बोलीकर्ता से गुणवत्ता प्रबंधन प्रणाली अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR QUALITY MANAGEMENT SYSTEM REQUIREMENTS FROM BIDDERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
2	12.06.20	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

ISO	-	International Organization for Standardization
MR	-	Material Requisition
PO	-	Purchase Order
PR	-	Purchase Requisition
QMS	-	Quality Management System

QMS Standards Committee

Convener: Mr. S.K. Badlani

Members:
Mr. Sanjay Mazumdar (Engg.)
Mr. R.K. Singh (SCM)
Mr. B. Biswas (SCM)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)

CONTENTS

1.0 SCOPE

This specification establishes the Quality Management System requirements to be met by BIDDER for following purpose:

- QMS requirements to be met by suppliers / contractors after award of work / during contract execution.

2.0 DEFINITIONS

2.1 Bidder

For the purpose of this specification, the word "BIDDER" means the person(s), firm, company or organization who is under the process of being contracted by EIL / Owner for delivery of some products (including service). The word is considered synonymous to supplier, contractor or vendor.

2.2 Project Quality Plan

Document tailored from Standard Quality Management System Manual of BIDDER, specifying how the quality requirements of the project will be met.

2.3 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

6-78-0002	Specification for Documentation Requirements from Contractors
6-78-0003	Specification for Documentation Requirements from Suppliers

4.0 QUALITY MANAGEMENT SYSTEM – GENERAL

Unless otherwise agreed with EIL / Owner, the BIDDER proposed quality system shall fully satisfy all relevant requirements of ISO 9001 "Quality Management Systems – Requirements." Evidence of compliance shall be current certificate of quality system registration to ISO 9001 or a recent compliance audit recommending registration from a certification agency. The quality system shall provide the planned and systematic control of all quality related activities for execution of contract. Implementation of the system shall be in accordance with BIDDER'S Quality Manual and PROJECT specific Quality Plan.

5.0 QUALITY SYSTEM REQUIREMENTS

5.1 BIDDER shall prepare and submit for review / record, Project Quality Plan / Quality Assurance Plan for contracted scope / job. The BIDDER'S Quality Plan shall address all of the applicable elements of ISO 9001, identify responsible parties within BIDDER'S organization, for the implementation / control of each area, reference the applicable procedures used to control / assure each area, and verify the documents produced for each area. The Project Quality Plan shall necessarily define control or make reference to the relevant procedures, for design and engineering, purchase, documentation, record control, bid evaluation, inspection, production / manufacturing, preservation, packaging and storage, quality control at construction site, pre-commissioning, commissioning and handing over (as applicable) in line with contract requirement and scope of work.

5.2 BIDDER shall identify all specified or implied statutory and regulatory requirements and communicate the same to all concerned in his organization and his sub contractor's organization for compliance.

5.3 BIDDER shall deploy competent and trained personnel for various activities for fulfillment of PO / contract. BIDDER shall arrange adequate infrastructure and work environment to ensure that the specification and quality of the deliverable are maintained.

5.4 BIDDER shall do the quality planning for all activities involved in delivery of order. The quality planning shall cover as minimum the following:

- Resources
- Product / deliverable characteristics to be controlled.
- Process characteristics to ensure the identified product characteristics are realized
- Identification of any measurement requirements, acceptance criteria
- Records to be generated
- Need for any documented procedure

The quality planning shall result into the quality assurance plan, inspection and test plans (ITPs) and job procedures for the project activities in the scope of bidder. These documents shall be submitted to EIL / Owner for review / approval, before commencement of work.

5.5 Requirements for sub-ordering of outsourced items / sub-contracting / purchasing of services specified in MR / contract / tender shall be adhered to. In general all outsourced items will be from approved vendors of EIL. Wherever requirements are not specified, or approved sub vendors do not exist, the sub-contractor shall establish and maintain a system for purchasing / sub-contracting to ensure that purchased product / service conforms to specified requirements in concurrence with EIL / Owner. Criteria for selection of sub-contractor, evaluation, re-evaluation, maintenance of purchasing data and verification of purchased product (sub-contractor services), constitute important components of this requirement.

5.6 BIDDER shall plan and carry production and service provision under controlled conditions. Controlled conditions shall include, as applicable

a) the availability of information that describes the characteristics of the product
b) the availability of work instructions
c) the use of suitable equipment
d) the availability and use of monitoring and measuring devices
e) the implementation of monitoring and measurement
f) the implementation of release, delivery and post-delivery activities

5.7 BIDDER shall validate any processes for production and service provision where resulting output cannot be verified by subsequent monitoring and measurement. This includes any process where deficiencies become apparent only after the product is in use or service has been delivered.

5.8 BIDDER shall establish a system for identification and traceability of product / deliverable throughout product realization. Product status with respect to inspection and testing requirements shall be identified.

5.9 BIDDER shall identify, verify, protect and safeguard EIL / Owner property (material / document) provided for use or incorporation into the product. If any Owner / EIL property is lost, damaged or otherwise found to be unsuitable for use, this shall be reported to the EIL / Owner.

5.10 BIDDER shall ensure the conformity of product / deliverable during internal processing and delivery to the intended destination. Requirements mentioned in the MR/ tender shall be adhered to.

5.11 BIDDER shall establish system to ensure that inspection and testing activities are carried out in line with requirements. Where necessary, measuring equipment shall be calibrated at specified frequency, against national or international measurement standards; where no such standard exists, the basis used for calibration shall be recorded. The measuring equipment shall be protected from damage during handling, maintenance and storage.

5.12 BIDDER shall ensure effective monitoring, using suitable methods, of the processes involved in production and other related processes for delivery of the scope of contract.

5.13 BIDDER shall monitor and measure the characteristics of the product / deliverable to verify that product requirement has been met. The inspection (stage as well as final) by BIDDER and EIL / Owner personnel shall be carried out strictly as per the approved ITPs or ITPs forming part of the contract. Product release or service delivery shall not proceed until the planned arrangements have been satisfactorily completed, unless otherwise approved by relevant authority and where applicable by Owner / EIL.

5.14 BIDDER shall establish and maintain a documented procedure to ensure that the product which does not conform to requirements is identified and controlled to prevent its unintended use or delivery

5.15 All non-conformities (NCs) / deficiencies found by the BIDDER'S inspection / surveillance staff shall be duly recorded, including their disposal action shall be recorded and resolved suitably. Effective corrective actions shall be implemented by the BIDDER so that similar NCs including deficiencies do not recur. The BIDDER shall take appropriate actions to address the Risks and Opportunities in the project.

5.16 All deficiencies noticed and reported by EIL / Owner shall be analyzed by the BIDDER and appropriate corrective actions shall be implemented. BIDDER shall intimate EIL / Owner of all such corrective action implemented by him.

5.17 BIDDER should follow the standards, specifications and approved drawings. Concessions / Deviations shall be allowed only in case of unavoidable circumstances. In such situations Concession / deviation request must be made by the BIDDER through online system of EIL eDMS. URL of EIL eDMS is http://edocx.eil.co.in/vportal.

5.18 BIDDER shall have documented procedure for control of documents.

5.19 All project records shall be carefully kept, maintained and protected for any damage or loss until the project completion, then handed over to EIL / Owner as per contract requirement (Refer Specification Nos. 6-78-0002 - Specification for Documentation Requirements from Contractors and 6-78-0003 - Specification for Documentation Requirements from Suppliers), or disposed as per relevant project procedure.

6.0 AUDITS

BIDDER shall plan and carry out the QMS audit for the job. Quality audit programme shall cover design, procurement, construction management and commissioning as applicable including activities carried out by sub-vendors and sub-contractors. This shall be additional to the certification body surveillance audits carried out under BIDDER'S own ISO 9001 certification scheme.

The audit programmes and audit reports shall be available with bidder for scrutiny by EIL / Owner. EIL or Owner's representative reserves the right to attend, as a witness, any audit conducted during the execution of the WORKS.

In addition to above, EIL, Owner and third party appointed by EIL / Owner may also perform Quality and Technical compliance audits. BIDDER shall provide assistance and access to their systems and sub-contractor / vendor systems as required for this purpose. Any deficiencies noted shall be immediately rectified by BIDDER.

7.0 DOCUMENTATION REQUIREMENTS

BIDDER shall submit following QMS documents immediately after award of work (Within one week) for record / review by EIL / Owner/ TPIA, as applicable.

- Organization chart (for complete organization structure and for the project)
- Project Quality Plan / Quality Assurance Plan
- Job specific Inspection Test Plans, if not attached with PR
- Job Procedures
- Inspection / Test Formats

In addition to above QMS documents, following documentation shall be maintained by the BIDDER for submission to EIL / Owner on demand at any point of time during execution of the project.

- Quality Manual
- Certificate of approval for compliance to ISO: 9001 standard
- Procedure for Control of Non-conforming Product
- Procedure for Control of Documents
- Sample audit report of the QMS internal and external audits conducted during last one year
- Customer satisfaction reports from at least 2 customers,
- Project QMS audit report
- Technical audit reports for the project
- Corrective action report on the audits

Documents as specified above are minimum requirements. BIDDER shall submit any other document / data required for completion of the job as per EIL / Owner instructions.

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SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM CONTRACTORS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
2	12.06..20	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

DCI	-	Document Control Index
FOA	-	Fax of Acceptance
IC	-	Inspection Certificate
IRN	-	Inspection Release Note
ITP	-	Inspection and Test Plan
LOA	-	Letter of Acceptance
QMS	-	Quality Management System
URL	-	Universal Resource Locator
V Portal	-	Vendor Portal

QMS Standards Committee

Convener: Mr. S.K. Badlani

Members:
Mr. Sanjay Mazumdar (Engg.)
Mr. R.K. Singh (SCM)
Mr. B. Biswas (SCM)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)

CONTENTS

Attachments

1.0 SCOPE

This specification establishes the Documentation Requirements from Contractors

All documents / data against the Tender / Contract shall be developed and submitted to EIL / Owner by the contractor for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Contractor

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

6-78-0001	Specification for Quality Management System Requirements from Bidders

4.0 DOCUMENTATION AND DATA REQUIREMENTS

4.1 Order Acknowledgement and Assigning Project Manager

After placement of order, Contractor shall acknowledge order through V-Portal within 7 days of receipt of FOA / PO. Contractor 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 Contractor

4.2.1 The contractor shall submit the documents and data against the Tender / Contract as per the list specified in respective Tender / Contract.

