	:	Quality Control
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
VDR	:	Vendor Data Requirement
XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr Rajesh Sinha	Mr. Himangshu Pal	Mr Chandrasekhar
Mr R Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Anil Kumar
Ms. Arvind NP Singh (Electrical)		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing & inspection requirements of Neutral Grounding Resistors.

2.0 REFERENCE DOCUMENTS

PO/PR & Standards referred there in /Job specifications / Approved documents/Relevant IS/IEC

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Material like Stainless steel grids, Resistors, Insulators, Bus Bars, Bushings, Current Transformers, Isolators, Sheet metal, MICA Ti Rod, cable gland, etc.	Visual, Dimensional, Chemical, Physical, Dielectric properties etc. as applicable	As per supplier's sampling plan	Sub-Supplier's TC / Supplier Test Records/ Third party lab/ Manufacturer's test certificates	H	H	-
3.0	**In process Inspection**	Assembly			-	H	-

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	NGR (Acceptance Tests)	• Physical and BoM Verification. • Dimension check including Bus size, Clearances, Creepage distances, etc. • Verification for external cable termination, Non magnetic gland plate and size of terminals/cable gland, earthing provision • Provision of lifting hooks and grouting of NGR Panel. • Series/parallel arrangements check of elements. • Measurement of Resistance • Continuity of Electrical Circuit & Functional Test • Power frequency voltage (HV) withstand test • Insulation resistance before and after HV tests • Verify provision of earthing. • Space heater functioning. • Rated short time temperature rise test in a proportionately sized enclosure by passing rated current on a limited resistor section as per	100%	Inspection test records	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		specification at constant Voltage (One unit/Rating) • Temperature rise test on a limited resister section (Min 2 element) in a proportionately sized enclosure at 10 % of rated current at constant Voltage (One unit/Rating) (As specified in Technical Data sheet/EIL Spec/ Approved ITP)					
4.2	Submission of certificates / documents	• Degree of protection certificate as applicable.	Sample/Proto type	Statutory Approval Certificates / Type Test Certificates	-	H	R
5.0	**Painting**						
5.1	Painting and Packing	• Visual. • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation.	100%	Test records	-	H	--
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports and MTCs. • IC issuance	-	Supplier's Test Records / Inspection	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
				Certificate (IC)			
6.2	Final Document submission	Compilation of Inspection reports, drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.

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वाल्व रेगुलेटिड स्टेशनरी लैड एसिड बैटरी के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR STATIONARY VALVE REGULATED LEAD ACID BATTERY

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	15.05.2020	Revised and Reissued	YVT	VR	RKS	SKS
2	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
1	29.06.2012	Revised and Reissued	RKP	RJD	AKC	DM
0	01.12.2008	Issued for implementation	SA	SKD	SKP	VC

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Abbreviations

BIS/IS	:	Bureau of-Indian Standards
EPC	:	Engineering Procurement Construction
IC	:	Inspection Certificate
IEC	:	International Electrotechnical Commission
PO	:	Purchase Order
PR	:	Purchase Requisition
QC	:	Quality Control
RPO	:	Regional Procurement Office
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
VDR	:	Vendor Data Requirement

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members:

Mr Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrasekhar	Ms. Arvind NP Singh (Electrical)
Mr R Muthuramalingam	Mr Avdhesh Agrawal	Mr. Mahendra Mittal	

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing & inspection requirements of Stationary Valve Regulated Lead Acid Battery.

