PURCHASE SPECIFICATION
FOR
SUPPLY OF WATER BASED FIRE PROTECTION EQUIPMENTS

PROJECT	**: RLNG FUEL CONVERSION PROJECT**
CUSTOMER	**: HINDUSTAN PETROLEUM CORPORATION LIMITED (HPCL)**
CONSULTANT	**: NIL**

IMPORTANT INSTRUCTION TO BIDDER

DOCUMENTS TO BE SUBMITTED WITH THE BID:

The bidder must submit the following documents along with their bid.

a) Un-priced copy of price format indicating quoted/ not quoted against each line item.

b) Signed copy of the Technical Specification.

c) No Deviation certificate

BHEL's decision will be final in case vendor fails to submit above documents.

1. INTENT OF SPECIFICATION:

The intent of this document is to establish the minimum requirement of Supply including selection, manufacture, assembly, inspection, shop testing, shop painting, packing, transportation and delivery at RLNG Fuel conversion project, HPCL- Visakhapatnam site in proper condition.

The equipment and supply shall conform to high standard of engineering and applicable codes/standards and shall be capable of performing intended operation in a manner acceptable to the Purchaser and end customer.

2. NOTES TO BIDDERS

2.1. This specification shall be read in conjunction with all its enclosures. In case of any discrepancy arising between this job specification & its enclosures, the same shall be brought to the notice of BHEL in pre-bid queries OR the most stringent of all shall be followed. It is the responsibility of bidder to read and understand the specification and the enclosures. Any queries on the specification shall be raised by bidders during pre-bid stage and clarifications may be sought from BHEL. If the queries on the specification are raised after pre-bid stage or during order execution stage, it shall be binding on the bidder to comply with the final decision made by the BHEL without any techno-commercial implications.

2.2. All materials supplied under this contract shall be new and unused. All equipment connected with the above systems shall be UL/FM/VDs/LPCB/ISI approved.

2.3. Bidder to confirm that the performance guarantee of the equipment shall be as per data meeting specification requirements and system requirement.

2.4. All erection hardware including structural steel, fittings, brackets, U clamps, nuts & bolts etc. that are required for the erection of Water Based FPS equipment (as per the scope of this bid) shall be included in the scope of bidder and the same shall be included in the base price.

2.5. The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipment and the Water Based FPS equipment system as a whole.

2.6. Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.

2.7. Only calibrated instruments shall be used for testing of the equipment.

2.8. Bidder shall include all the accessories that are associated with the equipment mentioned in the scope of supply. If bidder feels that some variations are necessary in the scope of supply or otherwise, the same shall be brought out in the pre-bid queries – for which a prescribed format is enclosed in annexure-2. All the issues shall be resolved in the pre-bid stage only and no deviation is allowed in the contract.

2.9. The design information, specifications and drawings indicate the "Minimum" requirements and are intended to enable Bidders to ascertain the extent of the work involved. Bidders are expected to supplement the information included in this specification as required and submit a comprehensive bid.

2.10. Bidder to refer to the Special Conditions of the contract (SCC) & General Conditions of the Contract (GCC) of tender specifications.

3. PROJECT DESCRIPTION

1	Owner	Hindustan Petroleum Corporation Limited (HPCL)
2	Project	RLNG Fuel conversion project
3	Location	Visakhapatnam, Andhra Pradesh
4	Latitude & Longitude	$22^{o}13'19"$ N; $84^{o}53'51"$
5	Consultant	----
6	Nearest Airport	Visakhapatnam
7	Nearest Railway Station	Visakhapatnam
8	Nearest Port	Visakhapatnam
9	Nearest Town	Visakhapatnam
10	Nearest Highway	Visakhapatnam
11	Elevation of TG Building	El.(+)4.8M

4. BIDDER'S SCOPE OF SUPPLY:

The supply for major equipment/items of Water Based Fire Protection System (WBFPS) of this project shall consists of the following:

4.1. **HYDRANT VALVE:**

Sl. No.	Description	Quantity
1	Double Headed Hydrant Valves Assembly (Stand post type)	03 Sets

One set shall comprise of Two 63mm dia. Hydrant valve mounted on a 150 NB Stand post.
All other technical details shall be as per Annexure-5.

Testing Requirements: As per Approved datasheet and QAP.

4.2. **HOSE BOX**

Sl. No.	Description	Quantity
1	FRP Hose cabinet Size :900x600x250mm	03 Nos.

a) Hose cabinet shall be self-supported (Stand post type), suitable for outdoor installation. It shall be suitable for housing Two nos. 63mm &15M length Hose & One No. Branch pipe with Universal type Nozzle.
b) Hose box shall be provided with accessories as per technical datasheet (annexure-5).

4.3. **FIRE HOSE WITH COUPLING**

Sl. No.	Size	Quantity
1	Fire Hose of 15 m length with Delivery Hose coupling	06 Nos.

a) Fire hose shall be REINFORCED RUBBER LINED TO IS: 636 (TYPE-3).
b) Testing Requirements:
   - Percolation test
   - Pressure test
   - Burst test
c) Technical details shall be as per annexure-5.

4.4. **BRANCH PIPE WITH ACCESSORIES**

Sl. No.	Description	Quantity
1.	Branch Pipes With Universal Type (Triple Purpose) Nozzle & Quick coupling (Confirming to IS 2871).	03 Nos.

a) Technical details shall be as per annexure-5.

Testing Requirements:

The branch pipe, coupling and nozzles shall be subject to a hydrostatic test pressure to detect any leakage.

4.5. **Documentation and Deliverables:**

4.5.1. Engineering Documentation:

a) General arrangement drawings of all equipment
b) Datasheet of all equipment
c) Submission and approvals of engineering documents as per the master documentation list given in Annexure-3

4.5.2. Project Documentation:

a) Billing Break-up
b) QAP
c) Inspection reports and test certificates as applicable
d) Schedule of delivery
e) Packing lists of each consignments
f) Site storage instructions

NOTE:

Bidder to note that the above list is not exhaustive and any other service required as per the intent of this specification/project requirements/good engineering practice shall be deemed to be included in bidder's scope without any commercial implication to the purchaser.

5. EXCLUSIONS:

i. Storage, preservation of Materials/Equipment at site (however detailed storage and preservation procedure shall be furnished by bidder)

ii. All Erection and Commissioning

iii. All civil works

6. GENERAL TECHNICAL DETAILS:

6.1. Applicable Codes & Standards

The codes and standards shall be applicable as mentioned in the datasheet.

6.2. Latest edition of applicable codes/Standards/Statutory Regulations referred to in the Bid Document shall correspond to the edition as on the date of issue of bid.

6.3. All addenda including the latest addenda to all the above codes and standards (latest editions) shall be followed by the bidder.

6.4. All equipment/items supplied shall conform to the provisions of statutory & other regulations in force in India and the State/Province where the project is executed, such as the Indian Factories Act, Indian Electricity (Supply) Act, Indian Electricity Act, Indian Electricity Rules, International Electric Technical Commission (IEC) Publication, Environmental Rules, etc. Obtaining of all permission and approvals from statutory authorities for the installation of the plant and machinery, and to ensure that the purchaser /end customer does not face any problems in future on account of non-conformance with these regulations as indicated above, shall be the responsibility of the bidder. All the legal formalities including preparation of documents, furnishing clarifications, information etc. as and when required, for obtaining any of the permissions and approvals related to the Items/Equipments/Accessories being procured will have to be done by the bidder.

6.5. BHEL will not provide copies of any standards to bidders. It is the responsibility of bidder to arrange / refer to applicable latest standards.

7. SUB VENDOR LIST

Refer Annexure-6.

8. INSPECTION AND TESTING (Refer GCC, SCC)

8.1. Bidder shall maintain an effective Quality Assurance System, to ensure that all equipment and material supplied as a part of the Water Based FPS equipment meet required Quality standards and specifications.

8.2. Bidder to follow the Quality plan for the equipment /items as attached as Annexure-7 . After award of contract bidder shall submit Quality Plan for approval as per the attached format only (for equipment /items, where QAP are not attached). The quality plan shall be submitted in EIL quality plan format.

8.3. Bidder to confirm that instruments required for performance testing of various Equipment / systems of the package shall be arranged by bidder at site without any cost Implication to BHEL.

8.4. The instruments and test kits required for pre-commissioning checks (for the equipment under scope of supply) shall be provided by bidder. Bidder can take these items back after the checks are performed at site. No additional cost shall be claimed for this purpose. The checks shall be performed with calibrated instruments only.

8.5. Bidder to confirm that all instruments for testing shall be calibrated before taking up testing.

9. DOCUMENTATION:

9.1. MASTER DOCUMENT LIST

Bidder shall ensure submission of all documentation as per Master Document List (Annexure-3) as attached in the purchase specification.

9.2. DRAWING APPROVAL / REVIEW CATEGORY:

a) Following classes of review shall be followed for all the documents engineered by the bidder

- APPROVAL (A)
  Approval is mandatory and bidder cannot proceed without obtaining Purchaser's approval (eg. Layouts, schemes etc.)

- INFORMATION / RECORDS (I)
  This type of documents shall be submitted to Purchaser for his information (eg. data sheets, GA drawings etc.)

Type of Code used as per BHEL for approval/comments of Documents:

Code-1 : No comments

Code-2 : Comments as marked cleared for manufacturing

Code-3 : Comments as marked but not cleared for manufacturing

Code-4 : Retained for information

9.3. **DRAWINGS REVIEW AND APPROVALS**

a) Bidder to understand that efficient handling of drawings and documents to be prepared by him under the contract is the key to the timely completion of the Water Based FPS equipment. By accepting the contract the bidder undertakes to ensure that all drawings and documents to be submitted by him to the Purchaser/ End Customer shall be of professional quality and conforming to the contractual requirements.

b) Each drawing submitted by the bidder shall be clearly marked with the name of the Owner, the unit designation, the specifications, title, the specification number and the name of the Project with revision No. and date. If standards, catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English.

c) Approval/review of drawings do not absolve the bidder from in-correct/faulty design or manufacturing of equipment/materials. It is the sole responsibility of bidder to rectify the faulty or incorrect designs at any stage of contract.

d) Review of drawings and documents issued by bidder shall be carried out by Purchaser /End customer.

Bidder shall furnish the first set of drawings/document within 15 days progressively. All revised drawings/documents after incorporating the comments shall be furnished within 07 days. BHEL shall furnish comments (if any) /approval on the documents within 14 days after the receipt of same.

9.4. **Engineering Completion**

a) The Engineering shall be considered as completed after the following activities are finished:

- Final approval of all the Documents which are in 'Approval' Category as per Master Document List (MDL)

- After successful review of drawings/documents which are in 'Information' Category as per Master Document List (MDL)

b) Following may be noted wrt the drawing submission schedule:

SL NO.	DESCRIPTION	NUMBER OF COPIES TO BE SUBMITTED	WHEN TO SUBMIT
1.	Initial drawings / documents under approval and information category.	2	As per approved Master document list
2.	Revised drawings / documents incorporating BHEL's comments.	2	Within 1 week of receipt of commented drawings from BHEL
3.	Final Drawings/ documents	11	Within 2 months of placement of order.
4.	Erection Drawings / documents	11	1 Month before dispatch of equipment, The list of documents identified under master document list for erection to be furnished in 5 nos. of folders.
5.	FINAL Erection / Installation Manual for distribution	7	
6.	As built Drawings / documents	7	
7.	Operation & Maintenance Manual	7	2 months before the delivery date of equipment
8.	Performance & functional Guarantee test reports	7	
9. 6	Type Test Certificate	2	Within one month after dispatch of equipment
10. 7	Commissioning & Performance Procedure Manual	3	Within one month after dispatch of equipment
11.	Commissioning & Performance Procedure Manual	2	

9.5. **Document submission procedure**

a) Hard copies of all the documents shall be forwarded to the following address:

Name: (Name will be intimated during detail engineering)

Address: Bharat Heavy Electrical Limited

New Engineering Building, Project Engineering and Systems Division

RC Puram, Hyderabad- 32

b) A copy document submittal note shall be furnished to purchase dept. /BHEL.

10. PRICE BID FORMAT (Refer Annexure-1)

10.1. Supply of Water Based FPS equipment as envisaged in this bid document shall be executed by the bidder on UNIT RATE contract basis.

10.2. All the items included in the price bid format shall be quoted as per tender specification and pre-bid clarifications, if any. Responsibility of ensuring correctness & completeness of scope of supply as per specification requirement solely lies with bidder.

10.3. Prices quoted by the bidder shall remain firm till the successful handing over of the Water Based FPS equipment to end customer. Any request for upward revision of price during any intermediate stage before handing over the plant to end customer will be rejected by BHEL.

10.4. Bidder to refer to GCC & SCC for the applicable taxes and duties. Bidder to quote only base rates for all the items. Applicable taxes and duties shall be indicated separately.

10.5. **Bidder shall confirm that he has quoted all items by marking "Quoted" in the price bid and enclose the same in their technical offer. Price shall not be specified in the technical offer.**

11. DEVATIONS TO SPECIFICATIONS:

11.1. Any deviation or variation from the scope, requirement and/or intent of this specification shall be clearly defined under relevant attachment (refer Annexure - 2) of the Bid forms irrespective of the fact that such deviations/ variations may be standard practice or a possible interpretation of the specification by the Bidder. Except for those deviations/ variations covered as a part of pre bid clarification, it will be the responsibility of the bidder to fully meet the intent and the requirements of the specification within the quoted price. No other deviation whatsoever from this specification, except for the have been specifically agreed by purchaser as a part of pre-bid clarification shall be considered.

11.2. In case the bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, he shall recommend the same along with reasons in a separate section as a part of pre-bid query to enable purchaser take a suitable decision on the requirement of the same.

11.3. Information like Bill of materials (BOM), Instrument list, datasheets, and typical specifications enclosed by the bidder as a part of their bid, shall be retained for information only and shall not be referred by contractor as contractual agreement. No implication shall be admissible on the basis of these documents during any stage of contract execution. System wise BOQ shall be finalized based on approved drawings during detail engineering stage.

12. MARKING , PACKING AND DESPATCH

12.1. MARKING

i. All items shall be marked (stamped/etched) in accordance with the applicable code/standard/specification. In addition, the item code, if available, shall also be marked.

ii. For ease of identification, the color of painted strip (wherever required) shall be as per the applicable standard.

iii. Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinarily or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.

12.2. DISPATCH

i. All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to the finish. Crates/cases shall have skid bottom for handling.

ii. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchaser order.

iii. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.

iv. A separate document indicating the details of all the items having shelf life shall be furnished. Prior permission from BHEL shall be taken before dispatch of any of the item having shelf life. Bidder to note that any eventual delay on account of this will not be attributable to them.

12.3. The following minimum packing procedures shall be followed :

i. All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.

ii. Rust preventive on machined surfaces to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent.

iii. Each variety and size of item shall be supplied in separate packaging marked with the purchase order no., item code (if available), and the salient specifications.

iv. All instrumentation items shall be properly packed to prevent damage during transit due to vibration, physical contact, moisture ingress, rainwater and pilferage.

v. All the items which the Bidders considered liable to be damaged during shipment or storage, shall be packaged for separate shipment. If instruments are removed from the panel, they and their connection shall be suitably tagged to ensure simple re installation at the job site. Each instrument shall be sealed in plastic bags containing moisture absorbing desiccants.

vi. It shall be bidder’s sole responsibility to protect all the material during period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid

atmosphere, rough handling in transit and including delays in transit. Bidder shall be responsible for any damage to equipment/material due to above reasons.

vii. Spare parts shall be packaged separately and clearly marked as 'Spare Parts'

viii. Loose vendor items sent by Vendors to sites shall be quantified/numbered/tagged and not merely mentioned as ONE lot of loose items

ix. Mandatory spares should be supplied separately with green colour painted box.

x. A packing list covering items having shelf life are to be intimated to site. Also, shelf life items shall be packed separately in black color painted box for easy identification at site.

xi. For packing and painting procedure please refer annexure -4.