4.2.2 Review of the contractor drawings / Documents by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the contractor of his responsibility / contractual obligation to comply with Tender / Contract 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 contractor without any extra cost or time, whether or not comments on the same were received from EIL during the drawing review / inspection stage.

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

4.2.4 Documents as specified in Tender / Contract are minimum requirements. Contractor 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 System of units.

4.3.2 Before submitting the drawings and documents, contractor shall ensure that the following information are properly entered in each drawing:

Tender Number
Name of Equipment / Package
Equipment / Package Tag No.
Name of Project
Owner
Main Contractor (if work is sub-contracted)
Drawing / Document Title
Drawing / Document No.
Drawing / Document Revision No. and Date

4.4 Review and Approval of Documents by Contractor

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

4.5 Document Category

4.5.1 **Review Category**

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

Review Code 1	-	No comments. Proceed with Manufacture / Fabrication / Construction as per the document.
Review Code 2	-	Proceed with Manufacture / Fabrication / Construction as per commented document. Revised document required.
Review Code 3	-	Document does not conform to basic requirements as marked. Resubmit for review.
R	-	Document is retained for Records. Proceed with Manufacturing / fabrication as per Tender/ Contract Requirement.
V	-	Void

4.6 Methodology for Submission of Documents to EIL / Owner

4.6.1 Document Control Index (DCI)

Contractor shall create and submit Document Control Index (DCI) for review 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. The detail guidelines for uploading documents on EIL Vendor Portal are available on following URL

http://edocx.eil.co.in/vportal

4.6.3 Statutory Approvals

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

4.6.4 Schedule and Progress Reporting

Contractor shall submit monthly progress report (MPR) and updated procurement, engineering and manufacturing status (schedule vs. actual) and highlight constraints, if any, along with action plan for mitigation, to the EIL / Owner by 1st week of every month. One month Look-ahead schedule including the mobilization plan shall be submitted within 2 weeks from FOA / LOA. In case of exigencies, EIL / Owner can ask for report submission as required on weekly / fortnightly / adhoc basis depending upon supply status and contractor shall furnish such reports promptly without any price implication. Format for progress report shall be submitted by the contractor during kick off meeting or within one week of receiving FOA / LOA, whichever is earlier.

4.6.5 Quality Assurance Plan / Inspection and Test Plan

Inspection and test plans attached if any, to the tender are generic and indicative only. Immediately after receipt of the order, contractor shall submit within one week of receiving FOA / LOA, job specific ITPs based on the indicative ITPs. Further, contractor shall also submit Quality Assurance Plan for project activities in the scope of contract, starting from manufacturing to handing over / commissioning, these plans shall cover / identify the activities, relevant procedure, if any, code of conformance, resources for performance and checking / monitoring, approval requirements and authority, records to be generated and audit scope by EIL/Owner.

For EPCC / LSTK / Package contracts, the contractor shall prepare a list of items / equipment and their inspection categorization plans for all items included in the scope of supply immediately after receipt of order and obtain 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.

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

Contractor shall ensure that all documents viz. documents reviewed, manufacture's test certificate etc., mentioned in Inspection Release Note (IRN), issued by EIL / third party against the materials supplied by contractor, are sent to EIL along with the IRN.

IRN / IC shall be issued by EIL Inspector / third party inspection agency only after all the drawings/documents as per DCI are submitted and are accepted under review code-1 & code R. Material / Equipment dispatch from contractor's / sub vendor's works shall not commence till above condition is met.

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

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) Tender document number
b) List of drawings / documents with EIL approval code
c) Tests witnessed, documents reviewed
d) Compliance statement by TPIA that product meets the requirement as specified in EIL standard specifications, Inspection Test Plan / QAP and approved documents.

4.6.7 **Pre Commissioning & Commissioning Activities Management System (PCAMS)**

Pre Commissioning & Commissioning activities management system software shall be followed for Mechanical completion, check listing of loops, punch points, hydro test and issue of Formats during the Pre Commissioning and Commissioning activities and the same can be accessed on following URL

https://pcams.eil.co.in/

4.7 Final Documentation

4.7.1 As built Drawings

Minor Shop / Site changes made by contractor 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 contractor. These 'As-built' drawings shall be reviewed and stamped by EIL Inspector / Site engineer / TPIA also, as the case may be. Format for completeness of final documents (Format No. 3-78-0004) is attached with this specification. Contractor shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously contractor shall incorporate the shop / site changes in the native soft files of the drawings also.

4.7.2 As built Final Documents

As built final documents shall be submitted as listed in Tender / Contract

4.7.3 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.

Final Documentation shall be bound in hard board plastic folder(s) of size 265 mm x 315 mm ($10^1/_2$ inch x $12^1/_2$ 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 numbers 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 contractor. 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 Tender No., name of project, name of customer, package equipment tag no. & name (if applicable). 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.

4.7.4 **Submission of Soft copies**

Contractor 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, contractor 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 the above documents shall also be uploaded on the EIL Vendor Portal and if applicable on Client Server also.

4.7.5 **Completeness of Final Documentation**

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

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

Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Rev. 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

आपूर्तिकर्ताओं से प्रलेखन अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committe Convener	Standards Bureau Chairman
					Approved by	
2	12.06.20	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

DCI	-	Document Control Index
eDMS	-	Electronic Document Management System
FOA	-	Fax of Acceptance
IC	-	Inspection Certificate
IRN	-	Inspection Release Note
ITP	-	Inspection and Test Plan
LOA	-	Letter of Acceptance
MR	-	Material Requisition
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. S.K. Badlani

Members:
Mr. Sanjay Mazumdar (Engg.)
Mr. R.K. Singh (SCM)
Mr. B. Biswas (SCM)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)

CONTENTS

Attachments

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 (including service). 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

6-78-0001	Specification for Quality Management System Requirements from Bidders

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 respective PO / 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 of comments 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	- 1 week
Document Control Index	- 2 weeks
Other Documents / Drawings	- As per approved Document Control Index

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 System of units.

4.3.2 Before forwarding the drawings and documents, contractor shall 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 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 supplier require 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

4.5.1 **Review Category**

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

Review Code 1	-	No comments. Proceed with Manufacture / Fabrication as per the document.
Review Code 2	-	Proceed with Manufacture / Fabrication as per commented document. Revised document required.
Review Code 3	-	Document does not conform to basic requirements as marked. Resubmit for review.
R	-	Document is retained for Records. Proceed with Manufacturing / Fabrication as per PR / Tender requirements.
V	-	Void

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) for review 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 Vendor Portal are available on following 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 manufacturing schedule for the order, with key milestone activities (such as document submission, sub ordering, manufacturing, Inspection, dispatches, etc) to meet delivery as per FOA / PO terms. Supplier shall submit manufacturing schedule to concerned Regional Procurement Office (RPO) of EIL / Owner for review within 2 weeks from date of FOA / PO.

4.6.5 Schedule and Progress Reporting

Supplier shall submit monthly progress (MPR) report and updated procurement, engineering, manufacturing status, Inspection and dispatch status (schedule vs. actual) and highlight constraints, if any, along with action plan for mitigation, to the concerned Regional Procurement Office (RPO) of EIL / Owner by 1st week of every month., First MPR shall be submitted within 2 weeks from FOA / LOA. In case of exigencies, EIL / Owner can ask for report submission as required on weekly / fortnightly / adhoc 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.

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 Requisition:**

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 to concerned Regional Procurement Office (RPO) of EIL / TPIA / Owner with advance notice as per contract along with Internal test reports.

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 by the 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-1 or 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
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. Consignment 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

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. Supplier shall submit dispatch details to concerned RPO of EIL / Owner within a day of dispatch. Dispatch details shall include Lorry Receipt (LR) number / Dispatch Number, Transporter Name, Date of dispatch, Packing list, Invoice copy etc.

4.10 Final Documentation

4.10.1 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.

4.10.2 **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.

4.10.3 **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.

Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm ($10^{1}/_{2}$ inch x $12^{1}/_{2}$ 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 clip. 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.

4.10.4 **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 the above documents shall also be uploaded on the EIL Vendor Portal and if applicable on Client Server also.

4.10.5 **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.

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

Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Rev. 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

पेट्रोलियम रिफाइनरी वातावरण में सॉर सर्विस में इस्तेमाल होने वाले कार्बन स्टील अवयवों हेतु सामग्री अपेक्षा

MATERIAL REQUIREMENTS FOR CARBON STEEL COMPONENTS USED IN SOUR SERVICE IN PETROLEUM REFINERY ENVIRONMENTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	05.07.19	REAFFIRMED AND RE-ISSUED	SM	DD	SG	RKT
1	07.10.11	REVISED & ISSUED AS STANDARD SPECIFICATION	AR	SG	PPL	DM
0	07.10.04	REVISED & ISSUED AS STANDARD SPECIFICATION	GM	VRK	KKM	SKG

Abbreviations:

ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing and Materials
ISO	:	International Organization for Standardization
NACE	:	National Association of Corrosion Engineers

Materials & Coating Standards Committee:

Convener : Mr. S.Ghosal

Members :
Mr. Deepak Gupta (Projects)
Mr. M. Ismaeel (Piping)
Mr. K.J Harinarayan (SME)
Mr. D.C.Brahma (Structure)
Mr. R. Muthu Ramalingam (SCM)
Mr. Divyajyot Singh (Construction)
Mr. Naveen Parashar (Projects)
Mr. Satya Sridhar (Process-2)

CONTENTS

1.0 SCOPE

1.1 In general, for refinery services, NACE International Standard MR0103 shall be applicable. For refinery services where Hydrogen Induced Cracking (HIC) resistant carbon steel is specifically mentioned in the process documents, this specification shall be followed.

1.2 This specification lays down the requirements related to the chemical composition, manufacture, fabrication and testing requirements for carbon steel components intended to be used in sour service in petroleum refinery environments. These requirements are specified in order to make the carbon steel component resistant to the various forms of material damage in a sour environment, such as Sulfide Stress Cracking (SSC), Hydrogen Induced Cracking (HIC), Stress Oriented Hydrogen Induced Cracking (SOHIC), Blistering etc. These requirements can be used for resisting Alkaline Stress Corrosion Cracking (ASCC) also. This specification is applicable for corrosive petroleum refining facilities.