2.0 REFERENCE DOCUMENTS

PO/PR & Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	As per applicable BIS/IEC Standards	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Material like cover seals, containers, lids, Regulating valves, Flame arrester, Electrolyte, Battery stand and other accessories	Checking the capability of components to withstand fire and flame. Oxygen Index TC for material of container, lid, cover and seal. Physical, Chemical and mechanical properties.	100%	Sub-Supplier's TC / Supplier Test Records/ Third party lab	H	H	R
3.0	**Inprocess Inspection**						
3.1	Battery assembly	• Visual, Dimensions, Bill of Material • Polarity and absence of short circuit • Charging and Discharging of cells	100%	Supplier's Test Records	-	H	R
4.0	**Final Inspection**						
4.1	Battery(Acceptance Tests)	• Visual • Polarity and absence of short circuit • Dimension, mass and layout check. • Test for Ampere Hour Capacity. • Test for voltage during discharge. • Internal resistance test	As per IS 15549/ latest applicable IS Sampling Plan (per lot)	Inspection test records	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	Battery Stand	Dimension, Paint Shade/thickness	100%	Inspection test records	H	H	R
4.3	Battery (Type Tests)	• Acid Retention Capability Test on Separators. • Wicking Test on Separator. • Test on Vent Seal Operation • Test for Oxygen Recombination Efficiency. • Ampere hour and Watt-hour Efficiency test • Test for charge retention/ Loss of capacity. • Life cycle test on similar model/type.	As per IS 15549 Sampling plan / Rating/type	Type Test Records	-	H	R
5.0	**Painting and Packing**						
5.1	Painting and Packing	• Visual, Packing list. • Proper packing to avoid any damage during transportation.	100%	Supplier's records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal/Witnessed Test Reports. • IC issuance.	100%	Supplier's Test Records / Inspection Certificate (IC)	-	H	H
6.2	Final Document submission	Compilation of Inspection reports/Certificates, drawings, etc., as per VDR / PR	100%	Final Documents, Final Document Completeness Certificate	-	H	H

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

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NOTES :-

1. For package orders (involving battery under scope of supply), battery inspection including witness of acceptance tests shall be carried out by package supplier/contractor or their appointed representative, prior to submission of inspection documents for EIL/TPIA review.
2. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
3. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
4. For EPC Jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

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संचार और अग्नि चेतावनी केबल के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR COMMUNICATION AND FIRE ALARM CABLES

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	26.05.2020	Revised and Reissued	MM	RS	RKS	SKS
3	30.01.2014	Revised and Reissued	MJ	RS	RKS	SC
2	29.06.2012	Revised and Reissued	RKP	RJD	AKC	SC
1	28.09.2007	Revised and Re-issued	AKG	PPM	MVKK	VC
0	30.04.2002	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations:

BIS	:	Bureau of Indian Standard	MTC	:	Material Test Certificate
DOT	:	Department of Telecommunication	NEMA	:	National Electrical Manufacturers Association
EPC	:	Engineering Procurement & Construction	No	:	Number
ERTL	:	Electronics Regional Test Laboratory	PD	:	Partial Discharge
FM	:	Factory Mutual	PE	:	Polyethylene
ITP	:	Inspection and Test Plan	PO	:	Purchase Order
IP	:	Ingress Protection	PR	:	Purchase Requisition
IC	:	Inspection Certification	PVC	:	Poly Vinyl Chloride
IGC	:	Inter Granular Corrosion	QC	:	Quality Control
IEC	:	International Electro technical Commission	TC	:	Test Certificate
IS	:	Indian Standard	TPI or TPIA	:	Third Party Inspection Agency
JEC	:	Japanese Electro technical Committee	VDR	:	Vendor Data Requirement
Min	:	Minimum	XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members: Mr. Rajesh Sinha, Mr. Himangshu Pal, Mr. Chandrasekhar, Mrs. Arvind NP Singh (Electrical), Mr. R Muthuramalingam, Mr Avdhesh Agrawal, Mr. Mahendra Mittal