SPECIFIED DESIGN ORD OF REVISIONS				
Rev. No.	**Date**	**Revision Details**	**Revised By**	**Approved By**
00	23.04.22	First Issue	----------	P.C. Sekhar

ANNEXURE 1

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING & SYSTEMS DIVISION
RAMACHANDRAPURAM: HYDERABAD - 502 032

PRICE FORMAT FOR FIRE FIGHTING EQUIPMENT (Rev 00)

PROJECT	**RLNG FUEL CONVERSION PROJECT,HPCL VIZAG, INDIA**
CUSTOMER	**HINDUSTAN PETROLEUM CORPORATION LIMITED, VISAKHAPATNAM**
CONSULTANT	---
ESC	---

Bidder's Name : <Bidder to indicate>	
Bidder's Offer No. & Dt. : <Bidder to indicate>	
Bidder's Ref No. & Dt. :<Bidder to indicate>	
BHEL Enq. No. & date :<Bidder to indicate>	

Sl.No.	Item Description	Qty.	Unit	Weightage w.r.t Overall Price (In %)	Bidder's confirmation (Quoted/ Not Quoted)	HSN / SAC Code	GST (%)
A	**MATERIAL SUPPLY: [Material code: PY9751805015]**						
1	Double headed Fire Hydrant valve with stand post as per IS:5290 type-A	3	Nos.	36.73%			
2	FRP Hose box (900x600x250 mm)	3	Nos.	27.59%			
3	Fire hose with coupling (IS:636 Type-3)	6	Nos.	28.99%			
4	Branch pipe with nozzle (universal type) as per IS:2871	3	Nos.	6.69%			
	Grand total price for Sl.No. A (Inclusive of Packing & Forwarding and Freight)			**100.00%**			

Packing & Forwarding, Frieght, Insurance and GST :			
(I) For Supply:			
(i)	Packing & Forwarding :	In bidder's scope	Included in basic price
(ii)	Frieght:	In BGGTS scope	
(iii)	Insurance:	In BHEL's scope	--
(iv)	GST	Extra at actuals	Extra at actuals
(v)	Any other:	shall be included in basic price	Included in basic price

Notes:	
1	Bidders should quote the Total Bid Value both in figures & words in the specified place.
2	Bidders should mention the applicable HSN/SAC code along with GST% against respective line items.
3	Bidders shall not fill/edit/modify anything else in the Price Bid Format.
4	The rates of line items mentioned in the Price Format shall be derived by BHEL by multiplying the Total Bid Value quoted by the Bidder with the Weightage Factor assigned against respective line items. The rate of each item shall be rounded off to the next 1 (one) Indian paise.
5	The Total Bid Value quoted by the Bidder shall represent the total landed cost for this enquiry and shall include Packing & Forwarding Charges, Freight and all applicable taxes and duties, other than GST. GST shall be paid extra by BHEL at applicable rates.
6	Evaluation shall be done on the basis of total bid value (Grand Total Price as above) i.e. the total landed cost to BHEL for this enquiry.
7	**The bidders will also provide UN-PRICED PRICE FORMAT strictly in the BHEL price format given above, in the techno commercial part of their offers. BID WILL BE REJECTED IF ANY OTHER PRICE FORMAT IS USED. Both priced and un-priced price formats to be provided by the bidders shall be signed and stamped copies.**
8	Bidder to quote strictly as per BHEL's NIT requirements.
9	Bidder to note that this is a LUMP SUM Turn-Key Order. However (a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably. (b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage. Bidder to note that the variation in quantities of any item shall be limited to (-) 10 % to (+) 20 %.
10	Prices quoted by bidders for items under main offer : Sl. No.A will be considered for evaluation of lowest bidder.
12	Reference document: **BHEL Technical specification PY-51832_Rev 00**
13	Unpriced price bid format indicating as "Quoted" against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.

PROJECT : RLNG FUEL CONVERSION PROJECT , HPCL VIZAG				
PACKAGE : Fire fighting equipment				
DOCUMENT : PRE BID QUERY FORMAT				
RFQ/NIT REF:				
S.NO	CLAUSE NO	DESCRIPTION AS PER SPEC	QUERIES BY BIDDER	BHEL REPLIES

ANNEXURE-3 MASTER DOCUMENT SCHEDULE

1	LIST OF SUPERCEEDED DRAWINGS / DOCUMENTS				S	TO INDEX PAGE		NO COMMENTS				1
2	LIST OF ACTIVE DRAWINGS / DOCUMENTS				A	TODAY'S DATE		COMMENTS AS MARKED CLEARED FOR MANU				2
3	LIST OF DRAWINGS/DOCUMENTS UNDER PREPARATION				UP			COMMENTS AS MARKED				3
4	LIST OF BHEL APPROVED DRAWINGS				ADS			RETAINED FOR INFORMATION				4
S. NO	DRAWING/ DOCUMENTS	DWG. NO.	REV	SCHEDULE OF SUBMISSION	APPR (A/I)	SENT BY BIDDER (SOFT COPY)	HARD COPY RECEIVED FROM BIDDER	COMMENTS SEND TO BIDDER	STS	PEND	BHEL APP STATUS	REMARKS
1	Drawings & Documents Pending with BIDDER								A	P-BIDDER	1	
2	Drawings & Documents Pending with BHEL								A	P-BHEL	2	
3	Drawings & Documents Approved by BHEL								A	ADS	3	
4	Superceeded Drawings								S	S	4	
1	Datasheet and GA Drg of Double Headed Hydrant valve with standpost Assembly			Within 15 days after placement of Purchase Order	A							
2	Datasheet and GA Drg of Hose box			Within 15 days after placement of Purchase Order	A							
3	Datasheet and GA Drg of Fire hose with coupling			Within 15 days after placement of Purchase Order	A							
4	Datasheet and GA Drg of Branch pipes and accessories			Within 15 days after placement of Purchase Order	A							
5	STORAGE PROCEDURE			Within 30 days after placement of Purchase Order	I							
6	BILLING BREAKUP			Within 45 days after placement of Purchase Order	I							
7	PACKING LIST			Within 90 days after placement of Purchase Order	I							
8	QAP OF ALL EQUIPMENTS			Within 15 days after placement of Purchase Order	A							

Note:

1 Bidder to furnish the documents as per the schedule date of submission. Delay in submission of documnets shall be calculated based on the above schedule.

2 All drawings / documents shall be reviewed by the purchaser with 14 working days of receipt of drawing at Purchaser's end.

3 All drawings / documents shall be revised and resubmitted by the Bidder with 7 working days of receipt of observations/comments from Purchaser's end.

ANNEXURE-4

DOMESTIC PACKING

COMMON GUIDELINES

1 GENERAL:

This standard lays down packing instructions for domestic packing of Components/Assemblies/Equipment to be despatched against Customer's contracts, for which there are no special instructions issued by the Engineering Departments.

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. For specific applications the concerned engineering department shall issue a product standard. Reference of this product standard, must appear in the Shipping list/Packing List.

2 TYPES OF PACKING:

The following 5 types of packings have been standardized for packing of General Components/Assemblies.

1) '**OP**' - Open Type.
2) **'PP'** - Partially Packed.
3) '**CP**' – Crate/Box Packing - Components/Equipment requiring physical protection.
4) '**CQ**' - Case Packing - Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
5) '**CR**' - Case Packing - Electrical Components/Assemblies, which require special packing viz. Water Proof, Shock Proof etc…

3 DESCRIPTION OF TYPES OF PACKING:

The various types of packing, as standardized above, are described below.

3.1 'OP' - Open Type

In case, of components which are not affected by water & dust and do not require special protection, are generally not machined, shall be sent as open packages. However, these components may be sent in crates, wherever necessary.

3.2 'PP' - Partially Packed

Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film to Specification No.AA51420. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film

3.3 'CP' - Crate Packing

Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.

3.4 'CQ' - Case Packing - Machined Components/Assemblies/Equipment

Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of

silica gel to AA55619 or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420, wherever required.

3.5 'CR' - Case Packing - Electrical & Electronic Components/Assemblies

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel to AA55619 packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420 before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel to AA 55619.

Empty space in the cartons shall be filled with rubberized coir to get proper cushioning effect. The cartons shall be manufactured from corrugated Fiber Board, meeting requirements of AA51414.

4 PREPARATION OF PACKING CASES

4.1 DOMESTIC:

Based on the availability, the wood shall be Rubber wood (Havea Brasiliensis)/Pine wood for packing of cubicles, loose items, spares and photovoltaic items meant for customers in India**.**

4.2 DIMENSIONS:

a) Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25 +2/-3 mm.

b) Width of all planks including the tongue shall be more than 125mm and after plaining it shall be minimum 100mm.

c) Minimum number of planks shall be used for a shook.

d) Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel.

e) External sides of front and rear planks to be plained to facilitate writing of address and other markings.

f) Width of binding planks shall be minimum 100mm.

g) Distance between any 2 binding planks shall be less than 750mm.

h) diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm

i) Distance of the outer edges of these planks from the edge of case shall be less than 250mm.

j) Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

4.3 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

4.4 TONGUE AND GROOVE JOINTS

Two Consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

4.5 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

4.6 CHEMICAL TREATMENTS FOR PRESERVATION OF WOOD

1) This treatment provides protection to the packing wood against deterioration due to fungi and attack by termites, borers and marine organism and any kind of infections.
2) The wooden planks, after making tongues / grooves shall be treated with chemicals. For pine wood, treatment with ASCU/ CCA solution need not be done.
3) The chemical used shall be ready mix ASCU paste. This consists of Arsenic pent oxide, copper sulphate sodium dichromate. This Paste shall be mixed at the rate of 1 kg of paste per 10 liters of water to the extent of water used. Alternate this CCA paste as mentioned at Para 4.6.5) can also be used.
4) The chemical treatment shall be done at the premises of the contractor. A cement concrete tank of capacity to hold a minimum of 2000liters of solution shall be constructed. The solution shall be prepared in the presence of BHEL Representative by contractor. The wooden planks shall be soaked in the solution for a minimum of 12 hours. The solution shall be replenished after treating a maximum of 12 cubic meters of wood. A log book shall be maintained by the contractor to give the details of date of preparation of solution, quantity of solution prepared, quantity of chemicals used, Quantity of wood treated and the details of replenishment. Samples of solutions before mixing will be tested at the laboratories designated by BHEL. The testing fees to be paid to the laboratories will have to be borne by the contractor. The paste shall be tested as and when required.
5) Specifications for water soluble type wood preservatives: Copper – Chromium – Arsenic [CCA]: Copper – Chromium – Arsenic preservative formulation shall be as per IS:10013 Part – II – 1981 shall consist of following active ingredients in nominal proportions by weight as shown below:

– Arsenic Pent oxide	AS2O52H2O	12.5
– Copper Sulphate	CuSO45H2O	37.5
– Sodium Dichromate	Na2Cr2O75H2O	50.0
– Or Potassium Dichromate	K2Cr2O7	

4.7 OTHER MATERIALS

4.7.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

4.7.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

4.7.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6 +0.01mm. The material shall be free from rust.

4.7.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

4.7.5 BRACKETS

These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

4.7.6 FASTENERS

Bolts, double nuts, spring washers will have to be used for packing of some special items like transformers, reactors, breakers, etc., to hold the job to the bottom plank of the box. The bolts, nuts, washers will be provided by the vendor. Drilling of holes will have to be done using contractor's tools.

4.7.7 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

70GSM (Colourless) Multi Layered Cross Laminated Polythelene Film Specification No: AA51420 are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

4.7.8 RUBBERISED COIR:

The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

4.7.9 FOAM RUBBER / 'U' FOAM:

This is used for covering the delicate items. This material is provided by the vendor.

4.7.10 MARKING PLATE:

This shall be of anodized aluminium sheet. Details and specifications are given in Fig-4

4.7.11 PACKING SLIP HOLDER:

This shall be of galvanized iron tinned sheet /Aluminium sheet

4.7.12 SILICA GEL:

This shall be of indicating type to conform to IS: 3401/AA55619.

4.7.13 COTTON BAGS:

These are used for holding silica gel. The bags shall have the following matter indicated on them:

BHEL-UNIT NAME	PLACE-PINCODE
SILICA GEL	INDICATING TYPE
BLUE :	ACTIVE
ROSE :	REDUCED ACTIVITY
WHITE :	NO ACTIVITY. TO BE REPLACED WITH FRESH SILICA GEL

4.7.14 COTTON/ PLASTIC TAPE:

This is used for tying small items. And also to prevent vibrations of moving parts within the cubicles.

4.7.15 MARKING INK:

The ink used normally is black in color. In some special cases other color also will have to be used. The ink shall be non-fading/indelible and non-washable by water.

4.7.16 POLYETHYLENE BAGS:

These are to be used for keeping the Packing slips. The bag shall be of size 70mm X 100mm (minimum).

4.7.17 Hessian cloth, twine thread, paint will have to be used in packing certain items.

4.7.18 Mechanical Latching clamps:

For CLW Railway panels and similar Panels self-locking clamps can also be used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. For reusable boxes, these clamps provide easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.

4.7.19 STICKERS

The following stickers to be put by the vendor on cubicles/Boxes after packing.

1. Case No sticker: 2 nos. Size 25.Cm x 0.45Cm
6) BHEL Monogram sticker: 1 no. Size 1.75Cm x 2.3Cm
7) Address sticker: 2 nos. Size 3.8Cm x 3.0Cm
8) Direction sticker " Front " & " Back " - 4 nos. Size 2.0Cm x 0.75Cm
9) Chain Mark Sticker: 4 Nos. Size – 3.0Cm x 0.75Cm
10) "Fragile " sticker: 2 Nos Size. 2.1Cm x 1.5Cm
11) "DO NOT STACK " sticker - 2 Nos. Size 3.0Cm x 2.2Cm

5 PACKING OF CUBICLES WITH RUBBER WOOD:

5.1 The packing is to be done as per clause 4 in all respects.

5.2 The cubicles are already fixed on wooden pallets. Hence the contractor need not arrange the bottom pallets normally.

5.3 The cubicles will be of different sizes both widthwise and lengthwise. The cubicles may be made up of single suite, 2 Suite, 3 Suite, 4 Suite, etc., The width of the cubicles generally varies from 400 mm to 1650mm.The length of the cubicle, generally varies from 1500 mm to 4800 mm. The height is normally 2430 mm. In some cases, the height may be less/more**.**

5.4 MULTI LAYER CROSS LAMINATED POLY FILM

The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.7.7) using blue nails (as per 4.7.2) wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.

The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film (as per 4.7.7). This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.

The cubicles shall be covered with Multi-layer cross laminated poly film (as per 4.7.7).

5.5 SILICA GEL:

Silica gel (as per 4.3.15) packed in cotton bags shall be kept at different places inside the cubicle as per BHEL-Unit directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 4.7.13).

5.6 LOOSE PARTS:

Any loose parts in the cubicles shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

5.7 WOODEN BATTENS:

In case of cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/battens of proper size shall be provided to give strength to the package.

5.8 RUBBERISED COIR:

Gap between the cubicle and the case shall be filled with rubberized coir (as per 4.7.8) with distance between consecutive layers less than 500mm.

5.9 CLAMPING:

Packing shall be bound at edges by nailing M.S. Clamps / Brackets (as per 4.7.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

5.10 PACKING SLIP:

Packing slip kept in the polyethylene bag (As per 4.7.16) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 4.7.11) shall be nailed to front / rear of case.

5.11 MARKING PLATE:

One no. (As per 4.7.10) shall be nailed to the front side of the case.

5.12 CASE MOUNTING:

After complete packing, stencil marking of various details and marking of symbols shall be done as per BHEL instructions using indelible / non washable marking ink.

5.13 Different types (Typical) of Cubicles with sizes for Packing

1. Single suite cubicle - 900 x 950 x2500
2. Two suite cubicle - 1650 x 950 x 2500
3. Three suite cubicle - 2400 x 950 x2500
4. Four suite cubicle - 3150 x 950 x 2500
5. Regulation cub - 1300 x 1350 x 2500
6. Thy cub - 2870 x 1350 x 2500
7. VFD Cub - 3800 x 1550 x 2500

5.14 PACKING OF CUBICLES WITH PINE WOOD

Packing of cubicles for export shall be done exactly in same manner as described at Cl.No 5 except for the following changes: -

Wood shall be Silver oak/ Pine wood instead of rubber wood.

– Double polyethylene petticoat instead of one.

– Fumigation may have to be done if required (BHEL Scope).

6 PACKING OF LOOSE ITEMS/SPARES USING RUBBER WOOD:

1) Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.
2) Wood shall be rubber wood with Tongue and Groove joint as per clause 4.4.
3) Chemical treatment as per Clause 4.6 to be done.
4) Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.
5) External surface of planks on front and rear shall be plane 100% (except bottom plank).
6) Inner surfaces of all 6 sides shall be lined with bitumen coated hessian polyethylene Kraft paper (as per clause 4.7.7) using blue nails.
7) Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
8) Internal packing: Items that go into the box shall be packed using 70GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No: AA51420. Any space left Between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect .
9) Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.

10) Silica gel as per clause 4.7.12 held in cotton bags as per clause 4.7.13 shall be kept at proper places in the box.

11) Packing slip kept in polyethylene bag (clause 4.7.16) shall be placed in the box.

12) Marking plate as per clause 4.7.10 shall be nailed to side of the box.

13) Two numbers of hoop iron strips as per clause 4.7.3 shall be strapped tightly on the case using clips.

14) Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.

15) Loose items to be kept inside the cubicle

- The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually, kept in wooden box and tied firmly in bottom of Cubicle.

- Other items which are given loose in addition to cubicle shall be packed in separate boxes.