1.3 The service medium is defined as "Sour" when the service environment conforms to one of the following conditions, as defined in NACE International Standard MR0103:

Service environments containing free water (in liquid phase) and

(a) >50 ppmw dissolved H_2S in the free water,

(b) Free water pH < 4 and some dissolved H_2S present,

(c) Free water pH >7.6 and 20 ppmw dissolved hydrogen cyanide (HCN) in the water and some dissolved H_2S present,

(d) >0.003 MPa absolute (0.05psia) partial pressure H_2S in the gas in processes with a gas phase.

2.0 REFERENCED CODES/STANDARDS

NACE MR 0103	ASTM A 694	ASTM A 770
NACE RP 0472	ASTM A 216	ASTM A 370
NACE Publication 8X194 & 8X294	ASTM A 106	ASTM A 578
NACE TM 0284	API 5 L	ASME SEC II PART C
ASTM A 20	API 6 A	ASME SEC VIII-DIV.I
ASTM A 516	ASTM E 18	ASME SEC IX
ASTM A 105	ASTM E 45	ANSI B 16.34
ASTM A 234	ASTM E 92	ANSI B 31.3

All ASTM Standard designations shall be applicable for corresponding ASME designations which would be read as ASME SA XXX instead of ASTM A XXX.

3.0 GENERAL REQUIREMENTS

3.1 The steel for sour service shall be manufactured by either basic oxygen or electric arc furnace route and shall be fully killed and fine grained.

3.2 Carbon steel shall not contain intentional additions of elements such as lead, selenium or sulphur to improve machinability.

3.3 Carbon steel shall be used in one of the following heat treatment conditions.

(i) Hot-rolled
(ii) Annealed
(iii) Normalised
(iv) Normalised and tempered
(v) Normalised, austenitised, quenched and tempered
(vi) Austenitised, quenched and tempered.

3.4 All material after cold forming shall be thermally stress relieved to meet a hardness requirement of 200 BHN maximum.

3.5 All products shall be free of low temperature transformation microstructures such as bainite bands or islets of martensite.

4.0 MATERIAL SPECIFICATION

All items are required to conform to the chemical composition of the respective specification as listed below.

Plate: ASME SA516 Gr.60

Pipe: ASME SA106 Gr. B or SA333 Gr.1 or 6

Forgings: ASME SA105 or SA350 Gr.LF1 or LF2 or SA266 Class 1

Fittings: ASME SA234 Gr. WCB or SA420 Gr.WPL6

Castings: ASME SA216 Gr. WCA, WCB or WCC or SA352 Gr. LCA, LCB or LCC

Tubing: ASME SA179 or SA214

5.0 PRODUCT SPECIFIC REQUIREMNTS

5.1 Plates and Rolled Products

All rolled products such as plates and sheets and fittings / pipes made of rolled products shall meet the following specific requirements.

5.1.1 The steel shall be made through a clean steel making route and shall have minimum of inclusions.

5.1.2 The sulphur level shall be restricted to 0.003 wt%.

5.1.3 The steel shall be calcium treated for inclusion morphology control and the Ca/S ratio shall be in the range of 2 to 3. When sulphur content is less than 0.0015%, then Ca/S ratio is not applicable and calcium can be present up to 50 ppm.

5.1.4 For plates including and above 25 mm thick, through-thickness tensile testing shall be carried out in accordance with ASTM A770, with minimum reduction in area being 35% as determined in accordance with ASTM A370, on one plate per heat.

5.1.5 No repair welding shall be permitted on plated.

5.1.6 When the fabrication of the components from the previously HIC tested plates involves no heavy wall thickness reduction or material flow, such as bending, spinning or welding, no fresh HIC test would be required on the final product. However, for fabrication of products where heavy reduction of thickness and heavy flow of material is encountered while forming such as like forging, extrusion or drawing, metallographic examination of the final product shall be required to be carried out to ensure absence of elongated inclusions.

5.1.7 The plates shall be procured only from pre-qualified manufacturers.

5.2 Pre-qualification criteria for manufacturers/suppliers with prior experience track record

The manufacturers/suppliers who have proven track record of supplying materials for sour service applications in petroleum refineries to any of the process licensors such as UOP/IFP/EXXON/BP/CHEVRON or any of the reputed operating companies/consultants like ONGC/IOCL/HPCL/BPCL/EIL will be considered as 'pre-qualified manufacturers", on production of the relevant purchase orders and test certificates, certified by a witnessing third party inspection agency such as DNV/LLOYDS/BV/ABSTECH/TUV/SGS/CEIL for the conformance of the materials to the respective materials specification of the mentioned operators/engineering consultants. For pre-qualified vendors, Clause No. 5.4 is not applicable.

5.3 Pre-qualification criteria for new manufacturers/suppliers without track record

The manufacturers/suppliers who have no track record of supplying sour service materials to any of the process licensors or the reputed operating companies/consultants as mentioned in Clause No. 5.2 above, shall be considered as new manufacturers and shall be subjected to the elaborate pre-qualification by any one of the reputed third party inspection agencies like DNV/LLOYDS/BV/ABSTECH/TUV/SGS/CEIL as per the requirements.

5.4 Hydrogen Induced Cracking (HIC) Test

The requirements for HIC test shall be as follows.

(i) This test is required for manufacturers pre-qualification only.

(ii) This test shall be performed on a set of three specimens representing each production batch/heat of rolled products in accordance with NACE TM0284 with the following acceptance criteria:

(a) Crack Length Ratio (CLR) $\leq$ 10.0%
(b) Crack Sensitivity Ratio (CSR) $\leq$ 1%

(iii) In case of failure of any one of the specimens, three (3) more specimens from the same product shall be retested and all the specimens shall meet the acceptance criteria. In case of failure of any retest sample, the material shall be rejected.

6.0 POST WELD HEAT TREATMENT (PWHT) AND HARDNESS REQUIREMENT

All the weld joints, irrespective of thickness, shall be given a post weld heat treatment. The temperature range for PWHT is 595-650°C with a close control. Other aspects such as rate of heating, holding time etc. for PWHT shall be as per ASME Sec.VIII, Div.I /ANSI B31.3 requirements. The hardness of the weldment after PWHT shall be 200 BHN maximum.

ध्वनिक रोधन के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR ACOUSTIC INSULATION

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	24-09-2018	ISSUED AS STANDARD SPECIFICATION	PP	BS	PS	RKT

Abbreviations

ASTM	:	American Society for Testing and Materials
CINI	:	Committee Industrial Insulation
dB	:	Decibel
ISO	:	International Organization for Standardization
ITP	:	Inspection Test Plan
LRB	:	Light Resin Bond
MAR	:	Material Approval Request

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 (PDD)
Dr. Arijit Roy (Materials & Corrosion)
Mr. Neeraj Rai (Pipelines)
Mr. Ravindra Kumar (Construction)

CONTENTS

FIGURES

1.0 INTRODUCTION

1.1 Scope

This specification outlines the design and installation aspects of acoustic insulation and provides guidance for selection of acoustic class and extent of insulation needed for meeting a desired noise reduction.

This standard is applicable for acoustic insulation of cylindrical steel pipes attached to a noise source (such as valves, compressor, pumps, ejectors etc.) The standard is not applicable for rectangular ducting and vessels or machinery.

1.2 Definitions

Acoustic insulation: Insulation applied with an objective to reduce the noise level radiated from pipes

Acoustic class: A predefined insulation system consisting of sound absorbing / resilient material (rock wool/ glass wool/ ceramic fiber) and impermeable outer cover (cladding) with defined minimum insertion loss across frequency spectrum of the noise

Noise level dB(A): Cumulative of A-weighted average of sound radiated across the octave band spectrum, expressed in decibel dB(A)

Loudness of the sound in decibels dB(A) can be expressed in terms of sound pressure level measured at specified location with respect to sound source or in sound power (cumulative of sound pressure across the pipe length). In this specification, sound is expressed in power level.

Sound spectra: Frequency distribution of the sound in decibels (dB) at different frequency (Hz) across octave band of the sound.

Insertion loss: Difference in sound power in decibels dB(A) across the octave band (frequency spectrum) before and after application of the acoustic insulation

2.0 INFORMATION REQUIRED FROM VENDOR

The equipment supplier (valves, compressor, pumps, ejectors etc. to which the pipe is attached) shall specify the below information of the unsilenced noise source

a) **overall sound level in decibels *dB(A)*** and
b) **octave band spectrum** (frequency distribution of the sound in decibels (dB) at middle of different octave band (Hz)

Note: In case, frequency distribution is not provided and overall noise level in decibels is the only information available, the octave band spectrum shall be derived by subtracting the spectral shape from overall dB(A) for specific for the source given in Table-3.

3.0 ACOUSTIC CLASSES

Acoustic insulation shall essentially consist of a sound absorbing / resilient fibrous material (e.g. rock wool) and impermeable outer cover (metal cladding). There are three insulation classes defined. Each class shall have specified minimum insertion loss across frequency spectrum of the noise.

3.1 Description of Acoustic Classes

Three insulation classes denoted by A, B and C are referred in this specification. Physical description of the insulation classes and their acoustic performance (minimum insertion loss, when the specific insulation is applied) are given Table-1 and Table-2 respectively.

TABLE-1
PHYSICAL DESCRIPTION OF INSULATION CLASSES A, B & C

Acoustic Class	Pipe Diameter OD (mm)	Insulation		Cladding		
		Material	Minimum Thickness (mm)	Material	Minimum mass (kg/m2)	Indicative thickness (mm)
A	-	Rockwool/ glass wool/ ceramic fiber (see Note-2)	50	Stainless steel A240 TP 304	4.5	0.6
B	-		100		6.0	0.8
C	< 300		100		7.8	1.0
	300-649		100		10	1.3
	> 650 (Note-1)		Two layer 50+50		6	on 1st layer
					10	outer cladding

Notes:

1. *For pipe diameter ≥ 650 mm, two layer insulation shall be used with one intermediate cladding between the two layers and one final cladding on outer layer. Minimum mass for two types of cladding as specified shall be applicable.*

2. *Insulation material for acoustic purpose shall be mineral fiber (rock wool/ glass wool/ ceramic fiber) of appropriate density having mechanical stiffness less than $10^5/t$ N/m^3 (t=insulation thickness) and air flow resistivity in the range 2500-75000 N-sec-m^{-4}. Refer detail specification in section 6.0*
3. *For acoustic class-A, valve, flanges and extended pipe supports need not be insulated.*

4. *For acoustic class-B & C, valve and flanges shall be insulated with same class that of the pipes. Extended pipe supports shall be insulated up to the concrete or steel base or alternatively to the vibration isolator.*

5. *Wherever a high mass per unit area is required (e.g. Insulation Class-C), the cladding may be composed of stainless steel/ aluminized steel/ aluminium (aluminium not an option for fire safe insulation) of appropriate thickness with mass loaded anti drumming heavy vinyl/ flexible plastic sheet as inner layer meeting the specified overall mass per unit area.*

3.2 Acoustic Performance

Insertion loss is the reduction in sound across various frequencies when the particular insulation class is applied. The insertion loss is also dependent on the pipe diameter. Minimum insertion losses of the three acoustic classes at various pipe diameters are defined in Table-2.