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of flame retardant type PVC sheathed cables for use in Plant communication, Fire Alarm systems and Jelly filled telecommunication cables.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming raw material like Copper ,Aluminum, PVC, PE, XLPE , Jelly Compound, Armour material, etc. (as applicable)	Dimensional, Purity, Physical, Chemical Properties, Tests on jelly compound as per DOT spec.	Sample	Sub supplier TC/Supplier's Test Records/ Third party Lab	H	H	**R**
3.0	**In process Inspection**						
3.1	Manufacturing Stage	Dimensions at various stages, Spark test, Stage Inspection, pursulphate test for conductor.	100%	Supplier's Test Records	-	H	**R**
4.0	**Final Inspection**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Final Inspection on completed cable	Visual, Drum details, Size, Ends Capping, Drums Condition, Marking on outer sheath (such as incremental length, voltage grade, manufacturer's name and for jelly filled cables marking as per DOT spec), Color coding/Identification of cores, conductor resistance ,high voltage etc.	100%	Inspection Witness Record	-	H	RW
4.2	Final Inspection on completed Cable(Jelly Filled Cables) Acceptance Test	• Dimension checks. • Test for insulation and sheath. • Continuity of conductors, absence of crossed pairs and absence of contact with poly-al tape • Continuity in poly-al tape and overlap • Color coding • Conductor Resistance, Resistance Unbalance in pair. • Mutual capacitance (pair/average), Capacitance Unbalance (pair to ground and pair to pair) • Cross talk • Attenuation • Drip test • Dielectric Strength/High Voltage test • Insulation Resistance/ Volume resistivity • Conductor Annealing	As per IS sampling plan	Inspection Witness Record	-	H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• Armour Galvanization • Armour coverage • Availability of rip cord • Overall finish and Drum length by re-winding (1 or 2 drum per lot) • Oxygen and temperature index test (1 sample/lot) • Water Penetration test (2 sample per lot) • Cable bend test (1 sample per lot)					
4.3	Final Inspection on completed Cable(Jelly Filled Cables) Type Tests	• Type tests on insulated conductors, compatibility of Insulation and filling compound as per DOT spec. • Type tests on Composite sheath and Jacket as per DOT spec	On Sample	Supplier's Test Records	-	H	R
4.4	Final Inspection on completed Cable(Non Jelly Filled Cables) Acceptance Test	• Dimension checks • Continuity of conductors • Color code • Overlap in poly-al tape and drain wire resistance (if shielding specified) • Conductor Resistance. • Drain wire resistance • Mutual capacitance (pair/average), Capacitance Unbalance (pair to ground and	As per IS sampling plan	Inspection Witness Record	-	H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		pair to pair) for communication cables • Dielectric Strength/ High Voltage test • Insulation Resistance • Tensile and Elongation (without ageing) • Conductor Annealing • Armour Galvanization & coverage • Availability of rip cord • Tests on Insulation and sheath as per IS/IEC *					
4.5	Final Inspection on completed Cable(Non Jelly Filled Cables) Special Test	• Oxygen & temperature Index Test • Flammability test as per applicable specification (IS 10810 Part 61 & Part 62, Cat AF) • Smoke density test • Acid gas generation test • Test for Rodent & termite repulsion • Surface finish and drum length check by wiring(Rewinding 1 or 2 drum) • Test for circuit integrity for fire survival cables as per IEC (as applicable	1 Sample/Lot For ladder test (1 sample/order)	Inspection Witness Record	-	H	RW
4.6	Final Inspection on completed Cable (Non Jelly Filled Cables) Type Tests	• Type test on conductor as per spec • Type tests on insulation and Sheath as per spec • Test certificate for circuit integrity as per IEC 60331-21(for fire survival cable)	On Sample	Supplier's Test Records	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports and MTCs. • IC issuance	-	Supplier's Test Records / Inspection Certificate (IC)	-	H	H
6.2	Final Document submission	Compilation of Inspection reports, drawings, etc as per VDR / PR	100%	Final data folder / Completeness certificate	-	H	H

* Thermal Stability, Hot deformation, Heat shock and Shrinkage tests on insulation and sheath shall be witnessed by EIL (One Sample/Lot), all other tests as per IS-5831 shall be carried out by supplier and test reports shall be reviewed by EIL.