7 BOX SIZES

7.1 BOX SIZES

Table 1 – SPARES WOODEN BOX DETAILS

SNO	BOX TYPE	BOX SIZE (in mm)	BOX Wt (in KG)	Carrying Capacity
1	A	800 X 200 X 200	15	
2	B	1500 X 200 X 200	22	
3	C	2000 X 200 X 200	27	
4	D	1100 X 200 X 200	15	
5	E	200 X 200 X 200	5	
6	F	320 X 250 X 260	13	
7	G	320 X 250 X 430	16	
8	H	430 X 370 X 430	23	
9	I	1100 X 400 X 400	45	
10	J	1500 X 500 X 400	65	
11	K	2000 X 500 X 400	93	
12	L	2500 X 500 X 400	88	
13	M	900 X 600 X 600	100	
14	N	3000 X 400 X 400	60	
15	P	600 X 500 X 400	35	
16	Q	710 X 630 X 600	90	
17	R	850 X 630 X 670	102	
18	S	1000 X 770 X 670	140	
19	T	2500 X 850 X 800	180	
20	U	1500 X 700 X 700	120	
21	W	1200X900X600	120	
22	Y	450 X 200 X 200	10	

7.2 BOX SIZES

Table 2 – VALVES WOODEN BOX DETAILS

BOX TYPE	BOX SIZE (in MM)	BOX Wt (in KG)	Carrying Capacity
1A	320X250X260	10	
1	320X250X430	15	
2	430X370X430	25	
3	670X670X470	65	
4	720X630X600	75	
6	1000X770X660	100	
7	1100X430X670	80	
8	1200X1200X900	80	
10	1300X770X1050	155	
11	2500X850X800	225	
12	2000X1500X1200	305	
14	1850X1050X1250	260	
15	2000X800X800	180	
17	2600X1500X1600	470	
21	250X250X600	20	
22	250X250X880	30	
23	300X300X700	25	
24	380X380X880	45	
25		25	
26	510X510X1400	60	
27	570X570X1400	80	
28	575X575X1875	105	
29	3600X1100X1100	390	
30	900X500X800	110	
52	2000X950X740	225	
53	1600X1120X700	220	
54	2500X2000X1200	490	
55	2900X1900X1400	525	
56	3000X1000X900	370	
57	3200X2200X950	450	
58	2150X1100X750	325	
61	2000X2000X700	130	
62	700X1200X1325	130	

TYPICAL PATTERN OF WOODEN BOX

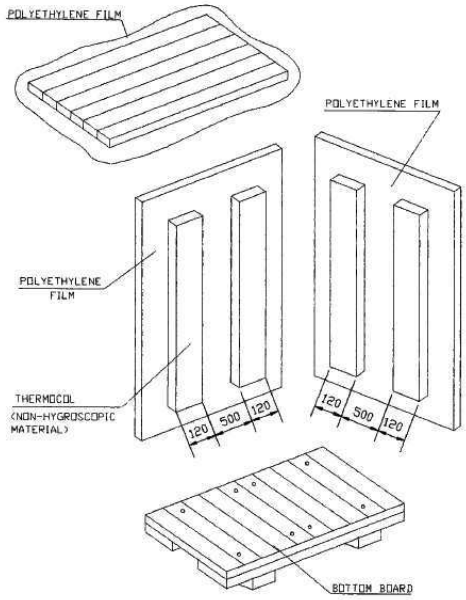


Figure 1

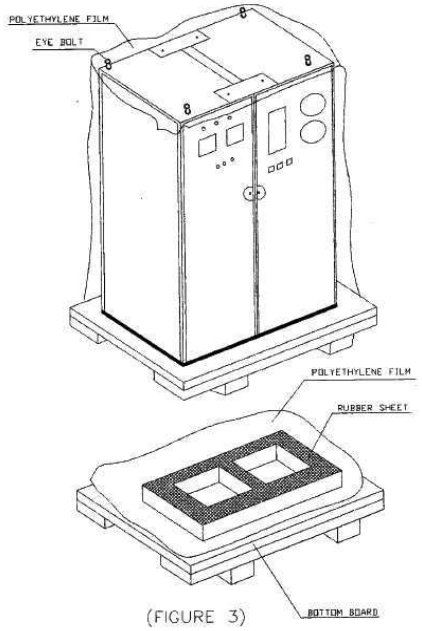


Figure 2

7.3 STANDARD BOX SIZES

WOODEN BOXES:

SL NO	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
01	I	2370	1570	1650	675	4000
02	IIA	1570	720	885	200	2500
03	II	1200	900	600	150	2000
04	III	900	600	600	100	1000
05	IV	600	450	450	40	750
06	V	600	300	300	35	500

STEEL BOXES:

SL NO	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
07	I	2480	1680	1500	339	4500
08	II	1200	900	600	061	2000
09	IIB	1800	850	950	115	2500
10	III	900	600	600	029	1000
11	IV	600	450	500	019	750
12	V	400	350	300	011	500

Table 3

7.4 STEEL CONTAINERS

Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies. The containers are to be made of structural steel as per AA10108 with proper reinforcement with I, C and T Sections.

a) Following precautions are to be taken during packing: -

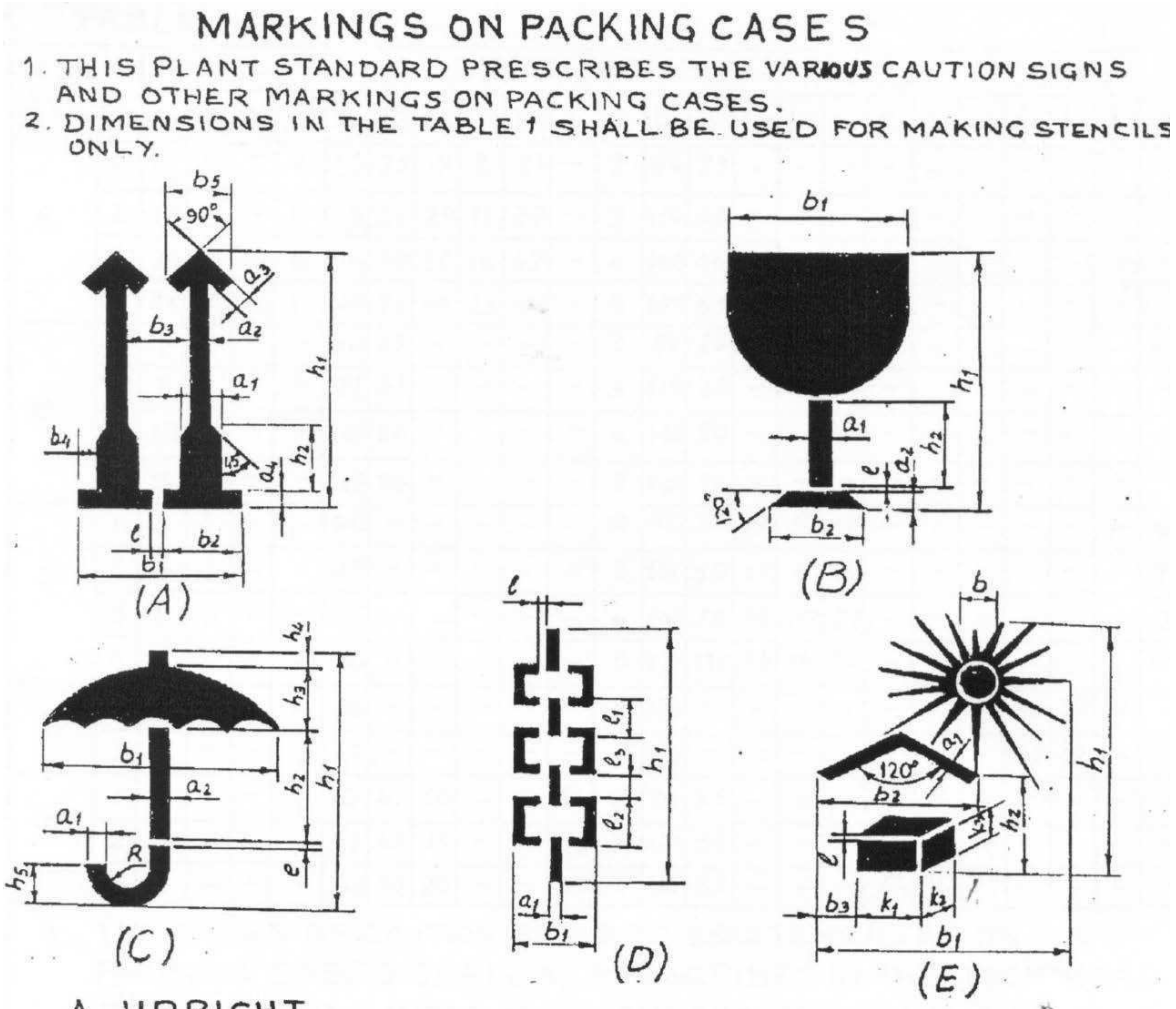
b) Put the machine in the steel container properly,

c) Cover the machine with polythene.

d) To arrest the movement in the steel container necessary wooden Blocks/Battons may be put.

e) Put cover on steel, container and Bolt Properly

8 MARKINGS/STENCILINGS



Center of Gravity

Figure 3

CORPORATE STANDARD

DESIGN-ATION		DIMENSION IN MM																						
		a1	a2	a3	a4	b1	b2	b3	b4	b5	b	l	h1	h2	h3	h4	h5	k1	k2	k3	l1	l2	l3	R
A	1	12	5	5	4	52	25	19	8	21		2	84	23										
	2	17	7	7	6	75	36	29	11	30		3	119	33										
	3	24	10	10	8	104	50	38	16	42		4	168	46										
	4	34	14	14	11	147	71	59	23	60		5	239	65										
B	1	5	5			50	33					2	84	25										
	2	7	7			71	47					3	119	36										
	3	10	10			100	66					4	168	50										
	4	14	14			142	94					5	239	71										
C	1	4	3			66						2	80	39	19	5	11							6
	2	6	4			85						3	114	55	27	7	16							9
	3	8	6			120						4	160	78	38	10	22							12
	4	11	9			170						5	227	110	54	14	31							17
D	1	6				30						4	148								30	30	10	
	2	9				42						5	209								42	42	14	
E	1	3				69	47	10			16	2	91	26				17	8	11				
	2	4				98	67	15			23	3	128	33				24	11	16				
	3	6				138	94	20			32	4	182	62				34	16	22				

Table 4

Black and Red Marking Ink to IS:1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink

"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".

Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height.

In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel(AA56126).

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.

Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

Note: Incase the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

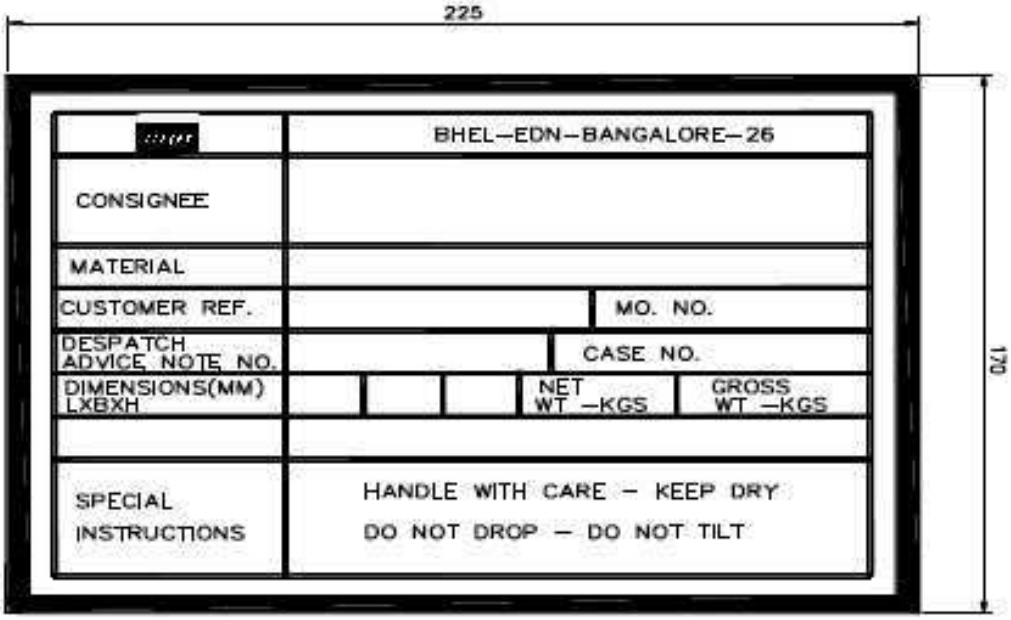


Figure 4 – TYPICAL MARKING PLATE

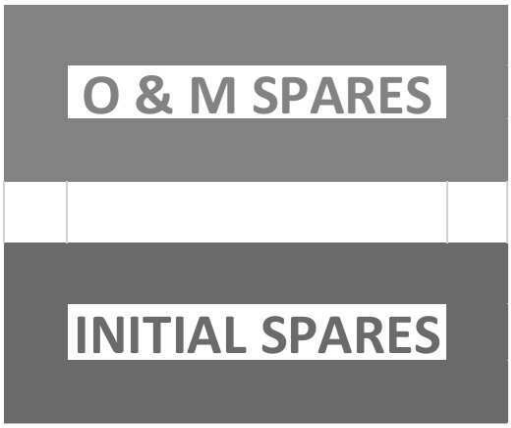


Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

9 RECYCLING OF INCOMING WOODEN PACKING CASES

OBJECTIVES

– To utilize useable wood of incoming packing cases, for manufacturing of new packing boxes.
– To recycle incoming wooden packing cases, as such, wherever possible.

1) All incoming wooden packing cases received from suppliers /customers will be opened carefully, with the intention of reusing them, by Shop.
2) After carefully taking out the contents, the empty wooden packing cases will be shifted by Shop to the specified locations i.e. bin / nearly spaces, already earmarked in stores.
3) Material shifting contractor engaged by store, will collect all such wooden packing cases and scrap wood from specified points, on a regular basis.
4) After collecting / loading the empty packing cases/ scrap wood, contractor will take thecarrier first to weighment bridge for weighment, thereafter, he will go to Carpentry, where Carpentry representative will identify the packing cases which can be used by Carpentry for manufacturing of New Packing Boxes. All such identified packing boxes will be unloaded and handed over to Carpentry by contractor.
5) These packing boxes will be made re-useable after necessary rectification and additional work.
6) Contractor will again take the carrier for weighment and this second reading will also berecorded on the same “Weighment Slip”.
7) Weight of empty packing cases / scrap wood taken will be calculated on thebasis of 1st and 2nd weighment readings recorded on the “Weighment Slip”. A copy of“Weighment Slip” (where both the weighment readings are recorded) will be given by the contractor to the carpentry representative. Based on this “Weighment Slip”, carpentry will maintain a register in which details of quantity received will be recorded.
8) All “Weighment Slips” will invariably be signed by carpentry representative (even when no boxes have been unloaded by carpentry). Store will accept the scrap wood only if “Weighment Slips” are signed by carpentry representative.
9) Balance empty packing cases / scrap wood will be handed over by contractor to Store, for storing in scrap yard.
10) A separate area in Scrap yard will be provided, for executing the work of de-nailingof wooden packing cases, under supervision of carpentry.
11) Carpentry contractor will identify packing cases / scrap wood for denailing, which will behanded over to him by Store, at Scrap yard, for denailing and further operation.
12) Quality and Carpentry will jointly inspect the wood generated by de-nailing process and will prepare “INSPECTION CUM RECEIPT REPORT OF USEABLE WOOD RECEIVED FROM TPS –STORE BY CARPENTRY”.
13) After acceptance of the wood by Quality and Carpentry, the same will be shifted to carpentry for receipt and its record will be maintained by carpentry.
14) This will be a Permanent Productivity Project executed by carpentry. “Productivity Savings “duly verified at the current Purchase Order rate of wood, will be sent every month to Resource Management Department, for highlighting it in their monthly progress report.