TABLE-2
MINIMUM INSERTION LOSS FOR INSULATION CLASSES A, B & C

Acoustic Class	Pipe diameter OD (mm)	Octave band centre frequency (Hz)						
		125	250	500	1000	2000	4000	8000
Correction factor*		16	9	3	0	-1	-1	1
		Minimum insertion loss (dB)						
A	< 300	-4	-4	2	9	16	22	29
	300-649	-4	-4	2	9	16	22	29
	650-1000	-4	2	7	13	19	24	30
B	< 300	-9	-3	3	11	19	27	35
	300-649	-9	-3	6	15	24	33	42
	650-1000	-7	2	11	20	29	36	42
C	< 300	-5	-1	11	23	34	38	42
	300-649	-7	4	14	24	34	38	42
	> 650	1	9	17	26	34	38	42

4.0 DESIGN ASPECTS FOR ACOUSTIC INSULATION

4.1 Painting Under Insulation

Piping to be applied acoustic insulation shall have under insulation painting for corrosion protection as it would normally have for other insulation purposes as per relevant codes / standards / specification applicable for the temperature.

4.2 Spacers & Support Rings

Where insulation is composed of semi-rigid sections (such as preformed pipe sections) and the pipe is horizontal, spacer or support ring may be avoided.

In all other cases, where soft blankets or LRB mattress is used and piping is vertical and cladding supports are necessary, the pacers/ support ring wherever used shall contain resilient elements for vibration isolation.

4.3 Insulation of Valves & Fittings

Valves, flanges etc. shall be designed with removable enclosure type insulation with lifting lugs.

4.4 Vibro-acoustic Seals

Appropriate vibro-acoustic seals to be applied between cladding and piping so that the cladding is isolated from vibrating pipes. There shall be no direct contact between cladding and pipes/ encasing.

4.5 Acoustic Insulation for Hot Service

When insulation is required for hot as well as acoustic purpose, the insulation material meeting acoustic requirements of this specification shall be used. Thickness of the insulation

shall be determined by most stringent of the two requirements. For low operating temperature (upto 125°C) services a suitable moisture barrier shall be used over insulation.

4.6 Acoustic Insulation for Cold Service

Where insulation is required for cold and acoustic service, the cold insulation system (without cladding, but primary vapour barrier applied) shall be applied first to the pipe and the acoustic insulation shall be applied over it.

An additional vapour barrier layer shall be applied to the outside layer of the acoustic insulation underneath metal cladding. The metal cladding shall be secured the same manner a cold insulation cladding is used so that the underneath vapour barrier layer is not punctured (screws rivets etc. which may cause puncture of the underneath layer shall not be used).

5.0 SELECTION OF ACOUSTIC CLASS

5.1 The contractor shall to select one of these three acoustic classes from section 3.1 as per following guideline:

Obtain unsilelcned sound level from equipment supplier data (valves, compressor, pumps, ejectors etc.) to which the pipe is attached

a) overall sound level in decibels dB(A)
b) frequency distribution at middle of octave bands

If frequency distribution is not given, the octave band spectrum shall be derived by subtracting the standard spectral shape from overall dB(A). The standard spectral shape to be subtracted for various sources given in Table-3 below:

TABLE-3
SPECTRAL SHAPE OF NOISE FROM PIPES ATTACHED TO VARIOUS SOURCES

Source	Octave band centre frequency (Hz)						
	125	250	500	1000	2000	4000	8000
	Difference from overall dB(A) to linear octave band level dB						
Control valve	20	16	17	9	6	5	7
Centrifugal compressor	15	12	9	7	3	10	12
Centrifugal pump	4	2	4	5	7	9	12
Reciprocating compressor	3	4	5	6	8	8	8

5.2 Correction Factor (A-weighting)

Noise at different octave bands shall be corrected for A-weighting for relative weightages. A-weighting correction factor is irrespective of acoustic class and pipe diameter and given in Table-4.

TABLE-4
CORRECTION FACTOR FOR A-WEIGHTING

Acoustic Class	Pipe diameter OD (mm)	Octave band centre frequency (Hz)						
		125	250	500	1000	2000	4000	8000
Correction factor*(dB)		16	9	3	0	-1	-1	1

5.3 Required Noise Level Reduction

Determine the required noise level reduction from unlicensed sound level to the required target level in decibels dB(A).

5.4 Check and select the most optimum class from A, B & C

For a given acoustic class (A, B or C), subtract the minimum insertion loss from frequency distribution (provided by supplier OR derived using Table-3) and A-weighting correction (Table-4) against each octave band and determine the overall decibel level dB(A) for each class separately. Select the most optimum class for required noise reduction.

NOTE: In the event no information is available for original noise level and frequency distribution but acoustic insulation is to be applied the default system shall be class C.

5.5 Length of Acoustic Insulation

The length of the pipe to be insulated depends on pipe OD and whether the pipe is carrying gas vapour or liquid is to be determined using Table-5.

TABLE-5
CORRECTION FACTOR FOR A-WEIGHTING

Pipe OD (meter)	Required reduction In decibels dB(A)	Service	length (L) to be insulated (meter)
D	S	Gas/ Vapour	S x D/0.06
		Liquid	S x D/0.02

Note: In case the calculated length to be insulated is higher than the total length of the pipe, entire length have to be insulated from the noise source to the next silencer, vessel, heat exchanger, filter etc.

6.0 MATERIAL SPECIFICATION

Minimum technical specification of the major insulation materials and accessories are specified in this section. Based on the minimum technical requirement, the contractor shall select appropriate materials and submit MAR (material approval request at beginning of the job).

6.1 Insulation Material

Insulation material for the acoustic service can be rock wool/ glass wool/ ceramic fiber of appropriate density having mechanical stiffness less than 105/t N/m3 (t=insulation thickness) and air flow resistivity in the range 25000-75000 N-sec-m4 as per respective standards/ codes given below:

Insulation material	Class	Density
Rock wool	ASTM C 547 (preformed section)/ IS 9842 ASTM C 592 (LRB mattress) /IS 8183	100-150 kg/m^3
Glass wool	ASTM C 547/IS 8183	80 kg/m^3
Ceramic Fiber blanket	ASTM C 892	128 kg/m^3

Note: Additional requirement for chloride limits for carbon steel and stainless steel piping and/ or any other parameters for respective mineral fiber insulation as would normally be applicable for thermal insulation shall be complied.

6.2 Metal Cladding

Metal cladding for acoustic insulation shall be as per Table-1.

In case the cladding is used in combination with an anti drumming layer, the later may be a membrane of mass loaded sheet of flexible plastic with mineral fibers (2300 kg/m3, min thickness 3mm).

6.3 Ancillary Materials

Minimum technical requirement for the common ancillary materials required for acoustic insulation are specified below.

Material	Type	Description
End caps	SS304	Thickness min 1.3 mm
Retaining bands for insulation	ASTM A167 TP 304L	20 mm wide & 0.8 mm thick
Wires for insulation	ASTM A167 TP 304L	1mm
Retaining bands for cladding	ASTM A167 TP 316	20 mm wide & 0.8 mm thick
Adhesive/Sealing material/Mastic seal	Two component epoxy adhesive	
Resilient pads / Anti-vibration seal *(Note-1)*	Synthetic/ natural rubber base material	Width 50 mm x Thk 3 mm
Self strapping screw for cladding *(Note-2)*	SS 304/ cadmium plated steel	8 mm dia & 12 mm long with neoprene under head

Notes:

1. *In case the synthetic / natural rubber to be used for vibrating seals is incompatible for the operating temperature, a layer of compressed mineral fiber blanket to be used underneath of the seals.*

2. *For acoustic insulation over cold insulation/hot insulation, where an underneath vapour barrier/ moisture barrier layer is used, cladding shall be secured the same manner a cold insulation cladding is used (screws rivets etc. which may cause puncture of the underneath layer shall not be used).*

6.4 Moisture Barrier

(for application on outer surface of the insulation underneath cladding for operating temperature up to 175°C or less)

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.

Typical acceptable moisture barrier for application over insulation surface are: Foster 46-50 / Childlers AK-CRYL CP9/ TIC 2030.

Other products if considered shall have been evaluated and comply with the following minimum characteristics, for which contractor shall submit relevant credential and test reports for review/ approval:

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)

6.5 Primary Vapour Barrier

Primary vapour barrier shall be chlorosulfonated polyethylene rubber (or hypalon) based elastomeric polymer mastic, fire retardant, compatible with base insulation, stable in the range of -40 to +100 deg C.

The mastic shall be applied in two coats reinforced with glass fiber cloth (approx at centre of the coating). The coating shall be applied in two coats to appropriate wet thickness to obtain the specified dry film thickness. 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.

Characteristics	Parameter	Typical material (see Note)
Consistency	Thixotropic soft paste	Foster 60-38/39 TIC 4015 /16
Water vapour permeance	0.02 metric perms (max) with DFT 1.2-1.3mm as per ASTM E-96 procedure-E	
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: Typical materials are indicative only. Products meeting specified requirements as per ASTM E84 and E96 and proven under similar services may be used subject to approval of owner/ Engineer-in-charge.

7.0 APPLICATION

The insulation contractor shall adhere to the minimum technical requirements for quality control given in this specification:

7.1 The contractor's personnel shall be fully conversant and responsible for meeting the specified HSE requirements and shall strictly adhere to safety instructions and MSDS requirements of the insulation/ ancillary products and application.

7.2 The contractor shall select appropriate materials and submit MAR (material approval request) at beginning of the job. The contractor shall undertake guarantee of materials supplied against deviation or deterioration of any kind in respect of quality.

7.3 The contractor shall arrange for its personnel adequate personnel protection and safety gears like hand gloves, masks, spectacles etc.