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
3. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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न्यूमेरिकल रिले
के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
NUMERICAL RELAYS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	20.05.2020	Revised and Reiisued	JA	RA	RKS	SKS
2.	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
1	29.06.2012	Revised and Reissued	RKP	RJD	AKC	DM
0	08.12.2008	Issued for implementation	RB	SKD	SKP	VC

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Abbreviations

BIS	:	Bureau of Indian Standard	MTC	:	Material Test Certificate
BOM	:	Bill Of Material.	MMI	:	Man Machine Interface
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CT	:	Current Transformer	DCP	:	Data Concentrator Panel
DCS	:	Distributed Control System	IEC	:	International Electrotechnical commission
ERTL	:	Electronics Regional Test Laboratory	PQR	:	Procedure Qualification Record
ECS	:	Emergency Control System	PT	:	Potential Transformer.
EMC	:	Electro Magnetic Compatibility	PR	:	Purchase Requisition
FM	:	Factory Mutual	PMI	:	Positive Material Identification
FLP	:	Flame Proof	PVC	:	Poly Vinyl Chloride
GPS	:	Global Positioning Syetem	SLD	:	Single Line Diagram.
ITP	:	Inspection and Test Plan	TPI or TPIA	:	Third Party Inspection Agency
HV	:	High Voltage	SCADA	:	Supervisory Control And Data Acquisition
IR	:	Insulation Resistance	UPS	:	Uninterrupted Power Supply.
IS	:	Indian Standard			

Inspection Standards Committee

Convenor : Mr. R.K.Singh

Members:

Mr. Rajesh Sinha
Mr. R. Muthuramalingam
Ms. N.P. Singh (Electrical)
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. Chandrashekhar
Mr. Mahendra Mittal

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Numerical Relays, Data Concentrator and MMI Systems.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Raw Material/Components like Printed circuit Boards, Link Interface unit, Network Switches,Relays, Ethernet Cards, Communication cables, Power Supplies, Transducers, CT/PT, GPS System, Enclosure, Printer, Laptops, UPS, Desktop etc	Manufacturers' TC / Compliance.	100%	Material Test Certificates	H	H	R
3.0	**In process Inspection**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Final Inspection-Numerical Relays	• Visual checks and model verification • Self Diagnostics and communication integrity including time synchronization check, as per applicable standard • All functional characteristics checks as per job requirement.	100%	Supplier's Test Records and Inspection Witness Record	-	H	RW
4.2	Final Inspection- Data Concentrators/MMI (note -3)	• Physical, Dimensional and BOM Verification. • Schematic and Functional Checks. • Continuity Check of Control Wiring (Random). • High Voltage test and IR before and after HV. • Time Synchronization check with Job GPS system. • Redundancy checks of Processor, Communication and Power Supply • Data Logging, Alarm Generation, event Recording and Trends verification (with Time Stamping). • Verification of SLD Representation, Multi window Representation and Dynamic Graphics of MMI • Power Distribution Checks. • Input/ Output Tests	100%	Test Report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• Verification of Scan time (if Applicable) • Verification of Communication with SCADA/ECS/DCS (As applicable). • Verification of Control Access Levels (Operator/ Engineer/ Administrator) • Software License Check. • Relay shall be compatible with IEC-61850					
4.3	Type Tests-Numerical Relays	Type test certificates as per relevant Indian /International standards. Type tests shall include as minimum but not be limited to the following • Temperature withstand • Disturbance immunity • Electromagnetic compatibility (EMC) • HV withstands test for panel • Functional tests and Communication integrity • Relay characteristics verification • Degree of protection as per latest IS/IEC, for relays and Data Concentrator Panels (DCP). • Mechanical stress/ vibration test	Prototype for each model	Statutory Approval Certificates / Type Test Certificates	-	R	R
5.0	**Painting**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Protection against damage during transportation.	100%	Packing list / Supplier's Records	-	H	-

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Issuance of IC	-	Inspection Certificate Format	-	-	H
6.2	Final Document submission	• Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include minimum 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents .
3. DCP functional test shall be performed with Job relays.
4. For EPC jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

Signature Not Verified
Digitally signed by ARITRA DE
Date: 2026.05.18 17:47:31 IST
Location: eProcure-EPROC

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