10 STANDARD METHOD OF PACKING

Table 5 –

STANDARD METHOD OF PACKING

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
PRESSUE VESSELS								
TOWERS					O			
TANKS					O			
VESSELS					O			
GASKETS	O							
FASTENERS	O							

STANDARD METHOD OF PACKING

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
COVERS		O						
EXCHANGERS								
HEAT EXCHANGERS					O			
TUBE BUNDLE	O							
SHELL					O			
AIR FIN COOLERS					O			
COLOUMNS, MOTOR SUSPENSIONS, PLENUM CHAMBERS, SCREEN GUARDS, ETC					O			
BEARING BLOCKS	O							
FANS	O	O						
MOTORS	O							
GASKETS	O							
FASTENERS	O							
TEST FLANGES			O					
TEST RINGS			O					
COVERS			O					

DESCRIPTION	**CASE**	**CRATE**	**SKID**	**BUNDLE**	**BARE**	**DRUM**	**METAL DRUM**	**FIBRE DRUM**
CRYOGENIC VESSELS								
COLD CONVERTERS					O			
HORIZONTAL STORAGE TANKS					O			
TRANSPORTATION TANK					O			
COLD BOX					O			
DRYING UNIT					O			
DRYING BOTTLES					O			
MOISTURE SEPARATORS					O			
SILENCERS					O			
ONGC SKIDS					O			
VAPORISER		O						
SPECIAL PRODUCTS								
SI/VI PIPING		O						
CRO BIO CONTAINERS	O							
AIR BOTTLES	O							
TITANIUM BOTTLE	O							
WAR HEAD CONTAINER	O							
MISSILE CONTAINER	O							
FUEL CONTAINER	O							
AIR LOCK ASSEMBLY	O							

DESCRIPTION	**CASE**	**CRATE**	**SKID**	**BUNDLE**	**BARE**	**DRUM**	**METAL DRUM**	**FIBRE DRUM**
BOILERS								

CORPORATE STANDARD

BOILER DRUMS					O			
BOILER ITEMS								
COILS			O					
PANELS					O			
HEADERS			O		O			
FEEDERS								
MACHINED ITEMS								
SHELL SEGMENTS					O			
SHELL SEGMENTS IN STACKS					O			
SPHERE PETALS								
COLOUMNS, BASE PLATES, TIERCOS, PIPES, NOZZLE E1, F1, INTERNAL PIPES, PADS ETC.					O			
ROLLERS	O							
VALVE TRAYS								
VALVE TRAY COMPONENTS	O							
LATTICE GIRDERS		O						
FASTENERS	O							
GASKETS	O							

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
SUB CONTRACTS								
FAB STRUCTURALS					O			
SUPPORTING STRUCTURALS					O			
STRUCTURE SUB ASSEMBLY					O			
FAB PIPES					O			
GRATINGS					O			
STAIR CASES					O			
HANDRAILS/ PLATFORMS					O			
BOUGHT OUT COMPONENTS								
IRON & STEEL (LIKE PLATES, BEAMS, ANGLES, CHANNELS ETC.)					O			
PIPE FITTINGS								
CS PIPES, TUBES					O			
SS PIPES, TUBES					O			
FIN TUBES	O							
ELBOWS		O			O			
FLANGES	O	O						
VALVES	O							
GAUGES	O							
DEMISTERS		O						
DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM

ABSCRBANTS (LIKE MOLECULAR SIEVES, ACTIVATED ALUMINA, MOBILE SORBID)						O		
PAINT TINS		O						
PAINT DRUMS						O		
IGNITORS	O							
SPRAY NOZZLES	O							
ELECTRICAL INSTRUMENTATION								
MOTORS, PUMPS, COMPRESSORS, TURBINES	O							
SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES		O						
INDICATORS, VIBRATOR SWITCHES	O							
CABLE BUNDLES, CABLE DRUMS					O			
CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL		O						
OPERATIONAL SPARES	O							

11 PROCEDURE FOR HANDLING OF COMPONENTS

The purpose of this procedure is to protect the quality of the components/equipment while handling in various stages of manufacturing packing & despatching.

11.1 Adequate care shall be taken in handling the material, and components to avoid damage during receipts, storage issue manufacture & despatch operations.

11.2 Appropriate material handling equipment like fork lifters, cranes etc. shall be used where needed.

11.3 Lifting by crane and transportation by trolley of critical items and large components like rotors castings etc. shall be done carefully.

11.4 For critical items, where specified, special handling fixtures shall be used for lifting.

11.5 Slings and shackles used for lifting the components/equipment shall be checked for fitness and suitability before use.

11.6 Slings used on machined surfaces shall be suitably padded. No slings shall be used on journal surfaces.

11.7 Precision machined components like blades, catches, rollers etc. shall be lifted using suitable wooden pallets.

11.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH

Before loading/unloading a packing case from the carrier look for the following shipping instructions painted on the packing case.

a) The markings showing the upright position.

b) The markings showing the sling position

c) Markings showing the fragile contents.

d) Other required markings as per Cl.no:08

11.8.1 Appropriate cranes and slings should be used for different components/ cases. Slings should normally make an angle as minimum as possible (width wise) but in no case more than 15º.

11.8.2 Handling and lifting should be done without jerks or impacts.

11.8.3 Immediately after receipt of the goods, the packing should be examined all-round for any sign of damage. If necessary, lift the cover or a number of boards of the case so as to make the contents visible. In the event of sealed packing being used the plastic sheeting should not be damaged. It is imperative that the packing material is restored in original condition after the inspection.

11.8.4 On receipt of the equipment it should be checked with the shipping list and missing or damage if any should be reported immediately. It is important to arrange for immediate examination to determine the extent of the damage, the cause of the damage and where applicable the person or persons responsible for the damage. According to general practice when transporting by railway or by road vehicle the carrier concerned should be immediately called upon (within specified periods) for jointly establishing a statement of the damage. This is essential as a basis for a subsequent claim and possible damage report to the insurance company.

11.8.5 Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.

11.8.6 Silica gel and such other chemicals kept in the box as desiccants and indicators should also be left in the box itself.

12 GENERAL GUIDELINES FOR ODC TRANSPORTATION/DESPATCH

Based on the Dimensions/Weight indicated in the Transportation Sketch, the type of Trailer is decided and indicated in the Tender Enquiry.

12.1 TRANSPORTATION:

1. LOW BED TRAILERS (LB 8):

Well Bed Length:	10000mm
Over Gooseneck:	13000mm
Width:	3000mm
Carrying Capacity:	40MT

2. LOW BED TRAILERS (LB 16):

Well Bed Length:	12000mm
Over Gooseneck:	16000mm
Width:	3000mm
Carrying Capacity:	75MT

3. TOW TYPE TRAILERS (WITH FRONT DOLLEY 16 TYRES): 12000MM length
(for Exceptional equipment length: 30000mm and above)

Bigger Dia equipment are loaded in the Well with overhanging.

Smaller Dia equipment with excess length are loaded over Gooseneck with rear hanging.

The Vehicle Dimensions are defined above are only guidelines for selection based on actual Dimensions/ Weight of the Consignment

12.2 PACKING:

For all ODCs, Wooden Saddles are cut to the diameter of equipment as per the Transportation Sketch.

For Diameter up to 4000mm

Wooden Saddles Length: 1836/2743mm (6'0"/9'0")
Width: 300mm (1'0")
Height: Saddle + one/two wedges a top.
For Diameter up to 4000mm
Wooden Saddles Length: 3353mm (11'0")
Width: 300mm (1'0")
Height: Saddle + three/four wedges a top.

NUMBER OF SADDLES:
Minimum: 3 in case of Loading inside Well
+ 1 when loaded on Gooseneck.
Maximum: 4 in case of Loading inside Well
+2 when loaded on Gooseneck.

For Securing the equipment firmly on the Trailer, 19mm (3/4"), wire rope with 25mm (1") Heavy Duty Turn Buckles / BD Clamps are used as Lashing for the equipment.

12.3 NUMBER OF LASHINGS ARE:

	CONSIGNMENT LOADED INSIDE WELL BED	CONSIGNMENT LOADED OVER GOOSENECK
a) up to 40MT	4 (2 Single Line lashing 2 Double Line Lashing)	5 (3 Single Line Lashing 2 Double Line Lashing)
b) 40MT to 60MT	5 (3 Single Line Lashing 2 Double Line Lashing)	5 (Single Line Lashing 3Double Line Lashing)
c) 60MT and above	5 (2 Single Line Lashing 3 Double Line Lashing)	6 (3 Single Line Lashing 3 Double Line Lashing)

13 GUIDELINES FOR HANDLING/LOADING/LASHING

13.1 HANDLING

Figure 6

Before unloading the jobs Completely painted and neatly stencilled will be checked.

Pipes with split type end cover will be checked

Figure 7

All Coil Tubes to be provided with End Caps.

Figure 8

Neatly stacked Coil Assemblies.

Figure 9

Columns to be lifted with Nylon belts. This protect painting, edges and attachments.

Figure 10

13.2 LOADING

All the components to be transported by putting inside the properly fabricated Crating

Figure 11

Small components may fall down while transporting without closed crating and there are chances of missing of small parts. Hence, it is always better to transport small components in closed containers/crating. Loose to be being shipped in a closed crating.

Figure 12

No component loaded over the crating.

Figure 13

Headers supported with wooden V blocks at 3 meters interval.

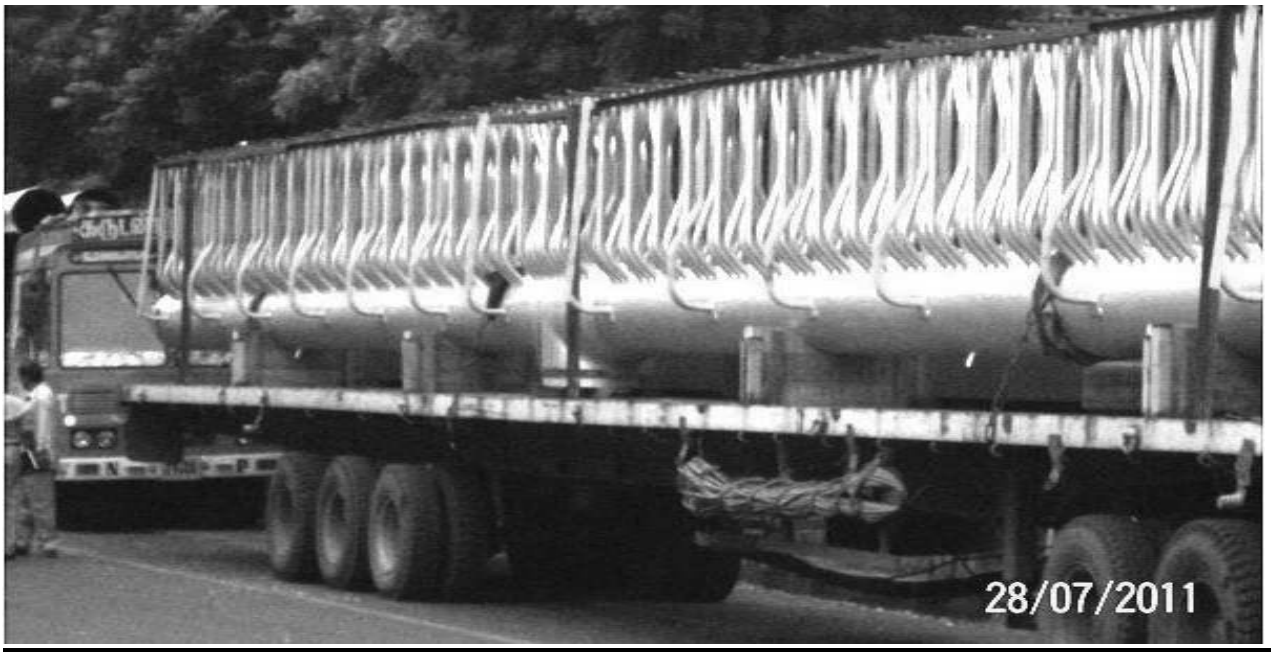


Figure 14

Spacers in between each coil assembly.

Figure 15

Goose pipe to be provided with rubber pad protects removal of painting and damage to the job.

Figure 16

13.3 LASHING

Use Nylon belts only for lashing of all components. It prevents removal off painting and cut in the materials.

Figure 17

Nylon Belts used for lashing the beams.

Figure 18

14 PRODUCT WISE SPECIAL INSTRUCTION

Additional instructions of packing not included in this standard shall be covered by individual product standard

15 REFERRED STANDARDS (Latest publications including amendments):

1) AA51420 2) AA55619 3) AA51414 4) IS:3401

5) AA10108 6) AA56126

SURFACE PREPARATION AND PRETREATMENT OF FERROUS SURFACE PRIOR TO PAINTING

1 GENERAL

This standard, details the surface preparation and pre-treatment of ferrous surfaces prior to painting. This includes removal of oil, grease, dirt and swarf followed by removal of rust by means of mechanical or chemical treatment.

Assistance has been taken from IS 8629, Part 2–1977 and Swedish Standard SIS 05 5900–1967 in preparing this standard.

2 REMOVAL OF OIL, GREASE, DIRT AND SWARF

Before application of paint, it is very essential to have a very clean surface. All oil, grease, dirt and swarf to be removed by means of solvent, alkali, emulsion or steam cleaning. Refer to specific MSDS (Material Safety Data Sheet) for precautions to be taken during storage, handling and disposal of such chemicals used.

2.1 Solvent cleaning

This shall be done by using petroleum solvent (other than CTC) or trichloroethylene.

2.1.1 Petroleum solvent cleaning

The method involves use of petroleum solvents like white spirit to BHEL specification AA56701. The process of cleaning such as immersion or brushing is decided depending on the size/shape of the component. However, sufficient time should be allowed for removal of the contaminants and in no case for less than one minute. Cleaning with brushing or wiping is used for the "insitu" cleaning of articles too large for immersion tanks or spray cleaning surfaces. The surface of the fabricated panel shall be cleaned with brush or cloth soaked in white spirit to BHEL specification AA56701 to remove stains of oil, grease etc. before rust removal. The solvent should be allowed to evaporate before next operation. If required, clean cotton cloth can be used for wiping the surface. The cloth shall be changed every time or the contaminants on the cloth will adhere to the substrate.

a) Process

Two main methods are given below. Details depend upon the quantity and characteristics of the parts or assemblies to be cleaned.

i) Immersion

This method may be used for unit parts or assemblies when contamination is light and when the highest degree of cleanliness is not essential; it is particularly suitable for hand cleaning in small tanks. The articles should be immersed in the solvent long enough to allow removal of the contaminants, and in no case for less than one minute. Agitation is desirable, and brushing or scrubbing with wire brushes will aid quick cleaning.

ii) Brushing or wiping

This method is intended for the removal of oil, grease and light contamination from bare metal areas or assemblies containing painted surfaces or non-metallic inserts that might be damaged by general application of solvent. It may also be used for the 'in-situ' cleaning of articles too large for immersion tanks or spray cleaning systems.

b) Handling precautions

Articles should be placed on hooks or racks or in suitable containers that permit adequate draining. They should not be handled with bare hands after cleaning. Clean gloves or similar protection should be used and handling kept to a minimum.

c) Safety precautions

Petroleum solvents should be used at room temperature in a well ventilated area and suitable exhausts and fire extinguishers should be provided, as these solvents are flammable. Oil-resisting synthetic rubber gloves should be worn when handling articles during cleaning, to protect the articles from sweat residues and to avoid any possible effect of the solvent on the skin. Care should be taken to avoid breathing the petroleum solvent vapour. Aprons, respirators and safety glasses shall be used by the operators who are responsible for the above operations.

d) Limitations

Petroleum solvent cleaning suffers from the following drawbacks:

i) Fire risk

ii) Brush or wipe or immersion methods being manual in operation are slow and time consuming and therefore unsuitable on their own for continuous production lines, and

iii) The degree of cleanliness achieved by such methods is not high and they are generally used for preliminary cleaning to supplement a proper degreasing operation.

2.1.2 Trichloroethylene cleaning

The method relates to surface cleaning with trichloroethylene solvent. This can be done by placing the equipment in the vapours of trichloroethylene or by immersing it in boiling trichloroethylene or by jetting trichloroethylene at high pressure on surfaces to be cleaned.

a) Degreasing

The three main processes are described below

The precise details of the equipment and the method of operation for each process depends on the quantity and characteristics of the parts or assemblies to be cleaned; the plant manufacturers' recommendations should be followed.

i) Vapour process

The remove simple films of oil and grease, articles may be subjected to the vapour process, in which the parts are exposed in a bath of solvent vapour. The vapour condenses on the cold surface of the articles and the condensate dissolves the oil and grease, taking it away to the base of the tank. To ensure the maximum condensation, the temperature of the articles should be as near to the room temperature as possible at the time of immersion. They should be passed through or suspended in the solvent vapour until no further condensation occurs, after which no further degreasing will take place. Articles with a very heavy film of grease may need a second exposure after cooling.

ii) Liquid process

Loosely bound contamination (too much for vapour treatment) such as polishing compound, swarf and road dirt may be removed by immersing the parts in vigorously boiling trichloroethylene.

iii) Jetting process

Articles with obstinate dirt deposits that cannot be removed by boiling trichloroethylene may require jetting at high pressure with the hot solvent. The jetting should be carried out only in equipment, specially designed for the purpose.

b) Handling precautions

During processing, the articles should be placed on hooks or racks or in a suitable container. They should be so arranged that there is adequate opportunity for the solvent to drain from holes, crevices, pockets and other irregularities. Parts or assemblies that would trap solvent should be rotated or tilted during the degreasing process to prevent drag-out of trichloroethylene. Handling may be reduced by

using mechanical and conveyor type degreasing plants which automatically rotate or tilt the articles. After cleaning, articles should not be handled with bare hands. Clean gloves or similar protection should be used.

c) Safety precautions

Trichloroethylene is a toxic substance. All safety precautions like wearing aprons, rubber gloves, respirators and safety glasses shall be used by the operator responsible for the above operations. Care should be taken to avoid breathing the vapour near degreasing equipment.

2.2 ALKALINE CLEANING

Cleaning of surface can be done by using alkaline degreasing agents, which are very good for cleaning but by and large injurious to skin. This process can be followed either by immersion in hot alkaline mixture or by electro cleaning process or by using jet cleaning process. In the electro cleaning process tank to be used as one electrode while job to the cleaned to other electrode. In the jet cleaning process, job to be cleaned is subjected to jet of hot alkaline solution at high pressure. Details of safety and handling as per IS 8629 Part 2.