7.4 Ensure painting under insulation is applied as per applicable painting & coating specification before start of insulation work.

7.5 The insulation system needs to be installed in dry condition.

7.6 The installation contractor shall prepare an ITP identifying stage inspections for which shall be approved by Engineer-in-charge of the insulation job.

7.7 Material shall be stored properly as per the instruction of supplier. Material shall preferably be stored in covered shed and protected against water ingress.

7.8 Insulation shall be applied snugly around piping, flanges, fittings and around shells and fronts of equipment. In case of double layer insulation, both the longitudinal and circumferential joints shall be staggered.

7.9 Bends, reducers and T-pieces, etc. shall be insulated with preformed insulation pipe sections or segments of the same insulation material.

7.10 Flange and valve boxes shall be provided with the same insulation thickness and cladding as indicated for the classification of the insulated system. The insulation shall be installed at the inside of the boxes. The inner surface layer shall be at least 10mm away from the flange or valve.

7.11 Removable insulation boxes shall overlap the adjacent pipeline insulation over a distance of at least the pipe insulation thickness of the piping insulation.

7.12 In case of preformed pipe section, every layer shall be separately fixed with at least 3 stainless steel wires, slab and blanket shall be fastened by steel band at interval of 300mm.

7.13 Joints in cladding shall be sealed with a band acoustic sealing material. Cladding joints shall have minimum 50 mm overlap and shall be secured by band at interval of 300mm.

7.14 At exposed flanges, acoustical insulation shall be terminated with an end cap. This cap shall be located as close to the flange as possible, however it will still allow bolt removal. The end cap shall be isolated from the pipe ends.

7.15 All termination points shall be sealed properly. Any protrusion shall be sealed to prevent any moisture ingress.

7.16 The contractor shall mobilize all required tools & tackles and carry out the insulation installation as per approved procedure.

7.17 Materials shall be stored properly to protect damage from adverse environments, such as humidity, moisture, rain, dust, dirt, sand, mud, salt air, etc.

7.18 Details of insulation work executed each day shall be maintained in a log book approved by the Engineer-in-charge which shall include the types and quality of insulation materials, name of the manufacturer, section numbers etc.

7.19 Sufficient number of qualified and experienced supervisors to be deployed in each shift to take care of all activities at site. One exclusive supervisor shall be engaged to take care of the quality aspect of insulation job.

7.20 The client/ Engineer-in-charge may inspect the insulation application at various stages during execution, any rectification suggested need to be taken care by the Contractor, without any time or cost implication.

8.0 INFORMATION REQUIRED FROM VENDOR

Following information is required from the contractor before start of acoustic insulation:

8.1 Calculation supporting selection of appropriate acoustic class complying guideline of 5.0 of this specification.

8.2 MAR (material approval request) for insulation, cladding ancillary materials.

8.3 Application procedure and ITP for stage inspections.

8.4 Details of qualification, experience and HSE exposure of the personnel going to be engaged for insulation supervision, inspection and quality control

8.5 List of equipments tools and tackles to be mobilized during the execution of the job.

8.6 Material test certificates relevant to physical and chemical tests (duly endorsed by the inspection agency) for insulation and ancillaries materials.

9.0 REFERENCE CODES AND STANDARDS

This specification refers standard practices of following codes and standards

ASTM Standards

ASTM A167	Specification for stainless and heat-resisting chromium nickel steel plate, sheet and strip
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 E96	Standard test methods for Water vapor transmission of materials
ASTM C892	Standard specification for High temperature fiber blanket thermal insulation
ASTM A240	Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet and strip for Pressure Vessels

BS Standards and Specifications

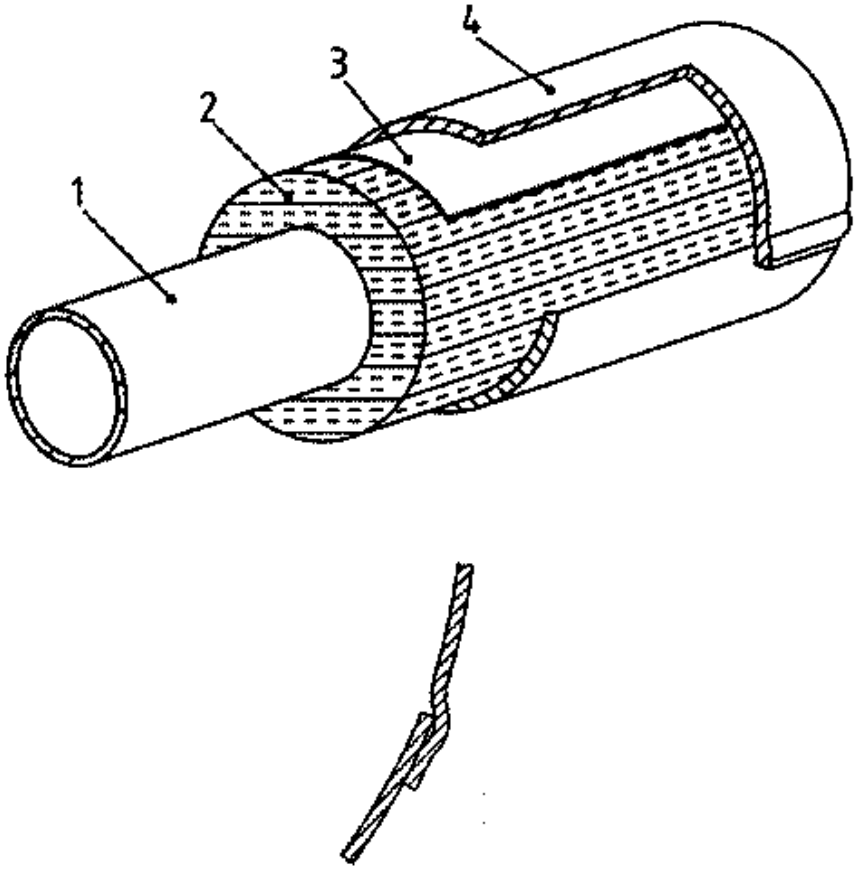
BS 1902 Prt 6	Ceramic fibre products
BS 2972	Method of test for Inorganic thermal insulating materials

IS Standards and Specifications

IS 8183	Bonded mineral wool-Specification
IS 9842	Preformed fibrous pipe insulation- Specification

Others

ISO 15665:	Acoustic insulation for Pipes, Valves and flanges
IEC 534-8-2:	Industrial process control valves - Part-8: Noise considerations
CINI Manual:	Insulation for industries

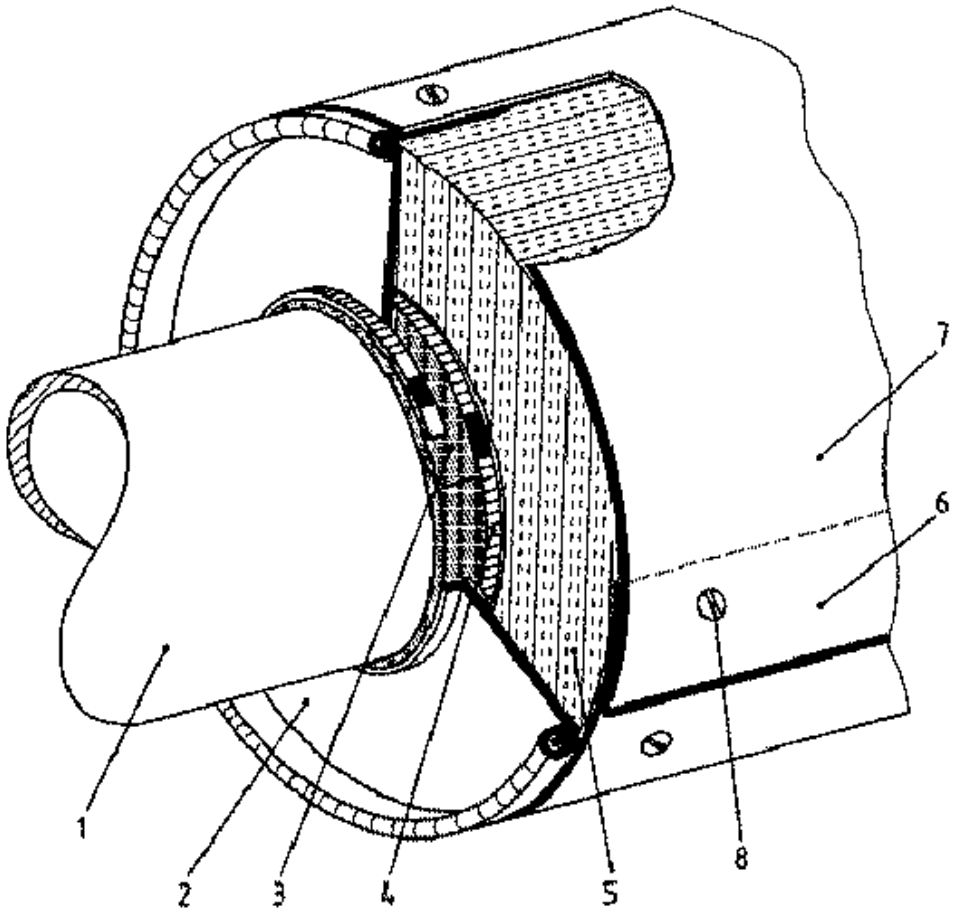


OVERLAP (SUCH THAT INGRESS OF RAIN WATER IS PREVENTED)

1. PIPE
2. MINERAL FIBER INSULATION
3. ADDED MASS OR DAMPING LAYER
4. CLADDING

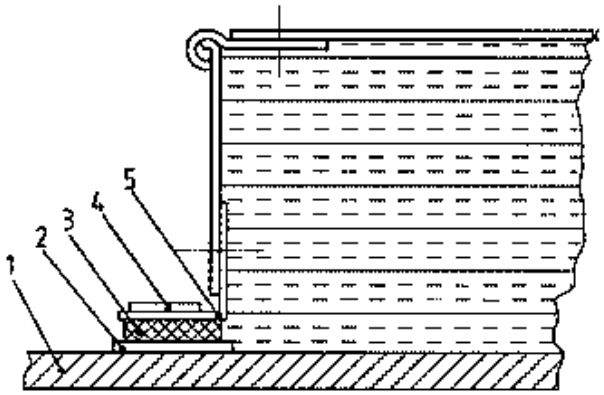
CLADDING MAY BE FIXED IN POSITION WITH RIVETS, SELF-TAPPING SCREWS, OR STAINLESS-STEEL RETAINING BANDS.

FIGURE- 01
GENERAL CONSTRUCTION OF ACOUSTIC INSULATION



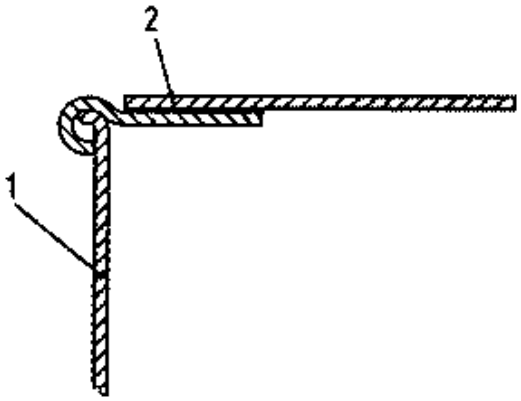
1. PIPE
2. END CAP, MAY CONSIST OF TWO OVERLAPPING HALVES WITH OVERLAP IN THE HORIZONTAL PLANE
3. VIBRO-ACOUSTIC SEAL
4. RETAINING BANDING
5. POROUS LAYER
6. OVERLAP (LONGITUDINAL SEAMS SHALL BE LOCATED IN THE 4 TO 5 O'CLOCK POSITION TO PREVENT MOISTURE INTRUSION)
7. CLADDING
8. FIXING SYSTEM OF THE CLADDING: RIVETS, SCREWS (THESE SHALL NOT BE USED WHEN CLADDING IS DIRECTLY OVER A VAPOUR BARRIER) OR STAINLESS-STEEL STRAPS

FIGURE- 02
TYPICAL ARRANGEMENT OF ACOUSTIC INSULATION WITH CLADDING AND END CAP



A) VIBRO-ACOUSTIC SEAL

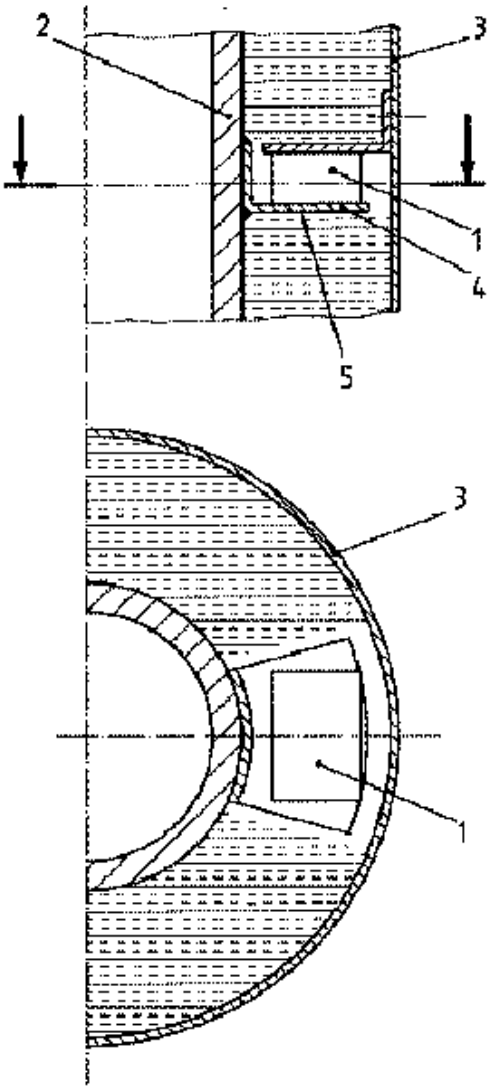
1. PIPE
2. ADHESIVE/SEALING LAYER
3. VIBRO-ACOUSTIC SEAL
4. RETAINING BAND
5. SHAPED PROFILE COLLAR



B) END CAP TO CLADDING SEAL

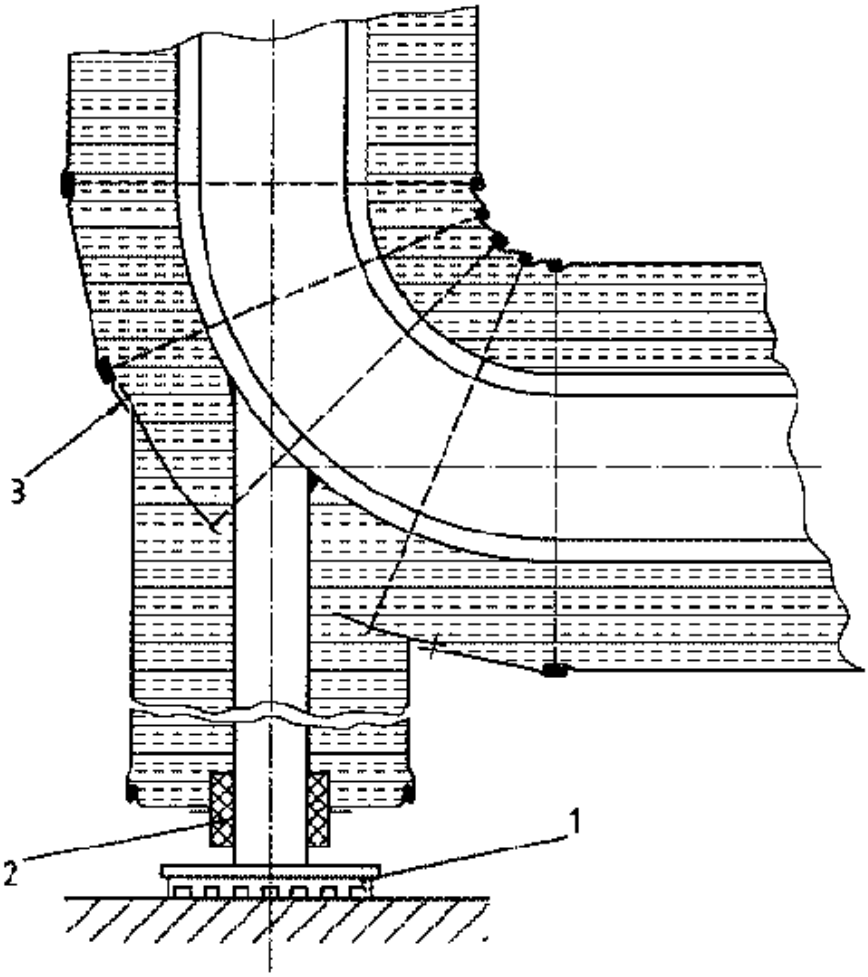
1. END CAP
2. MASTIC SEAL

FIGURE - 03
END CAP OF PIPE INSULATION



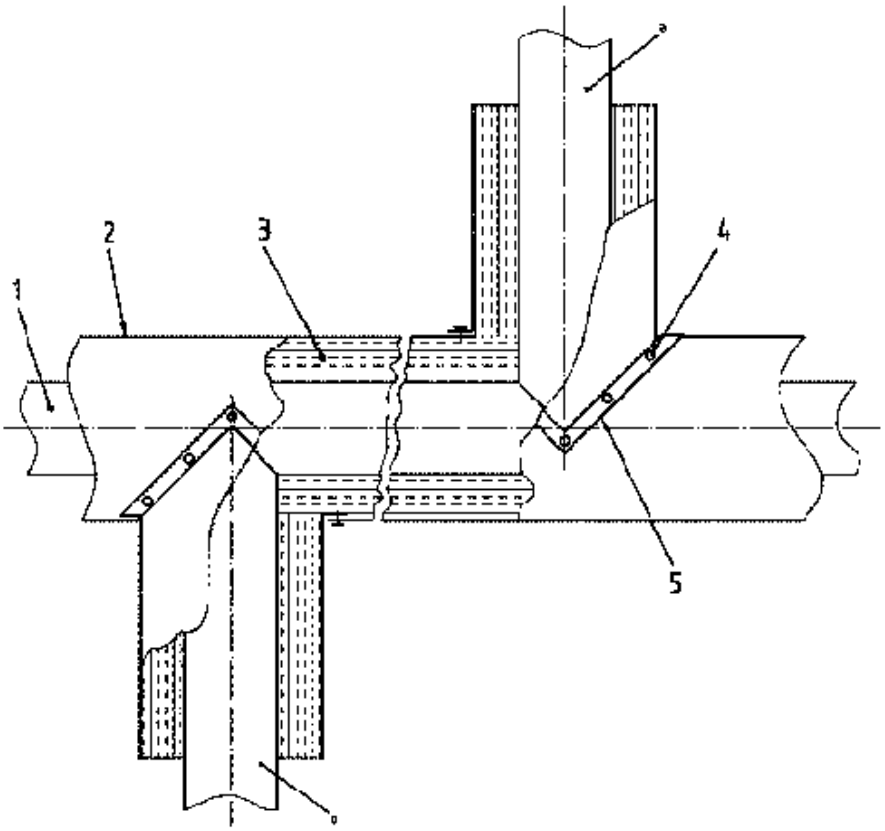
1. VIBRATION-ISOLATING PAD
2. PIPE WALL
3. CLADDING
4. VULCANIZED LAYER
5. SUPPORT ON STRAPPING BAND (OR WELDED)