2.3 EMULSION CLEANING

These are diphase cleaners of oil/water emulsion type. These cleaners may be applied by spray or dip, though spray is more common. Details of safety and handling as per IS 8629 Part 2.

2.4 STEAM CLEANING

This method related to the use of a jet of high pressure steam for the “in-situ" cleaning of large unit parts, assemblies and machinery that cannot be accommodated in a cleaning apparatus. The cleaning may be carried out with pure steam or with alkaline solution/steam mixture. Details of safety and handling as per IS 8629, Part 2.

3 REMOVAL OF RUST AND SCALE BY MECHANICAL OPERATIONS

3.1 HEAVY LOCALISED RUST

If rusting has occurred locally, but to such an extent that some pitting with hard rust flakes, is exhibited, the rust shall be first removed by using hand scraping or scraping with mechanical power tools or flame cleaning. The affected surface shall be treated as that mentioned for "Light Rust” in Clause 4.1.

3.1.1 Hand scraping

Scraping with a hand scraper generally follows by steel wire brushing and finally sanding the surface with a coarse sand paper, steel wool or emery paper.

3.1.2 Scraping with mechanical power tools

This gives better and quicker results than above, but it may not be possible to remove firmly adhering mill scale even with this method.

3.1.3 Flame cleaning

This is done by heating the surface with oxy-acetylene torch. Because of the difference in expansion between the heated mill scale and the bulk of the steel, the scale becomes loose and either falls off or is easily removed with wire brush. This process is not suitable for plates less than 6 mm thick because of buckling problem that may result during this process.

3.2 GENERAL RUSTING

If the surface is widely rusted to such as extent that pitting with hard flakes is exhibited, generally the job shall be grit or shot blasted. The principle is to impinge under pressure of air, a jet of sharp granulated steel (steel or non-metallic grit) on to the metal surface removing in the process any rust and scale, including firmly adhering mill scale. A steel surface properly cleaned by blasting may be immediately recognised by its silver grey surface and the criterion for good shot blasting is the evenness of the colour of the surface so cleaned. Precautions shall be taken when shot blasting light gauge steel to see that buckling does not occur as a result of continuous impingement of grit or steel shot under high velocity.

Before the process of blast, cleaning is carried out, may be cleaned by emulsion/steam cleaning to remove dirt, dust, grease etc.

3.3 BLAST CLEANING

The process of surface preparation by Blast Cleaning is described below:

3.3.1 White metal blast cleaning

A white metal blast cleaned surface when viewed without magnification shall be free of all visible oil, grease, dirt, dust, mill scale rust, paint oxides, corrosion products and other foreign materials.

3.3.2 Commercial blast cleaning

A commercial blast cleaned surface when viewed without magnification shall be free of all visible oil, grease, dirt, dust, mill scale rust, paint oxides, corrosion products and other foreign materials.

Staining shall be limited to no more than the 33% of each square inch of surface area and may consist of light shadows, slight streaks or minor discolouration caused by stains of rust. Stains of mill scale or stains of previously applied paint, slight residues of rust and paint may also be left in the bottom of the pits if the original surface is pitted.

3.3.3 Brush-off blast cleaning

A brush-off blast cleaned surface when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scales, loose rust and loose paint.

The entire surface shall be subjected to the abrasive blast. The remaining mill scale, rust or paint shall be tight.

When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system.

Immediately prior to paint application, the surface shall comply with the degree of cleaning as specified.

3.3.4 Near white blast cleaning

A near white blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products and other foreign matter, except for staining as noted below:

Staining shall be limited to no more than 5% of each square inch of surface area and may consist of light shadows, slight streaks or minor discolouration caused by stains of rust, stains of mill scale or stains of previously applied paint.

3.4 SURFACE PREPARATION BEFORE BLAST CLEANING

Before blast cleaning, visible deposits of oil or grease shall be removed by solvent cleaning.

Before blast cleaning the surface, imperfections shall be removed from the surface as specified below:

Weld spatter shall be removed by using chipping hammer, spud bar, scrapper or by grinding.

Areas of unacceptable porosity should be filled or closed over with a needle gun or peening hammer.

Sharp edges may be removed by grinding, mechanical sanding, filling etc.

Deep corrosion pits, gouges, clamp marks or other surface discontinuities may be repaired by grinding or filling.

Areas of poor design for corrosion protection such as tack or spot welded connections, back to back angles, crevices (narrow openings) may require corrections by structural or design modifications where this is not possible, particular consideration should be devoted to minimise the effect of such deficiencies.

Substrate Chemical contamination (for blasting): shall be conducted with any suitable method to identify salt contamination.

– Type of check : Measurement
– Quantam of check : One Test/abrasive lot used
– Acceptance Norm : Chloride < 15 µg/cm² (ppm), Sulphate < 20 ppm

3.5 BLAST CLEANING METHOD AND OPERATION

3.5.1 Clean, dry compressed air shall be used for nozzle blasting (moisture separators, oil separators, traps or other equipment may be necessary to achieve this requirement).

3.5.2 The various method of surface preparation to achieve a blast cleaned surface are as follows:

a) Dry abrasive blasting using compressed air, blast nozzles and abrasive.

b) Dry abrasive blasting using a closed cycle, recirculating abrasive system with compressed air, blast nozzles and abrasives with or without vacuum for dust and abrasive recovery.

c) Dry abrasive blasting using a closed cycle recirculating abrasive system with centrifugal wheels and abrasive.

3.6 PROFILE OF ROUGHNESS OBTAINED DURING BLASTING

This will depend upon the abrasive used, the air pressure and the technique of blasting. Too low a profile may not provide a sufficient key for a coating while too high a profile may result in uneven coverage of high sharp peaks leading to premature coating failure, particularly for thin coatings such as blast primers apart from higher paint consumption.

The following table gives a brief guide to typical roughness profiles obtained using various types of abrasives

Types of abrasive	Mesh size	Maximum height of profile
Very fine sand	80	37 microns
Coarse sand	12	70 microns
Iron shot S 390 Typical non metallic "Copper slag"	14	90 microns
1.5 to 2 mm grain size	--	75/100 microns
Iron grit no. G16	12	200 microns

Profile measurement shall be made using appropriate profile gauge supplied with calibration standards.

3.7 ABRASIVE SELECTION

The selection of the size and type of abrasives which will most effectively and economically produced the desired surface finish, shall be as per Section-5 of "Surface preparation commentary (SSPC-SP-COM)", encl.no.25.

In general, select the smallest size abrasive that will produce the desired cleaning results. Usually, this will give the fastest, most economical cleaning operation.

3.8 SURFACE PREPARATION AFTER BLAST CLEANING AND IMMEDIATELY PRIOR TO PAINTING

Visible deposits of oil, grease or other contaminants shall be removed by solvent cleaning.

Dust and loose residues shall be removed from prepared surfaces by brushing, blowing off with clean, dry air, or vacuum cleaning.

After blast cleaning, surface imperfection which remain shall be removed to the extent required as explained at 4.2.

Any visible rust that forms on the surface of the surface steel after blast cleaning shall be removed by re-blasting the rusted areas.

3.9 INSPECTION

All work and material supplied under this specification shall be subject to timely inspection by Q.C.

Conditions not complying with this specifications shall be corrected.

The engineering and process documents, sub-contract, scope-procurement documents should establish responsibility for inspection and for any required affidavit certifying full compliance with this specifications.

The appearance of the surface after cleaning should correspond to pictorial standard as mentioned below

	Blast cleaning method	Pictorial standard	For Pictorials
1	White metal blast cleaning (blast cleaning to visually clean steel)	A Sa 3, B Sa 3 C Sa 3 & D Sa 3	Annexure 1a
2	Commercial blast cleaning (light blast cleaning)	B Sa 1, C Sa 1 & D Sa1	Annexure 1b
3	Brush-off blast cleaning (through blast cleaning)	B Sa 2, C Sa 2 & D Sa2	Annexure 1c
4	Near white blast cleaning (very through blast cleaning)	A Sa 2 ½, B Sa 2 ½, C Sa 2 ½ & D Sa 2 ½	Annexure 1d

Alternatively, NACE Visual Comparators may also be used for inspection purposes.

The test for assessment of dust on steel surfaces prepared for painting can be carried out as per the Pressure-sensitive Tape method as per ISO 8502-3.

NOTE:

1) All jobs are generally to be shot/grit blasted.
2) For pictorial standard only coloured profile should be used. (xerox copy not to be referred)
3) Blast cleaning surface should be measured after cleaning.

4 REMOVAL OF RUST BY CHEMICAL CLEANING

4.1 Light Rust

If a thin film of very light rust exists on the work, it shall be removed by means of de-rusting solution /rust converter. After degreasing as above, the de-rusting solution shall be applied in a thin film, using brush or swab and left for 10 to 15 minutes. At the end of the period and before it has dried, it shall be wiped off with a clean dry cloth and the surface examined any red rust is still visible, further similar application shall be made until the surface exhibits a grey colour only.

The surface shall then be followed to dry and be brushed down with a clean dry brush before painting. The drying may be accelerated by swabbing or brushing the surface with Industrial Methylated Spirit (AA56705). This is recommended for faster drying and removal of un-reacted acid.

NOTE:

In case of Epoxy painting system like BHEL standard AA0674104 and AA0674111 shot blasting of surface shall conform to Sa 2 ½ minimum of Swedish Pictorial Standard SIS 055900.

4.2 SULPHURIC ACID, HYDROCHLORIC ACID OR PHOSPHORIC ACID PICKLING

To remove scale and rust, pickling can be done by using sulphuric acid 5 to 20% concentration by volume at 60 to 80°C or hydrochloric acid 20 to 50% concentration by volume at room temperature or phosphoric acid at 5 to 25% concentration by vol. At 60 to 85°C.Appropriate inhibitors shall be used in the pickling bath to reduce acid attach on the base metal. This shall be followed by washing in water followed by dipping in phosphoric acid solution, 1-2% concentration by volume.

NOTE:

The pickling acid selection should be made on the basis of the material pickled.

4.2.1 Process details

The components to be treated shall be immersed in the tanks made of steel with suitable lining with chemicals, temperature and dipping time as given below:

(Suitable chemicals as per applicable purchase specification from time to time shall be used according to the process)

Concentration process	Pointage (Chemical in water) see note below	Bath dipping see note below	Temp. (deg. C)	Time
Degreasing (if hot)	3-5% WT/VOL	27 - 45	80 - 90	10-15 minutes
Degreasing (if cold)	10-15% WT/VOL	80 - 90	Room temp.	10-15 minutes
Rinsing in cold running water tank with over flow arrangement				
De-rusting (cold)	20-40% VOL/VOL	20 - 40	Room temp.	10-20 minutes
Rinsing in cold running water tank with over flow arrangement				
Phosphating (cold)	5-6% VOL/VOL	25 - 30	Room temp.	20-30 minutes
Rinsing in cold running water tank with over flow arrangement				
Passivation (if hot)	0.1-0.2% VOL/VOL	Free acid: 0.1-0.2ml per 25ml; Total acid: 2.5ml max. per 25ml	50 - 60	30-45 seconds
Passivation (if cold)	Same as above	Same as above	Room temp.	2-3 minutes

NOTE

a) The values are indicative. The chemical concentration, temperature (hot or cold), dipping time are to be maintained as given by the manufacturer of the chemical and the nature of oil/soil/rust on the component.

b) Pointage: is the value of the titrate (chemical used for titration)

Of a given strength, when a sample (whose concentration is to be checked) of 10ml is taken for titration (for convenience of titration, add 100ml water, value will not be different if water is added or not). For example, when a 10ml of degreasing solution is titrated using 0.1 N hydrochloric acid, if the titrate value is 25ml, then the pointage of degreasing solution is 25.

4.2.2 Analysis of pre-treatment baths

a) Take 10ml of sample solution + 100ml water + 6 to 8 drops of indicator given. Pour into a 250ml conical flask and shake well.

b) Titrate against the chemical given and observe for the change in colour. Note the value of titrate used. That is the pointage, which shall be as per the process details given earlier.

Solution	Indicator	Titrate with	Turning point
Degreasing	Phenolpthalin	0.1 N Hydrochloric acid	Pink to clear
De-rusting	Methyl orange	1.0 N Sodium hydroxide	Orange to yellow
Phosphating	Phenolpthalin	0.1 N Sodium hydroxide	Colourless/slight yellowish to pink atleast for 10 seconds

Passivation - given in further pages

NOTE

Toner concentration checking: Dip starch iodide paper for one minute in solution, observe the change in colour.

Colour change	Inference
Remains white	Toner insufficient
Turns blue	Toner sufficient
Turns dark blue	Toner excess

Passivation solution Titration Analysis:

For free acid strength:

Take 25ml sample in a measuring flask and pour into 100ml conical flask. Add 6 to 8 drops of Bromocresol green solution. See the colour remains yellow, titrate using 0.1 N sodium hydroxide until colour changes to green or blue. Note the value of standard solution.

For total acid strength:

Continue titration adding phenolphalin indicator to 0.1 N sodium hydroxide until solution changes to purple. Note the volume of sodium hydroxide.

4.3 ELECTRO - CHEMICAL CLEANING

It is possible to remove rust and scale by cathodic treatment in acid solution, cathodic treatment in alkaline solution, anodic treatment or alkaline de-rusting process as per IS 6005.

NOTE

Within 8 hours of surface preparation, the job should be subjected to phosphating or application of priming paint.

Surface cleaning and painting should not be carried out when the humidity in the chamber is above 80% (RH).

5 INSPECTION FOR PROCESS CONTROL

Quality control inspector shall visually inspect the prepared surface for freedom from rust, stain, oil or grease before application of priming paint. The records of surface cleanliness (extent of cleaning and profile) shall also be inspected. It shall also be ensured that the shot blasted surface should be subjected to phosphating or application of priming paint within 4 hours except the jobs which need pressure testing due to code requirements.

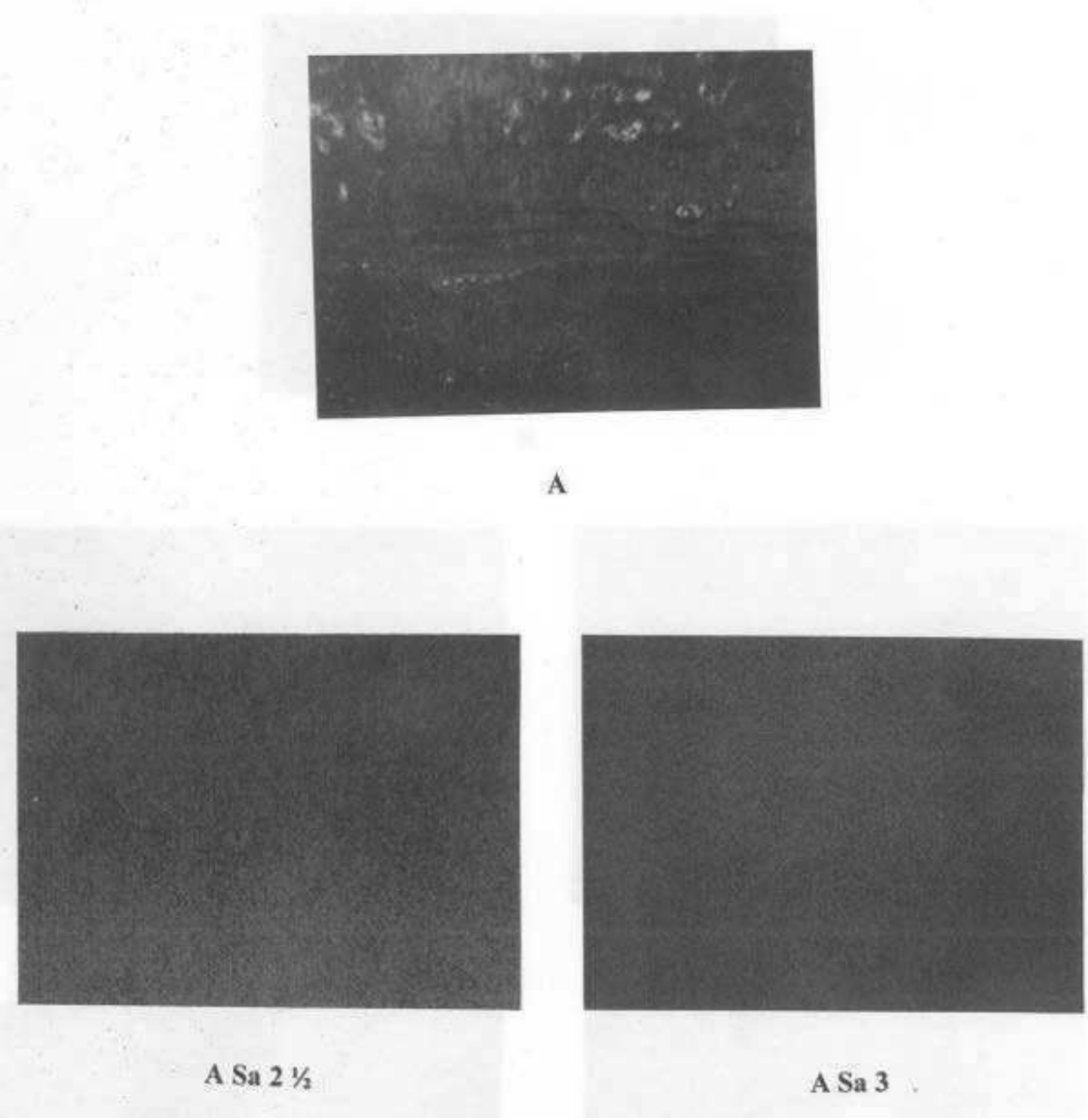
A comparative table showing the various equivalent standards is presented in the ANNEXURE 2.