FIGURE - 04
TYPICAL ARRANGEMENT FOR VIBRATION-ISOLATED CLADDING AND INSULATION SUPPORTS IN VERTICAL PIPES



1. VIBRATION-ISOLATING PAD
2. VIBRO-ACOUSTIC SEAL
3. MASTIC SEAL

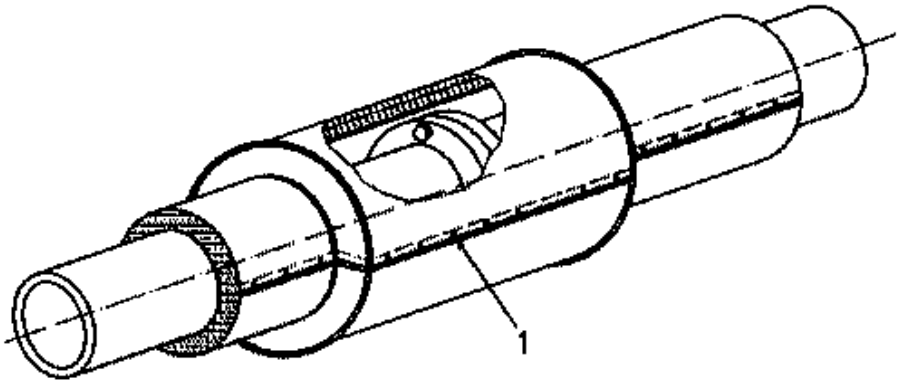
FIGURE- 05
SUPPORT FOR VERTICAL PIPE



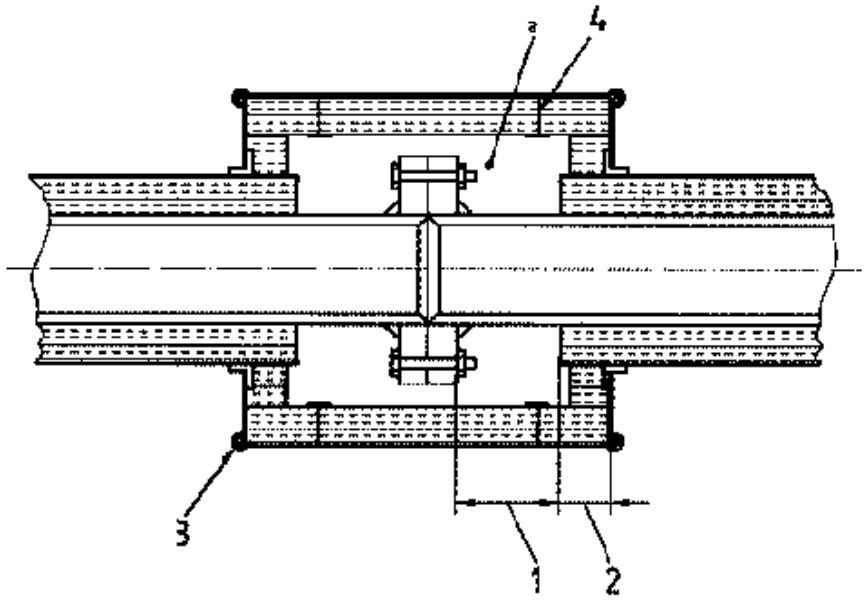
a) UPPER CONNECTION, b) LOWER CONNECTION

1. PIPE
2. CLADDING
3. POROUS LAYER
4. SCREWS OR RIVETS
5. MASTIC SEAL

FIGURE -06
TYPICAL ARRANGEMENT FOR BRANCHES AND TEES

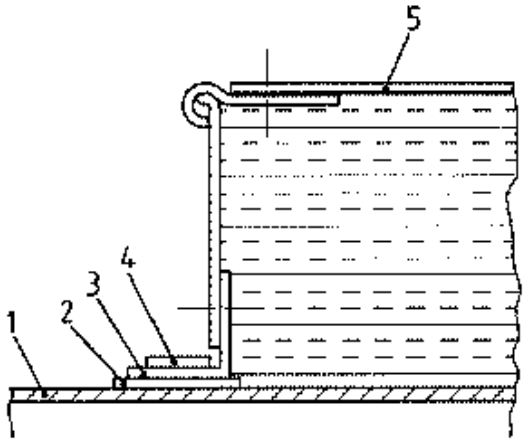


FIXING OF THE CLADDING: RIVETS, SCREWS
(STAINLESS-STEEL STRAPS TO BE USED WHEN A VAPOUR BARRIER IS USED UNDERNEATH)



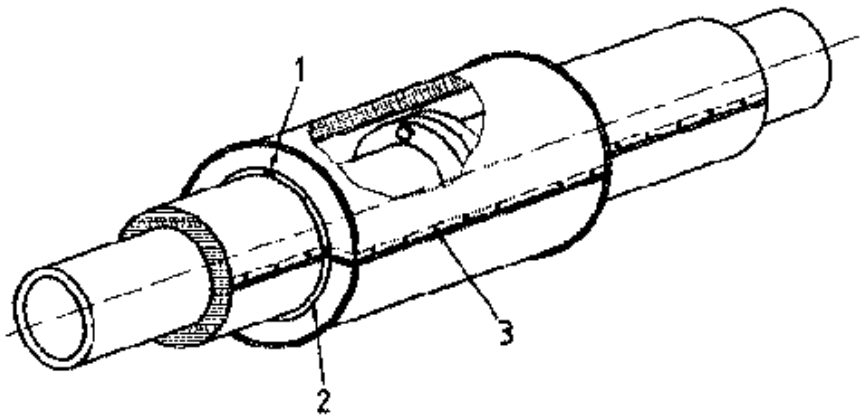
1. BOLT LENGTH + 30 MM
2. OVERLAP = INSULATION THICKNESS
3. LOCK FORMED
4. CLIP TO FIX POROUS LAYER
5. SPACE SHALL BE FILLED WITH POROUS MATERIAL

FIGURE - 07
ARRANGEMENT FOR THE ACOUSTIC INSULATION OF FLANGED JOINTS



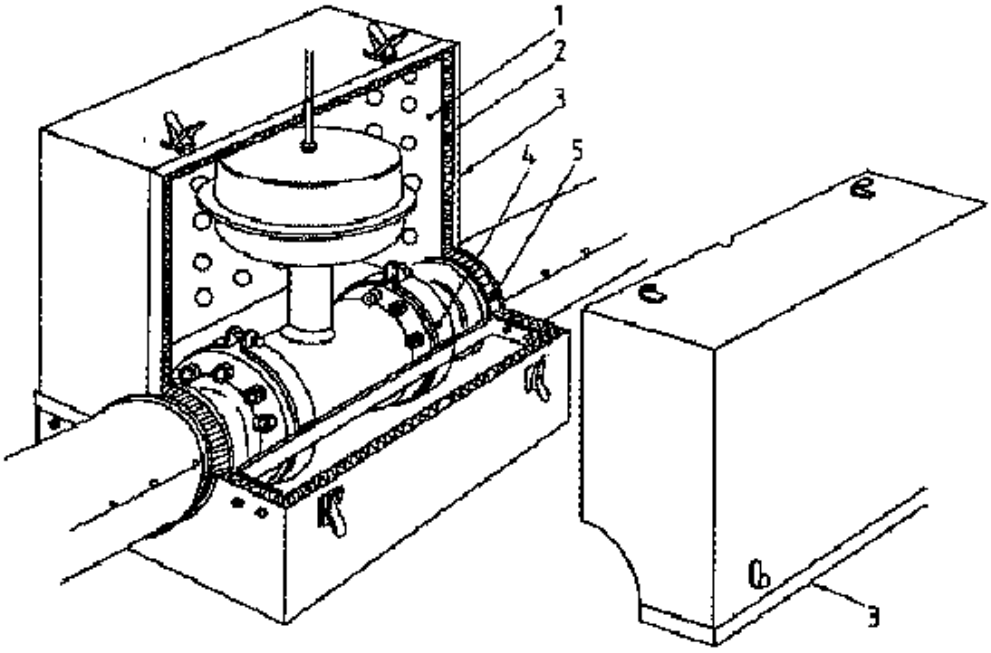
1. PIPE INSULATION CLADDING
2. ADHESIVE SEALING MASTIC LAYER
3. SHAPED PROFILE
4. RETAINING BAND (STAINLESS)
5. CLADDING (BOX)

FIGURE - 08
CONSTRUCTION DETAILS: END CAP OF ENCLOSURE



1. support
2. venting aperture
3. fixing system of the cladding: rivets, screws (these shall not be used when
4. cladding is directly over a vapour barrier) or stainless-steel straps

FIGURE - 09
VENTED ACOUSTIC INSULATION OF FLANGED JOINTS AND BELLOWS



1. perforated sheet
2. porous layer
3. locating edge to help locate upper portions
4. supporting framework clamped to flanges (over vibration isolation pad)
5. vibro-acoustic seal

FIGURE -10
EXAMPLE OF AN ACOUSTIC ENCLOSURE FOR A VALVE

Example: Selection of acoustic class

Find acoustic class and length of the insulation to be applied on 250 mm OD steel pipe in gas/vapour service attached to control valve radiating 100 dB(A), to be reduced to 85 dB(A).

Unsilenced sound level is 100 dB(A), required reduction (100-85) =15dB(A)
Noise source: Control valve, Octave band spectrum: not given

Step-1: Acoustic class selection

1. Derive octave band spectrum by subtracting differential dB specific to the source type using Table-3.

2. For an acoustic class, apply (subtract) the insertion loss for each octave band using data given for specific pipe OD in Table-2.

3. Apply (subtract) A-weighting correction factor (Table-4) from each octave band.

4. Calculate A-weighted decibel level of overall sound radiated from insulated pipe separately for each acoustic class using formula, check noise reduction achieved and select the most optimum class

   dB(A)insulated=10x log (antilog D125/10 + antilog D250/10 + ... + antilog D8000/10)

Calculation table with acoustic Class-A:

Octave band (Hz)	Bare Pipe dB(A)	Control valve data (Table-3) dB	Octave band estimate dB	Insertion loss for Class-A (Table-2) dB	Apply insertion loss dB	A-weighting correction (Table-4) dB	Insulated Pipe noise dB	Total Noise reduction
125		20	80	-4	84	16	68	
250		16	84	-4	88	9	79	
500		17	83	2	81	3	78	
1000		9	91	9	82	0	82	
2000		6	94	16	78	-1	79	
4000		5	95	22	73	-1	74	
8000		7	93	29	64	1	63	
dB(A)	100						86	14

Calculation table with acoustic Class-B:

Octave band (Hz)	Bare Pipe dB(A)	Control valve data (Table-3) dB	Octave band estimate dB	Insertion loss for Class-B (Table-2) dB	Apply insertion loss dB	A-weighting correction (Table-4) dB	Insulated Pipe noise dB	Total Noise reduction
125		20	80	-9	89	16	73	
250		16	84	-3	87	9	78	
500		17	83	3	80	3	77	
1000		9	91	11	80	0	80	
2000		6	94	19	75	-1	76	
4000		5	95	27	68	-1	69	
8000		7	93	35	58	1	57	
dB(A)	100						84	16

Calculation table with acoustic Class-C

Octave band (IIz)	Bare Pipe dB(A)	Control valve data (Table-3) dB	Octave band estimate dB	Insertion loss for Class-C (Table-2) dB	Apply insertion loss dB	A-weighting correction (Table-4) dB	Insulated Pipe noise dB	Total Noise reduction
125		20	80	-5	85	16	71	
250		16	84	-1	85	9	76	
500		17	83	11	72	3	69	
1000		9	91	23	68	0	68	
2000		6	94	34	60	-1	61	
4000		5	95	38	57	-1	58	
8000		7	93	42	51	1	50	
dB(A)	100						78	22

Therefore, Class-A is found to be ineffective. Class-B is the optimum insulation that can be chosen for the required noise reduction of 15 dB(A).