6 REFERRED STANDARDS (Latest Publications Including Amendments)

1) AA56701
2) AA56705
3) AA0674104
4) AA0674111
5) IS 6005
6) IS 8629 Part 2
7) ISO 8502
8) Swedish standard SIS: 05 5900-1967

Annexure-1a
(Clause 3.9)

SURFACE FINISH RUST GRADE



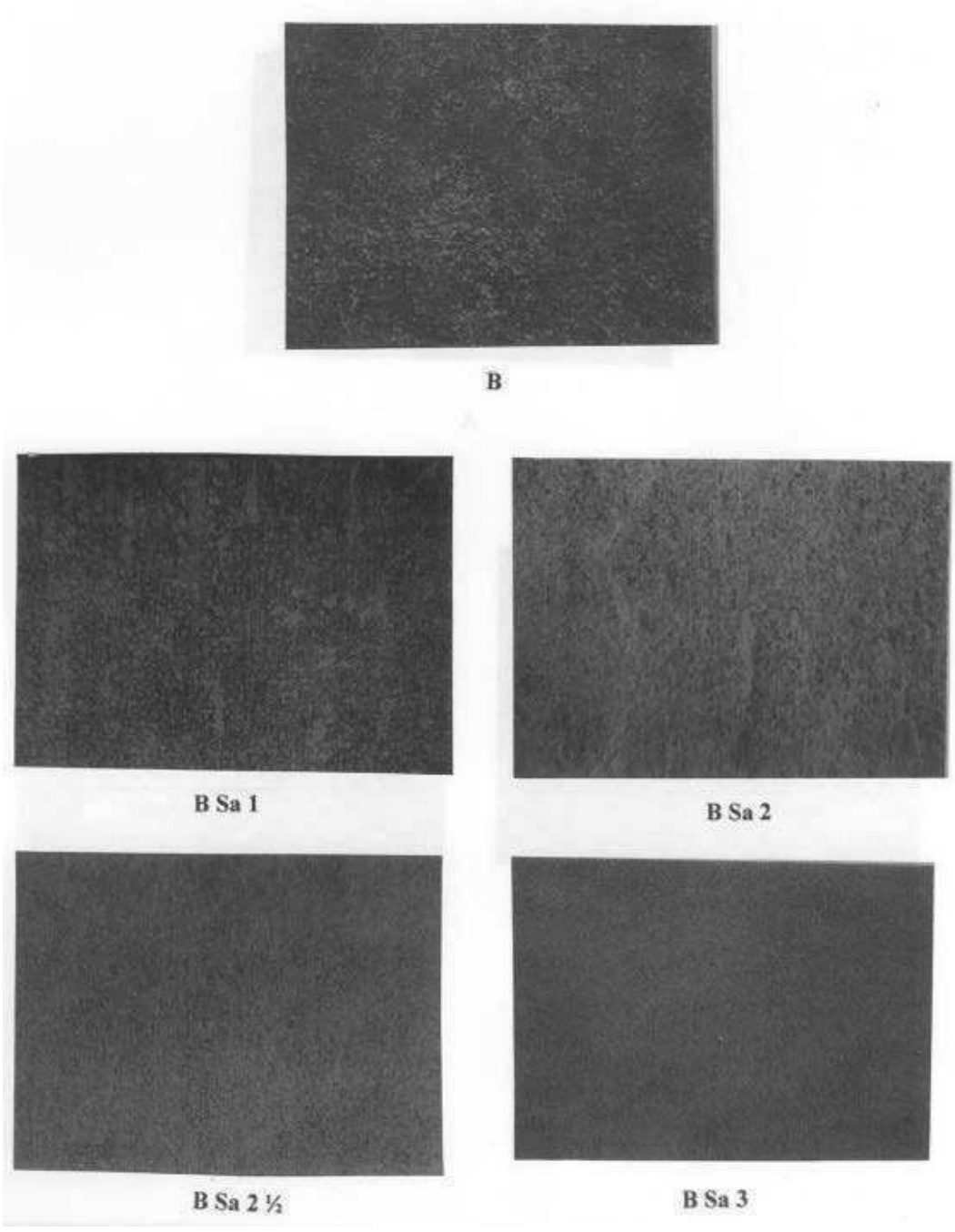
A

A Sa 2 ½

A Sa 3

Annexure-1b
(Clause 3.9)

SURFACE FINISH RUST GRADE



B

B Sa 1

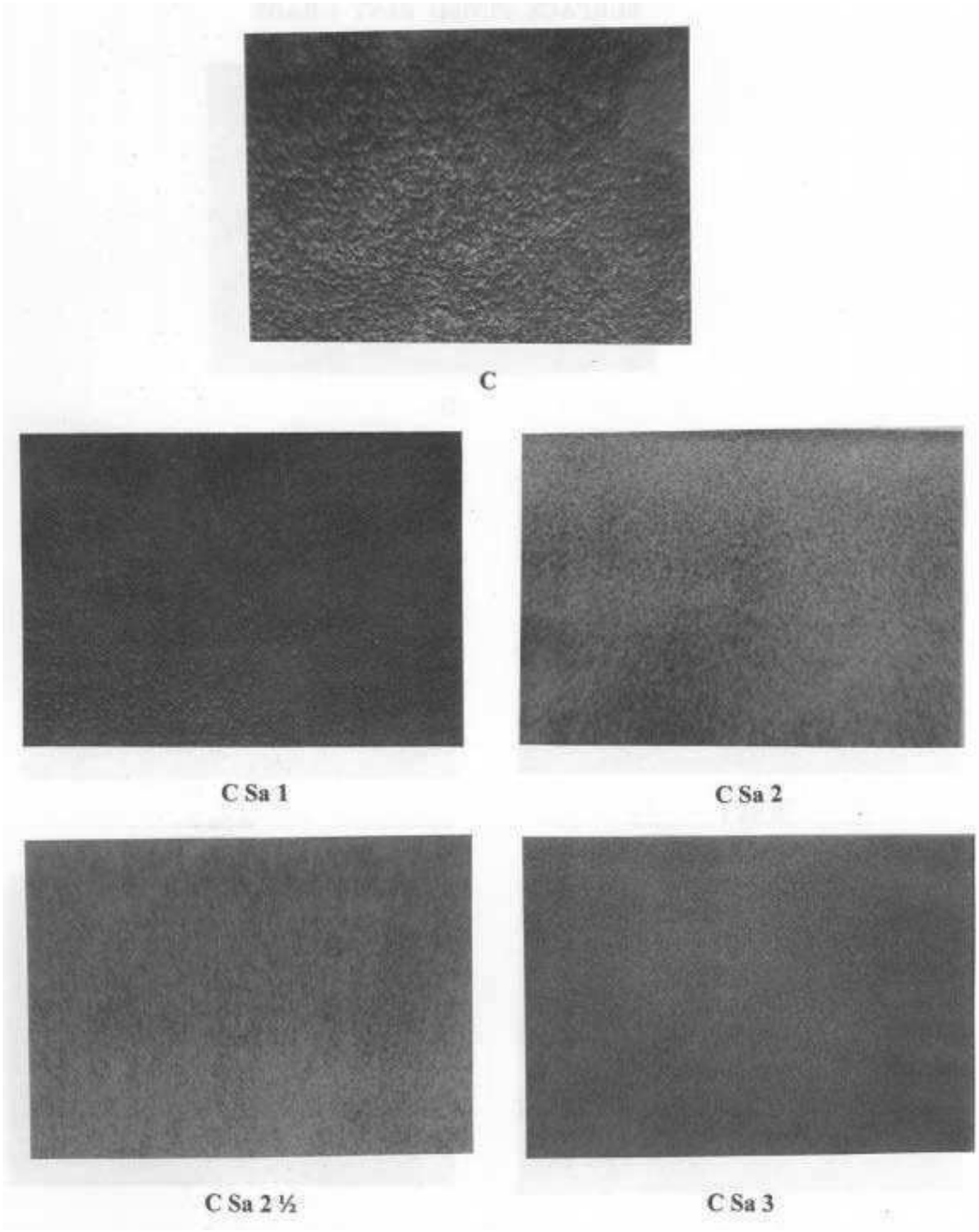
B Sa 2

B Sa 2 ½

B Sa 3

Annexure-1c
(Clause 3.9)

SURFACE FINISH RUST GRADE



C

C Sa 1

C Sa 2

C Sa 2 ½

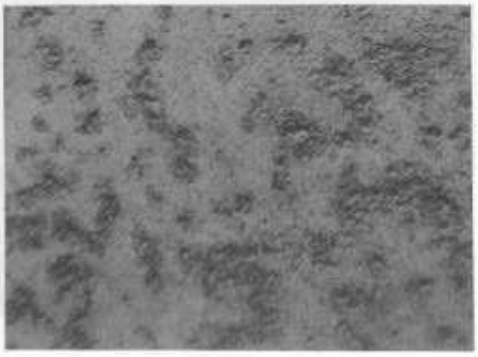
C Sa 3

Annexure-1d
(Clause 3.9)

SURFACE FINISH RUST GRADE

D

D Sa 1



D Sa 2

D Sa 2 ½

D Sa 3

CORPORATESTANDARD

Annexure-2
(Clause 5)

INTERNATIONAL STANDARDS FOR SURFACE PREPARATION – A COMPILATION OF NEAREST EQUIVALENTS

Sl No.	Surface preparation	Swedish standard SIS: 055900	German standard DIN: 55928 Part-4	SSPC standard	BS 4232	A.S. 1627 Part-4	BSI standard IS:477	NACE standard
1	Blasting cleaning to white metal	Sa 3	Sa 3	SSPC-SP 5	1st Quality	Class 3	Class A1.1	1
2	Blast cleaning to near white metal	Sa 2½	Sa 2½	SSPC-SP10	2nd Quality	Class 2½	Class A1.2	2
3	Blast cleaning to commercial quality	Sa 2	Sa 2	SSPC-SP 6	3rd Quality	Class 2	Class A1.3	3
4	Brush-off blast cleaning	Sa 1	Sa 1	SSPC-SP 7	--	Class 1	Class A 1.4	4
5	Power tool cleaning	St 3	St 3	SSPC-SP 3	--	AS 1627 Part 2	Class 6.2.1.2	--
6	Hand tool cleaning	St 2	St 2	SSPC-SP 2	--	AS 1627 Part 7	Class 6.2.1.2	--

NOTES FOR ABOVE Sl. Nos. :

1) Removal of all visible rust, mill scale, paint and other contaminants.
2) 95% of any section of surface area is free from all rust, mill scales and other visible residues.
3) Two-thirds of any section of the surface area is free from all rust, mill scales, etc.
4) Removal of all loose mill scales, rust and foreign matter.
5) Through scraping and wire brushing to remove loose mill scales, rust and foreign matter using power operated tools.
6) Removal of loose rust and soil by wire brushing without using power tools.

LOG SHEET FOR SURFACE PREPARATION AND PAINTING

1 GENERAL

This standard is devised to document the details of the process of surface preparation and painting followed. It also includes Do's and Don't to obtain product.
The document sheets have been prepared for recording various aspects of surface preparation and painting as recommended in BHEL standards AA0674101 & AA0674112.

2 SCOPE

Log sheets format devised have to be duly recorded for each job and document preserved by appropriate authority.
Do's and Don'ts provided in the document are guide lines pertaining to application and storage of paints. However the safety precautions provided in AA0462802 have to be observed while executing the job.

3 LOG SHEET

Drg no:	Description of the job:	Mono / Wo. No. PO No.
Customer:	Name of the item to be painted:	
Quality Plan no.	Customer specification	Painting scheme:

1.Surface preparation:	Start Date:		Finish date:	
Degreasing & shot Blasting	Chemical Cleaning	Surface Roughness	Zinc Phosphating	

2.Painting Process:					
Painting Scheme:			*Deviations if any:*		
2.1 Stripe Coat:	Start date:		Finish date:		
Method of Application					
Type of paint	Thinner	Make	Batch no	Carried out by	DFT
Temperature: wet bulb:		Dry Bulb:	Humidity	Surface Temp:	

2.2 Primer:	Start date:		Finish date:		
Type of paint	Thinner	Make	Batch no	Carried out by	DFT
1st coat					
2nd coat					
Temperature: wet bulb:		Dry Bulb:	Humidity:	Surface Temp:	

2.3 Intermediate Coat:	Start date:		Finish date:		
Type of paint	Thinner	Make	Batch no	Carried out by	DFT
1st coat					
2nd coat					
Temperature: wet bulb:		Dry Bulb:	Humidity:	Surface Temp:	

2.4 Finish Coat:	Start date:		Finish date:		
Method of Application					
Type of paint	Thinner	Make	Batch no	Carried out by	DFT
1st coat					
2nd coat					
3rd coat					
Temperature: wet bulb:		Dry Bulb:	Humidity:	Surface Temp:	

3. Quality checks: Inspected/ Tested by	Shop Incharge	Third Party Inspection
Visual Inspection		
Adhession Test		
Gloss level		
Finish		
Shade		
Holiday/ Pin hole Test (O.K. / NOT O.K.)		

4 Remarks:

The equipment used for holiday testing is & rating volts

5 GOOD PAINTING PRACTICES

5.1 DO'S

1) Remember, painting is an important value adding activity. Give it all your care.
2) Store paints in covered places. Avoid direct exposure to sunlight on paints.
3) Ensure the validity of the shelf life of the paint before use.
4) Roll the paint drum several times to ensure thorough mixing of the paint before use.
5) Use proper tools to open lid of the drum.
6) Mix the paints thoroughly to ensure homogeneity.
7) Apply strip coat on edges, corners and weld beads.
8) Follow instructions on the paint can or literature whenever a new scheme / source of paint is used.
9) Draw only the required quantity of the paint for the job and immediately recap the can.
10) Ensure proper ratio of mixing in case of two-pack system, as per norms.
11) Use only the specified thinner prescribed by the supplier or standard.
12) Ensure good quality of compressed air (free from moisture and oil) prior to spray painting.
13) Use only clean/new brushes of definite size for painting.
14) Clean the bristles well in the thinner before they are used for painting.
15) Painting shall be done in a well-ventilated area/identified area.
16) Ensure proper surface preparation as per the painting scheme.
17) Ensure that the blasted surface be painted within 4 hours after blasting.
18) Ensure that the surface to be painted is free from oil, grease, stray arcs, dents etc.
19) Adhere to the no. of coats shade, dry film thickness and inter-coat curing time interval as specified. Clarity with lab, if needed.
20) Use lint free cloth/clean wiping rags for cleaning the surfaces prior to painting.
21) Maintain the right distance between the surface and spray gun (6 inches to 8 inches).
22) Ensure that mixed paints will be used before the expiry of its pot life in case of two-pack systems.
23) Ensure that the items to be painted/painted are inspected and cleared by the QC personnel concerned.
24) Preserve the balance thinned paints in a separate closed container for future use, if they don't have any restricted pot life.
25) Clean the brush before and immediately after painting. Keep them clean during interruption too.
26) Apply a coat of weldable primer at site on weld edge preparation zone.
27) Use appropriate safety appliances for painting viz., face masks (for spray guns), nose respirator, gloves etc.
28) Mask the surface of wherever required.

5.2 DON' T S

1) Do not use the paint, which has crossed its expiry date.
2) Do not draw more paint than necessary from the stores.
3) Do not make holes in the drum to draw the paint.
4) Do not keep the paint drum open for a long time.
5) Do not inter-change the thinners for the same generic paint between suppliers.
6) Do not use kerosene as thinner.
7) Do not smoke while painting.
8) Do not leave the brush without cleaning after painting.
9) Do not paint close to a welding area.
10) Do not paint when there is rain or sandstorm or when the relative humidity is about 90%.
11) Do not paint when the metal is chill or very hot.
12) Do not paint when the surface is not cleaned/prepared for painting requirements.
13) Do not paint the finish coat if the primer coat is not satisfactory.
14) Do not leave the balance paint open after painting.