Step-2 Calculate length of the pipe to be insulated using Table-5

Using Table-5, length to be insulated can be found

L = S x D/0.06, S=15 dB(A) (required noise reduction) and D=0.25m (pipe OD)
= 15 x 0.25/0.06
– 62.5 meter

रीफ्रैक्टरी के लिए स्वास्थ्य, सुरक्षा और पर्यावरण आवश्यकताओं हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR HSE REQUIREMENTS FOR REFRACTORY

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	19-07-2019	ISSUED AS STANDARD SPEC	PP	BS	PS	RKT

Abbreviations

HSE	:	Health Safety and Environment
MSDS	:	Material Safety Datasheet
PPE	:	Personal Protective Equipment
RCF	:	Refractory Ceramic Fibre

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 Ravindra Kumar (Construction)

CONTENTS

1.0 INTRODUCTION

1.1 Scope

This specification outlines the Health and safety issues pertaining to handling refractory materials and waste generated during installation of refractory and /or removal of spent lining after service with an objective to minimize risk of the potential hazards.

The guideline mentioned in this specification is meant for compliance by the contractors who are involved in supply, installation, removal of refractory lining.

2.0 GENERAL

Refractory materials are generally composed of non metallic oxides like Al_2O_3,SiO_2, MgO, Na_2O, K_2O etc. which may contain varying degree of other constituents like high alumina cement and chemical binders. Risks associated are different with different materials depending on its mineralogical constituents, fineness etc.

The potential risks associated in handling a particular material are usually addressed in the MSDS (material safety datasheets) provided by refractory supplier. The contractor responsible for the job must categorize the materials according to the risks involved and comply to the requirements specified in MSDS with respect to HSE requirements for the employees and environment.

The contractor shall submit MSDS to owner/ PMC for review and carry out a job safety analysis for compliance to MSDS and project/ client specific HSE requirements.

3.0 REFRACTIORY TYPES

3.1 Refractory Brick

Refractory bricks which are used in Oil and gas are generally based on aluminosilicate. Respirable dust from these products may contain crystalline silica, which is known to cause respiratory disease. With respect to hazardous material identification system, the material is not reactive, non-flammable and no adverse effects of this material on the environment are anticipated.

3.2 Refractory Castable

Refractory castable which are generally used, are based on aluminosilicate cement bonded castable or High alumina chemically bonded castable. Prolonged or repeated inhalation of dusts of this product may cause lung disease (Silicosis). The product is stable under normal conditions and hazardous decomposition or polymerization does not occur. No adverse effects of this material on the environment are anticipated.

3.3 Ceramic Fiber Material

Refractory ceramic fibre (RCF) which is used for insulation, particularly in kilns and furnaces, is a form of man-made vitreous (silicate) fibre and consists of alumino-silicate fibres which can irritate the skin, eyes and upper respiratory tract but the main concern is that the individual fibres are small enough to penetrate deep into the lungs and possibly lead to the development of lung cancer and mesothelioma. An additional problem for users with ceramic fiber is that after being exposed to high temperatures for prolonged periods as can happen in kilns and furnaces, it is known that RCF at the surface of the lining devitrifies to crystalline phases including cristobalite, a form of crystalline silica which can cause silicosis.

Ceramic fiber is inert, stable and it is not soluble with water and as such does not pose detrimental effect on environment.

4.0 HSE FOR REFRACTORY HANDLING

4.1 General

The contractor executing the job shall be responsible for hazard identification and job safety analysis with respect to handling and application of various refractory types. All staff involved with refractory works and related activities should be provided safety induction and briefed about the risks and mitigation, first aid as per MSDS by refractory supplier.

4.2 All the staff will be provided with overalls, and anti-dust mask, in order to avoid inhalations of noxious dust. All the staff in charge of the works will wear necessary PPE like helmet, accident-prevention shoes, eye protection and protective gloves, etc.

4.3 Environmental protection should minimize the waste generated and impact by a specific segregation of difference type of waste, compaction and storage.

4.4 Barriers need to be installed around the installation area and area destined for handling of such material. Signage indicating danger and no-entry for unauthorized persons need to be put up at the barriers. General transit should not be allowed in the installation area, due to possible falling down of harmful elements.

4.5 Operators of gunning machine or paddle mixer and brick cutting machine must be competent, experienced people, and operate strictly as per approved operation procedure or manuals. The machines need to be checked regularly for good condition as per check list and certificate

5.0 JOB SAFETY ANALYSIS FOR REFRACTORY WORK

The refractory lining in furnace or high temperature equipment broadly includes lining materials like refractory brick, castable and ceramic fiber. The general risks associated during execution of those refractory works, potential hazard and current precautionary measures are tabulated below. The entire work force should be trained for fall protection and confined space working. Scaffolding should be checked and tagged prior to use, and related safety manual shall be implemented according to the project HSE requirement. While working in confined space air condition should be checked by certified tester.

Description of the Job	Potential HSE hazard	People at risk	Current precautionary measures
Refractory material transport from storage	Stumble and slip when carrying the material	Working people and site personnel	• Ensure that access is not blocked by the other materials, meanwhile keep the view clear and be careful of the loading the material. • Pay attention to loading the material in good order and the stack of the container not higher than the plate of the truck • Assign Flag man with the red vest to guide the driver • Use the correct tie connection of the rope to secure the material to prevent the material fall from the truck.

Description of the Job	Potential HSE hazard	People at risk	Current precautionary measures
Surface preparation	Suffocated injury and hurt by pressure in case blasting	Operator	• Blasting work should be by experienced person, and operate strictly as operation procedure • Regularly check that the sandblasting machine is in good condition • Ensure mechanical ventilation, and use respirators
Castable mixing	Injury hurt by machine, bad ventilation, bags catching fire, Skin contamination, Inhalation	Operator, Site worker and personnel	• All the castable material should be well stored with good ventilation conditions • Regularly check the condition of the machine as per check list and certificate • Put warning signs on the storage and keep fire extinguishers • Put MSDS at the working and storage location
Castable gunning, casting, hand packing, Vibracasting etc.	Injury hurt by machine, bad ventilation, Skin contamination, Inhalation	Site workers and Personnel	• The operator of Refractory gunning machine should be an experienced person, and operate strictly as operation procedure • Regularly check the condition of the machine as per check list and certificate • The working area should be barricaded, and have suitable signage • Worker should wear correct PPE and dust mask
Ceramic fiber Installation	Occupational diseases (Eyes and skin irritation, respiratory mucous membrane irritation)	Site workers and Personnel	• Check the effect with respect to MSDS • Worker should wear correct PPE and proper respiratory mask • Good housekeeping and material management
Brick installation	Skin contamination, Inhalation	Site workers and Personnel	• During brick installation the silica dust is created by the use of power saws cutting the bricks. Silica dust is a serious health threat. Use wet saws whenever possible when cutting brick. • Worker should wear correct PPE and proper respiratory mask • Good housekeeping and material management

6.0 WASTE MANAGEMENT PLAN AND DISPOSAL

6.1 General

Material safety datasheet of refractory materials should be checked and there should be awareness about the effect to people and environment, hazardous identification, first aid and fire fighting measures. Management of waste is an integral component of management of environment. Waste refractories which are intended to be disposed can be done with the following manners:

(a) Reusable portion of salvaged refractories can be recycled

(b) Broken pieces can be recycled/sold to outside parties

(c) Remaining debris can be dumped as a waste at some authorized disposal sites.

6.1.1 Do not handle the waste until all the safety precautions have been read and understood. Dispose the waste in accordance with local/regional/national/international HSE regulations.

6.1.2 The waste should be removed from site as soon as possible.

6.1.3 The cleaner should wear proper PPE when entering site.

6.1.4 The waste should be thrown into the assigned area; and should not set on fire.

6.1.5 Barriers need to be installed around the disposing area and area destined for handling of such material. Signage indicating danger and no-entry for unauthorized persons need to be put up at the barriers, while the work is in progress.

6.2 Disposal of Waste Refractory Bricks

6.2.1 The unused refractory brick is not considered a hazardous waste. The material may be recycled back to manufacturer or can be used for land filling.

6.2.2 For used refractory brick (for example in revamp work), disposal method shall be consulted with client. Refractory exposed to the furnace environment may have contaminations due to exposure to fuels and process conditions, hence client shall advise specific disposal method.

6.2.3 Avoid creating dust during handling, use or storage of this product. Do not breathe dust that may be created during the handling or use of this product.

6.3 Disposal of Waste Refractory Castable

6.3.1 The as manufactured refractory, dust or hydraulically set castable is not considered as hazardous waste. The material can be used for land filling.

6.3.2 For used refractory castable (for example in revamp work), disposal method shall be consulted with client. Refractory exposed to the furnace environment may have contaminations due to exposure to fuels and process conditions, hence client shall advise specific disposal method.

6.3.3 During handling, minimize dust, sweep, shovel or vacuum. Watch footing if particles fall onto walkways. Avoid direct contact with the product by wearing protective clothing, using approved respiratory protection and wearing gloves of the impermeable type.

6.4 Disposal of Waste Ceramic Fiber

6.4.1 Wastes generated during fabrication, installation or removal of RCF's is not defined as hazardous. Waste fibre should be carefully placed directly into heavy duty plastic bags and clearly labelled to indicate the contents and placed into deep landfills.

6.4.2 Because of the possible presence of crystalline silica in used RCF, particular care should be exercised during tear-out to minimize the generation of dust.

6.4.3 Whenever practical, used RCF products should be wetted with water from a fine spray nozzle and hose prior to removal. Effective use of the wetting procedures will reduce the cristoballite exposure hazard of RCF products.

6.4.4 All activities involving the cutting of RCF products shall be restricted to a designated area. Caution signs must be posted before work begins. Local exhaust ventilation must be employed.

6.4.5 Removal and demolition of RCF insulation should begin at the top of a structure and progress downward. Do not drop insulation from elevated areas to ground levels.

6.4.6 Handling can be source of dust emission and therefore the process should be designated to limit the amount of handling. Whenever possible handling should be carried out under controlled condition i.e. using dust exhaust system.