PROCESS FOR PAINTING OF METAL COMPONENTS AND STEEL SURFACES

1.0 GENERAL:

This standard details the process to be followed to provide a coating on metal components and technical information regarding generic of paint medium and application related information. The paint shall be applied by spray/brush/airless spray and dried by stoving/air drying. The painted surface shall be protecting the components in their environment of exposure. This specification supersedes other AA 0674111 and 0674122.

SPECIFIC DEFINITIONS:

DFT : Dry Film Thickness; the thickness of the dried or cured paint coating film.

Operating Temp. : Temperature at which painting is to be performed.

TDFT : Total Dry Film Thickness, the thickness of the total number of coatings specified after curing.

VS% : Volume Solids Percent

1.1 METHODS OF PAINT APPLICATION

The paint shall be applied in accordance with the paint manufacturer's product data sheet, which shall include the mixing ratio, the maturation time, the method of application, the use of thinners and coating intervals. The dry film thickness of individual coatings shall be as specified. Areas with inadequate coating thickness shall be thoroughly cleaned, if necessary, abraded and additional compatible coats shall be applied until they meet the required film thickness.

Painting shall not be performed when the temperature is less than 3°C above the dew point of the surrounding air or when the relative humidity of the air is greater than 85% unless local conditions dictate otherwise and the Principal is in agreement. Guidance on the estimation of the probability of condensation can be found from the Table referred in Annexure-I.

In addition, paints shall not be applied under the following conditions:

- when the surface temperature is greater than 40°C (unless a higher temperature is recommended by the paint manufacturer).
- when the air temperature is less than 10°C (depending on local conditions).
- when there is the likelihood of an unfavorable change in the weather conditions within two hours after painting.
- when there is deposition of moisture in the form of rain, condensation, frost etc. on the surface.
- when the available light, ventilation is not adequate for painting.

If condensation, rain, dust or other foreign materials contaminate the surface of a paint coating which is not dry to the touch, the paint shall be removed, the surface re-cleaned and fresh paint is applied in accordance with this specification.

Paints shall not be applied within 50mm of edges which will later have to be welded. Such weld areas should be taped for a distance of 50mm on either side of the weld line.

Extra coats of paint shall be applied on the areas where the shape and/or plane of application result in thinly applied coatings etc., at edges, welds, corners etc. To compensate for these effects, stripes coats of paints shall be applied (normally applied first so that they will be covered by the full coat).

When zinc rich primers are used, care shall be taken to avoid any possibility of over spraying onto duplex or austenitic stainless steels, nickel alloys or 9% nickel steel components.

Note : Zinc rich primers shall not be applied on equipment made from the above mentioned materials unless such equipment is located in a shielded position which will minimise the risk of molten zinc falling onto the equipment in the event of a fire.

Proper application of protective coatings is an important criterion in giving the paint system its required life. To achieve good finish out of paint systems recommended paint putty mastic compound may be used after primer / under coat compatible with system and recommended by manufacturer.

Given below are the four main application procedures along with the advantages and disadvantages of each.

1.1.1 Brush application :

Used frequently for decorative paints, in protective coatings this is in vogue in painting complex areas where the use of spray methods would increase the loss factor. However, a word of caution about brush application, it is difficult to achieve higher thickness with a high build coating by brush application in one coat. The process is relatively slow and may result in a poor finish for thixotropic or high viscosity top coats.

1.1.2 Conventional spray:

A widely accepted method of paint application where liquid paint is atomised by an air stream. A correct combination of air pressure, air volume and fluid flow has to be selected to achieve full atomisation and a paint film free of defect. One may also face problems like sagging, pin holing and poor paint flow if the control parameters are not monitored properly.

The major disadvantage of conventional spray is that high build coatings cannot be applied by this method, as most paints have to be thinned to a suitable viscosity for satisfactory atomisation.

1.1.4 Airless spray

This is by far the fastest and most versatile method because it enables application at variable thicknesses. The equipment utilises an electric or air driven motor and a high pressure fluid pump to compress the coating to extreme pressures. The paint is then made to pass through a special tip which atomises it, and thus controls the application properties.

The main advantages of this method are :

a) High build coatings can be applied without thinning.
b) Fast rate of application achievable.
c) Reduce pollution and environmental friendly.
d) Reduced wastage of material.
e) Less air consumption and saving of power.

As already indicated, the special tips used in the spray gun and the pressure control enables one to monitor application of very low to very high viscosity products. Similarly, different slot angles produce spray fans of different widths. The selection of a particular fan width is dependent on the shape and size of the structure to be painted. The choice of fan width is also related to orifice size. For the same orifice size the paint applied per unit area will be less, wider the spray fan. The general indication of orifice sizes is given below to help in choosing the proper orifice size for a paint.

Wet film thickness	**Orifice size(mm)**
Upto 50 microns	0.02 – 0.03
100-200 microns	0.03 – 0.04
>200 microns	0.04 – 0.07
Mastics	0.10 – 0.15

There are several designs of tips available, the choice of which depends upon the finish required, the ease of application and ease of cleaning blockages from tips.

Table-1.

Mode of Application	FORD CUP: 4 Viscosity in secs.
Brushing	40-60
Spraying	30±2

Note: Viscosity measurement of high build epoxy paint may be done by viscometer.

Above table gives general guideline about consistency to be maintained for brush/spray/airless spray painting unless otherwise specified by paint manufacturer.

1.2 PREPARATION OF PAINT :

All industrial paints generally consist of a binder medium, pigment, thinner and accelerator. The composition of constituents varies based on performance requirements.

The primer which form first coat on a surface has higher concentration of pigments and extenders than the finish paint which has higher concentration of medium. The concentration and type of accelerator depends on drying cycle requirements. Air drying paints are generally single pack systems except aluminum paints, epoxy, polyurethane etc. Some of the stoving compositions are also available in single pack. The binder mediums generally used in paints are oil based Alkyd phenolics, epoxy, silicone, vinyl ester and urethane resins. Generic information is provided in Cl.3 of this specification. All the paint manufacturers mostly provide processing conditions to be followed before application. However, a few are given below :

(a) When the containers of air drying paints are opened, the material is observed for skin formation. The skin formed should be carefully removed and settled pigment has to be broken up and loosened by vigorous stirring preferably mechanically to ensure homogenous dispersion. Care should be taken to avoid air entrapment while stirring. The paint, if required may be strained through muslin cloth or 60mesh sieve.

(b) **Maturation process** :

Maturation is an important criterion for two pack products where curing takes place through chemical reaction when the components are mixed before application. The mixed paint is normally matured for about 30 minutes to initiate the reaction process which ensures thickness build up and proper drying of the paint film unless otherwise specified.

Maturation time is, however, to be adjusted depending on pot life and ambient temperature. Products having a short pot life should be allowed less maturation time as recommended by supplier to provide the adequate effect during film formation.

1.3 APPLICATION LOSSES AND SPREADING RATE ESTIMATION

It is extremely complicated to estimate accurately the quantity of paint required for a particular job since the theoretical spreading rate does not take into account the various “losses” involved during application.

In the following paragraphs general guidelines are described taking into account major areas of losses and to arrive at appropriate requirement. Usually two types of losses are considered : **“Apparent Losses”** where the paint-though on the surface-does not contribute to the required thickness, and **“Actual Losses”** where the paint is wasted.

Apparent Losses

Effect of blast profile: On a blasted surface the film thickness over the peaks is less than the thickness over the troughs. However, it is the thickness over the peaks which is most important in relation to performance of the paint coating and hence it can be considered that the paint which does not contribute to this thickness is "lost in the steel profile". The extent of paint "loss" is proportional to the surface roughness produced by blasting or in other words, the dimension and type of abrasive used.

Typical "losses" in dry paint film thickness for given blast profiles are given below:

Surface	Blast profile	DFT loss
- Steel blasted using round - Shot And shop primed	0-50 microns	10 microns
- Fine open blasting	50-100 microns	35 microns
- Coarse open blasting	100-150 microns	60 microns
- Old pitted steel-reblasted	150-300 microns (or more)	125 microns (or more)

Paint distribution loss : This is loss of paint resulting from over-application when an attempt is made to achieve the minimum specified paint thickness with reasonable certainty.

The extra paint consumed over and above that calculated from the theoretical spreading rate is dependent on the method of application as well as on the type of structure being painted. A simple structure with a high proportion of flat surfaces should not incur heavy losses, but for complex structure losses will be high. Typical details given below:

Application	Type of structures	Loss(%)
Brush + Roller	Simple structures	5%
-do-	Complex structures	10-15%
Spray } Air / Airless	Simple structures	20%
Spray }	Complex structures	60% for single coat 40% for two coats 30% for three coats

When an open complex structure is sprayed, no realistic estimate can be made of paint distribution loss. In case the specification calls for a minimum thickness at all measured points, the distribution losses would be higher than those indicated above.

Actual losses: These include the paint loss during application and wastage

Application Loss: The paint which drips from a brush or roller during transfer from the container to the surface being painted can be termed as application loss. With care, this can be discounted as a significant contribution to overall "loss".

When application is done by spraying, losses are inevitable and their extent is dependent largely on the shape of the structure being painted together with atmospheric conditions.

The following spray losses are common:

Well ventilated but confined space	5%
Outdoors in almost static air	5 – 10%
Outdoors in windy conditions	Over 20% (This figure can be abnormally high if painting is done in unsuitable windy conditions).

Paint wastage: Some wastage is inevitable like paint spill, certain amount remaining in discarded containers and in case of two pack materials mixed paint left beyond its pot life.

The following losses are common:

Single pack materials	Not more than 5%
Two pack materials	5-10%

Spreading rate estimation:

Having given by the paint supplier the theoretical spreading rate and with the preceding loss factors, it is possible to calculate the practical spreading rate, as is illustrated by the following example for guidance.

Example :

Two coats of two pack paint are to be applied by spray in a confined space to a blasted surface of complete structure to yield a DFT of 100 microns per coat. The theoretical spreading rate is 6.0 sq. mtr/ltr. What is the practical spreading rate?

	First coat
Required DFT	100 microns
Loss due to surface roughness	10 microns
Loss due to distribution 40% i.e. 100x0.4	40 microns
	150.0 microns
Loss due to application 5% i.e. 150x0.05	7.5 microns
	157.5 microns
Loss due to wastage 10% ie. 157.5x0.1	15.75 microns
	173.25 microns

Extra paint used (173.25-100) $= \frac{73.25 \times 100}{100} = 73.3\%$

	Second coat
Required DFT	100 microns
Loss due to surface roughness	Nil
Loss due to distribution 40% i.e. 100 x 0.4	40 microns
	140 microns
Loss due to application 5% i.e. 140x0.05	7 microns
	147 microns
Loss due to wastage 10% i.e. 147 x 0.1	14.7 microns
	161.7 microns

Extra paint used (161.7 – 100) $= \frac{61.7 \times 100}{100} = 61.7\%$

Total loss for two coats $= \frac{73.3 + 61.7}{2}$ 67.5%

In other words, for the two coat of two pack system, 67.5% more paint is required than would be calculated from the theoretical spreading rate.

Loss factors : In the above example the theoretical spreading rate is 6 sq.mtr/ltr. In practice 1.68 ltr. Of paint can be expected to cover 6 sq.mtr.
Therefore, the practical spreading rate is $\frac{6}{1.68} = 3.6$ sq.mtr. /ltr.

The loss factor is usually expressed as the difference between the theoretical and practical spreading rates expressed as a percentage of the theoretical spreading rate. In the above example the loss factor is:

$$\frac{6 - 3.6}{6} = 40\%$$

Calculation of Volume Solids :

The volume solid of a paint can be calculated as follows :

$$\% \text{ volume solid} = \frac{\text{DFT(microns)} \times \text{Theoretical coverage(sq.mtr./ltr)}}{10}$$

The volume solids of a paint is an indicator of the mileage it will give at a specified thickness. A service life data published on life of paint with various polymeric medium in different environments is given in Table-II.

1.4 THINNER CONSUMPTION:

This is another important parameter and has to be closely monitored to obtain the desired performance from the paint film. In each Data Sheet a special section is devoted to thinner consumption which should be strictly adhered to. However, it should be noted that the mentioned quantity is only for adding to the paint. The consumption for an optimum environment depends on prevailing temperature, application methods, nature of surface, weather conditions and may require adjustment in thinner volume. The thinner used should be compatible with the paint and corresponds to the same batch of paint.

Adding a small percentage of extra thinner does not necessarily impair the film properties, but excess thinning increases the quantity of liquid paint without contributing to the solid content. The volume solid, after thinning, should be calculated and the resultant coverage worked out to achieve the recommended film thickness.

$$\text{Volume solid percentage after thinning} = \frac{\%\ \text{Volume solid} \times 100}{\%\ \text{thinner added} + 100}$$

2.0 SURFACE PREPARATION :

Surface preparation may be carried out as per BHEL STANDARD AA 0674101. However following instructions in general should be adhered to unless otherwise agreed upon

- Surfaces not to be painted shall be properly masked.
- Surfaces shall be cleaned by solvent cleaning method to remove oil, grease, dirt, cutting fluids and other contaminants.
- Surfaces to be coated shall be blast cleaned with suitable abrasive to the required surface finish for operating temperatures above 120° C and a minimum of a commercial blast cleaning for operating temperatures below 120° C.

- The average maximum blast profile shall be between 3.5 to 6.0 mils. For sand castings, average maximum surface profiles after blasting to be specified.

- All traces of abrasive and other debris shall be removed by brushing, sweeping, blowing with clean compressed air, and vacuuming before the application of any coating.

3.0 GENERIC PAINT CHARACTERISTICS:

Paint have polymeric resigns as binder mediums. These mediums are selected depending on the environment in which it has to operate.

For ease of reference, a generic description of the paint mediums are indicated below together with a specific characterisation of some of their properties.

- High solids, amine-cured epoxies:
  Polyamine-cured epoxies generally have a good resistance to chemicals and solvents.

- High build, polyamide-cured epoxies :
  Polyamide-cured epoxies exhibit a longer pot life, superior flexibility and durability compared with amine-cured epoxies. They possess adequate chemical resistance.

- High build, aliphatic polyurethanes :
  Two component isocyanate-free urethanes produce extremely hard, resistant and durable coatings. Aliphatic urethanes are preferred over aromatic urethanes because of their excellent durability and gloss retention.

- Phenolic epoxies :
  Two component, high build, amine-cured phenolic epoxy coatings have excellent resistance to a wide range of solvents and (organic) acids.

- (Alkyl) zinc silicate :
  Two component, moisture curing, zinc (alkyl) silicate coating, containing a minimum of 75% metallic zinc, is a hard, abrasion resistant coating that can withstand temperatures up to 400°C.

- Aluminium pigmented silicate :
  One component, (alkyl) silicate, zinc-free coating is suitable for temperatures up to 600°C.

- Aluminium silicones :
  Aluminium pigmented, silicone resin-based paint. Heat resistant up to 600°C. A minimum temperature of 200°C is required for 2 hours to obtain a sufficient cure.

- Silicone acrylics :
  One component, aluminium (or colour) pigmented acrylic-modified silicone resin. Heat resistant up to 350°C. Full cure can be achieved at ambient temperature.

- Zinc-rich epoxy primer :
  Two component, epoxy based primer. Developed to provide sacrificial protection to steel surfaces.

- Solvent free epoxies :
  Two component, amine cured, modified epoxies without solvent. They can be applied as a heavy duty coating up to 28 mil thick.

- Polysiloxane :
  Two component, inorganic polysiloxane. Used for heat resistance (continuous and cyclic) up to. 1110°C Current experience with this coating is good but still very limited.

- Thermally sprayed metal coatings :
  Thermally sprayed metal coatings may be used in applications where organic coatings are ineffective or cause product contamination.

- Black coal tar epoxy :
  Generally, Thixotropic amine cured two pack system. Conventional epoxy blended with high purity coal tar to impart flexibility, is mostly recommended for inner sides of water tanks.

The estimated life of the resin systems for various environments is given in Table-2.

Lead containing paints, should not be used because of the associated health and environmental restrictions that apply unless otherwise insisted upon.

Paints specifically intended for use on austenitic stainless steels or high nickel-chromium alloys shall not contain free chlorides or other halides after curing, although trace amounts in the raw materials is accepted. Chlorides or other halides tied up within the cured resin's chemical molecule are acceptable, unless they are subject to release through ageing within the temperature range specified. Such paint formulations shall also not contain metallic zinc, because of the possibility of inducing liquid metal embrittlement.

Note: It has been shown that zinc oxide or zinc phosphate, which are the more recent non-lead, non-chromate, corrosion inhibitive pigment developments, do not cause embrittlement even at 850°C.

3.1.0 PREPARATION OF THE PAINT AIR DRYING ENAMEL:

3.1.1 Removal of skin from the paint:

Before application, any skin formed on the paint in the container shall be carefully removed, any settled pigment broken up and loosened and the paint thoroughly stirred to ensure complete and uniform mixing of the constituents. Care shall be taken to avoid entering air into the paint while stirring. The paint shall be strained through a muslin cloth or 60 mesh sieve.

3.1.2 Consistency of the paint:

The paint shall be used at an appropriate consistency depending on the mode of application. Table 1 provides the general guidance.
The above consistency shall be adjusted using white spirit or recommended thinner to AA 56701depending on mode of application.

3.2.0 PREPARATION OF THE PAINT (ETCH PRIMER AND EPOXIDE PAINTS):

3.2.1 Etch primer:

Etch primer, as supplied, consists of two separate ingredients viz., primer base and accelerator. Shortly before use, mix together the primer base and accelerator in the proportions as per the recommendation of the supplier. The paint prepared as above does not require any thinning.

IMPORTANT NOTE:
After mixing, the paint shall be allowed to mature for 30 minutes unless otherwise specified. The mixed paint shall be used within 8 hours.

3.2.2 COMPOSITION:

The paint shall consist of a two pack system viz., base and accelerator, as per AA 56103.

Generally the base, shall consist of zinc tetroxy chromate pigment dispersed in Polyvinyl butyl resin solution while accelerator shall consists of orthophosphoric acid in suitable solutions like butanol, industrial methylated spirit, etc.

The base shall be in such a condition that uniform and smooth dispersion material is obtained by stirring. There shall not be any tendency for viscosity build up, gelling and pigment settlement throughout the shelf life of the paint.

Etch primer may be applied prior to epoxy paint wherever recommended.

3.2.3 Mixing of the constituents of epoxide paints:

a) These paints, as supplied, consist of two separate ingredients, namely base and accelerator. Shortly before mixing and use, these shall be thoroughly stirred. The base and the accelerator shall be accurately mixed together in the proportions as per the recommendations of the supplier.

   Accelerator should be added to the base but not the base to the accelerator. The paints shall be mixed with continuous stirring until a uniform consistency is obtained.

b) Consistencies of the paints :
   The paints mixed shall be used at an appropriate consistency depending on mode of application. Table 1 provides general guidance.

   Important Note:
   After mixing, the paint shall be allowed to mature for 30 minutes and the mixed paint shall be used within 8 hours, unless otherwise specified in, by the paint supplier. All other properties should be as per individual specification.

3.2.4 Safety precautions:

Etch primer and epoxy paints are liable to cause irritation to the skin. This may transpire into inflammation, swelling, rash or pustules on the hands, arms and occasionally on the whole body.

Following precautions should be observed while handling these materials:

i) Work place and storage rooms shall be adequately ventilated.
ii) Before starting the work, hands should be washed with soap and water and good barrier cream applied.
iii) Maximum care should be taken to avoid splashes on the skin
iv) Splashing on the skin should be immediately washed with soap and water.
v) After the work, hands, arms and face should be washed with soap and water followed by thorough drying with a clean towel.

3.3.0 PREPARATION OF THE PAINTS (ALUMINUM SILICON):

3.3.1 Mixing of paint material shall be in strict accordance with manufacturer's instructions

3.3.2 Thinning shall only be done if necessary for the workability of the paint and in accordance with manufacturer's instructions. Petroleum or mineral spirits shall be used for thinning and shall not exceed 5% by volume.

3.3.3 Application over ethyl silicate zinc-rich primer:

(a) Underlying inorganic zinc primer shall be completely cured before application of aluminum silicone topcoat.

(b) Apply one coat of aluminum silicone paint to achieve a dry film thickness of 15 - 30 µm. A thin mist coat may be necessary before full coat application to avoid top coat bubbling.

Allow to air dry for 16 hours before direct exposure to operating conditions of the heat or before curing.

All other properties should be as per relevant corporate supplier's standard.

3.4.0 PAINT APPLICATION :

3.4.1 Paint application shall comply with the requirements of individual specification and with the paint manufacturer's printed instruction.

3.4.2 Paint shall be applied at ambient temperatures preferably not below 10^{o} C.

3.4.3 Conventional air spray or airless spray application is acceptable. Brush application is also acceptable for surfaces inaccessible to spray and for touch up coats.

3.4.4 After thorough mixing of the product of two component systems, the maturation time as indicated in the manufacturer's product data sheet is to be allowed before applying the paint.

3.4.5 Short shelf life / two component paint mixture thickens as the time progresses and at the end of the pot life period, the mixture becomes highly viscous and unusable. It is best to consume mixed paint at least one hour before the end of the pot life.

3.4.6 Avoid using excess solvent than the recommended volumes since this leads to reduced dry film thickness, sagging and longer curing time.

3.4.7 Apply Epoxy Primer paint to achieve a dry film thickness of 35-50 microns and a coat of etch primer wherever recommended.

3.4.8 Allow the painted substrate to dry for 16 hrs before direct exposure to outside weather conditions or heat. In case of stoving paints, it is to be stoved at temperature and time specified in a suitable oven.

3.4.9 Apply a coat of finish paint after ensuring removal of dust, dirt and other contaminants from the primed surface. Intermediate coats of paints may be applied wherever recommended.

3.4.10 All measurements and instrument calibration shall be in accordance with the specification AA 067 41 05 and the data to be recorded in accordance with AA 067 41 06 for each job.

3.5.0 QUALITY CHECKS & INSPECTION:

3.5.1 Following points shall be ensured to achieve overall quality of the job:

(a) Compressed air used for spray application shall be free from oil, moisture and other contaminants.

(b) Steel surfaces to be painted shall be free from burrs, sharp edges, lamination, surface imperfections and any other contamination detrimental to paint adhesion finish or appearance.

(c) All surfaces to be coated have been cleaned in accordance with the requirements of BHEL STANDARD AA 067 4101.

(d) All surfaces to be coated shall be completely dry before paint application.

(e) Paint components shall be mixed as prescribed / recommended and mixed paint shall be consumed with in specified pot life.

(f) Drying / curing requirements shall be fully satisfied.

(g) Damaged paint coating shall be properly touched up before another coating application.

(h) All paint coating measurements like thickness gloss, finishing and adhesion shall be usable as per AA 067 41 05.

3.5.2 INSPECTION:

a) VISUAL:
The painted surfaces shall be free from spacks of iron, salt or dust. It shall be smooth and uniform and there will be no visible porosity, pot holes, or any other paint coating defects. If runs and sags dry spray and over spray are present these defects shall not be more than 5% in any given area (sq. feet) and cumulatively not more than 2% of total surface area unless otherwise specified.

b) Dry film thickness DFT: Dry film thickness should be measured with an appropriate measurement gauge calibrated as per AA 067 41 05. Unless otherwise specified.

c) ADHESION:
The adhesion of the primer to the steel substrate and the intercoat adhesion of the subsequent coat(s) after curing shall be determined by the application of a cross-cut test in accordance with BHEL Standard AA 067 41 05.

d) Gloss level: As per AA 067 41 05.

e) Finish: as per AA 067 41 05.

f) Shade: As per IS : 5 unless otherwise specified.

g) Coated surfaces are smooth and uniform in coverage.

h) There is no visible porosity or pot holes.

i) Unacceptable defects such as peeling, blistering cracking and damage caused by external sources are clearly marked with a mark-free chalk and with in the specification requirements.

j) Runs and sags, dry spray and over spray are not present in excess of 5% in any given square foot and cumulatively not in excess of 2% of any surface. Unless otherwise specified

k) Drying time/curing time requirements have been satisfied.

l) Holiday / pinhole detection shall be conducted on all conventional thin film thickness, having total DFT 0.5mm or less, by low voltage wet sponge method as per ASTM D5162. This is carried out after top coat applied & fully cured / dried. For tank & vessel internals 100% of the surface shall be tested. Special attention shall be paid to welds, edges & irregular surfaces for holiday / pinhole testing. For external surfaces, random inspection, which shall be representation of entire surface shall be tested. No pinhole is acceptable.

3.6.0 PAINTING SCHEMES:

Selection of painting scheme has to be made on specific operational and environmental requirements. Similarly, selection of colours have to be made suitably unless both are specified by the customer. – BHEL painting scheme for various power equipment and related components is given in annexure - II. However, any deviation from number of coats and thickness specified by customer shall be followed.

Typical painting schedules for various industrial components and painting systems are also given in Annexure III and IV respectively. For general reference.

The list of BHEL Corporate Standards on Paints is enclosed in Annexure-V.

ANNEXURE-I.

RELATIONSHIP BETWEEN `DEW POINT', AIR TEMPERATURE AND RELATIVE HUMIDITY.

Air Temp. °C	`Dew Point' in °C at Relative Humidity of								
	50%	55%	60%	65%	70%	75%	80%	85%	90%
5	-5	-3	-2	-1	0	1	2	3	4
6	-3	-3	-1	0	1	2	3	4	4
7	-3	-1	0	1	2	3	4	5	5
8	-2	-1	1	2	3	4	5	6	6
9	-1	0	1	3	4	5	6	7	7
10	0	1	3	4	5	6	7	8	9
11	1	2	4	5	6	7	8	9	9
12	2	3	5	5	7	8	9	9	10
13	3	4	5	6	8	9	10	10	11
14	4	5	6	7	8	10	11	12	12
15	5	6	7	8	9	11	12	12	13
16	5	7	8	9	10	12	12	13	14
17	7	8	9	10	12	12	14	14	15
18	7	9	10	11	12	13	14	15	16
19	8	10	11	12	13	14	15	16	17
20	9	11	12	13	14	15	16	17	18
21	10	12	13	14	15	16	17	18	19
22	11	13	14	15	16	17	18	19	20
23	12	14	15	16	17	18	19	20	21
24	13	14	16	17	18	19	20	21	22
25	14	15	17	18	19	20	21	22	23
26	15	16	18	19	20	21	22	23	24
27	16	17	18	20	21	22	23	24	25
28	17	18	19	21	22	23	24	25	26
29	18	19	20	22	23	24	25	26	27
30	18	20	21	23	24	25	26	27	28

BHEL PAINTING SCHEME FOR PRODUCT Annexure II

Sl. No.	System	Environment (See note 1)	General description	** Painting Scheme reference	Total Dry film Thickness, In µm TDFT	Remarks
1	Power Boiler	Rural	Epoxy Two pack (organic) Zinc rich and Two pack Polyurethane.	1	80	
		Industrial	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane.	2	180	
		Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	3	180	
		Industrial and coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	8	180	
2	HRSG /Industrial Boilers	Rural	Chlorinated Rubber Based, chemical resistant	4	120	
		Industrial	Epoxy Two pack (Organic) Zinc rich and Epoxy Two pack chemical resistant and Two pack Polyurethane	5	155	
		Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	3	180	
		Industrial and Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	8	180	
3	Column, Pressure Vessel, Heat Exchanger	Rural	Epoxy Two pack (organic) Zinc rich and Two pack Polyurethane	1	80	
		Industrial	Epoxy Two pack (organic) Zinc rich, Epoxy Two pack chemical resistant and Two pack Polyurethane	5	155	

** **Refer Annexure - II (a)**

Note -1 : The painting scheme specified provides life to first maintenance of 5 years, under specified environment.

Sl. No.	System	Environment (See note 1)	General description	** Painting Scheme reference	Total Dry film Thickness, in µm TDFT	Remarks
		Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	3	180	
		Industrial and Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane.	8	180	
4	Tankage	Rural	Chlorinated Rubber Based, chemical resistant	4	120	
		Industrial	Epoxy Two pack chemical resistant and Two pack Polyurethane	7	175	
		Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	3	180	
		Industrial and coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	8	180	
5	Rotating Equipment, Pumps, Compressors	Rural	Epoxy Two pack (organic) zinc rich and Epoxy Two pack chemical resistant and Two pack Polyurethane	5	155	
		Industrial	Epoxy Two pack chemical resistant and Two pack Polyurethane	7	175	
		Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	3	180	
		Industrial and coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	8	180	

**** Refer Annexure - II (a)**

II Continued..

Sl. No.	System	Environment (See note 1)	General description	** Painting Scheme reference	Total Dry film Thickness, in µm TDFT	Remarks
6	Piping Valve Fittings	Rural	Chlorinated Rubber based, chemical resistant	4	120	
		Industrial	Epoxy Two pack chemical resistant and Two pack Polyurethane.	7	175	
		Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	3	180	
		Industrial and coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	8	180	
7	Transformers Tank conservation Bushing Turact Header, Piping work support structure	Rural	Epoxy Two pack (organic) Zinc rich and Two pack Polyurethane.	1	80	
		Industrial	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	2	180	
		Coastal	Epoxy Two pack chemical resistant and Two pack Polyurethane	7	175	
		Industrial and Coastal	Inorganic alkyl Zinc silicate, Epoxy Two pack chemical resistant and Two pack Polyurethane	8	180	
8	Control Cubicles	For indoor installation	Epoxy Two pack chemical resistant and Two pack Polyurethane	10	170	appln. Only by spray

**** Refer Annexure -I I (a)**

Note 1: Rural = Exterior, Exposed non-polluted inland atmosphere, operating temperature upto 90º C
Industrial = Exterior, Exposed polluted inland atmosphere, operating temperature upto 90º C
Coastal = Exterior, Exposed non-polluted inland atmosphere, operating temperature upto 90º C
Industrial & Coastal = Exterior, Exposed polluted inland atmosphere, operating temperature upto 90º C

Note 2: For operating temperature 91 - 400 º C and 401 to 600 º C, the painting scheme reference no: 6 and no: 9 respectively shall be followed

BHEL Painting Schemes Details ANNEXURE - II (a)

Paint reference Scheme	Surface Prepn. Grade/ Surface profile	Primer Coat			Intermediate coat			Finish coat			Total DFT, in µm
		Primer paint	No. of coats	DFT in µm	Intermediate paint	No. of coats	DFT in µm	Finish paint (See note)	No. of coats	DFT in µm	
1	Shot Blasting to Sa 2 1/2 35 to 50 µm	Epoxy zinc rich primer (Two pack) AA 561 14	1	50	- -	--	--	Full gloss polyurethane finishing paint AA 561 42	1	30	80
2	Shot Blasting to Sa 2 1/2 35 to 50 µm	Inorganic Ethyl zinc silicate primer AA 561 13	1	75	High build intermediate Epoxy paint AA 561 12	1	75	Full gloss Polyurethane finishing paint AA 561 42	1	30	180

II (a) Continued….

Note: The shade of finish paint shall be decided based on the option of concerned unit / customer's requirement.

Paint reference Scheme	Surface Prepn. Grade/ Surface profile	Primer Coat			Intermediate coat			Finish coat			Total DFT, in µm
		Primer paint	No. of coats	DFT in µm	Intermediate paint	No. of coats	DFT in µm	Finish paint (See note)	No. of coats	DFT in µm	
3	Shot Blasting to Sa 2 1/2 35 to 50 µm	Inorganic Ethyl zinc silicate primer t AA 561 13	1	75	High build intermediate epoxy paint AA 561 12	1	75	Full gloss Polyurethane finishing paint t AA 561 42	1	30	180
4	Shot Blasting to Sa 2 1/2 35 to 50 µm	Chemical resistant Chlorinated Rubber base priming paint AA 561 07	2	70				Chemical resistant chlorinated rubber based finishing paint AA 561 36	2	50	120

II (a) Continued….

Paint reference Scheme	Surface Prepn. Grade/ Surface profile	Primer Coat			Intermediate coat			Finish coat			Total DFT, in µm
		Primer paint	No. of coats	DFT in µm	Intermediate paint	No. of coats	DFT in µm	Finish paint (See note)	No. of coats	DFT in µm	
5	Shot Blasting to Sa 2 1/2 35 to 50 µm	Epoxy based zinc rich primer (Two pack) AA 561 14	1	50	High build intermediate Epoxy paint AA 561 12	1	75	Full gloss Polyurethane finishing paint AA 561 42	1	30	155
6	Shot Blasting to Sa 2 1/2 35 to 50 µm	Inorganic Ethyl zinc silicate primer AA 561 13	1	75				Heat resistant air dry Aluminium paint Gr - I AA 561 49	2	40	115
7	Shot Blasting to Sa 2 1/2 35 to 50 µm	Chemical resistant epoxide redoxide zinc phosphate priming paint AA 561 05	2	70	High build intermediate epoxy paint AA 561 12	1	75	Full gloss Polyurethane finishing paint AA 561 42	1	30	175

II (a) Continued….

Paint reference Scheme	Surface Prepn. Grade/ Surface profile	Primer Coat			Intermediate coat			Finish coat			Total DFT, in µm
		Primer paint	No. of coats	DFT in µm	Intermediate paint	No. of coats	DFT in µm	Finish paint (note See)	No. of coats	DFT in µm	
8	Shot Blasting to Sa 2 1/2 35 to 50 µm	Inorganic Ethyl zinc silicate primer t AA 561 13	1	75	High build intermediate epoxy paint AA 561 12	1	75	Full gloss Polyurethane finishing paint AA 561 42	1	30	180
9	Shot Blasting to Sa 2 1/2 35 to 50 µm	Two pack, air drying heat resistant Polysilaxone paint AA 561 43	1	100	--	--	--	--	--	--	100

II (a) Continued….

Paint reference Scheme	Surface Prepn. Grade/ Surface profile	Primer Coat			Intermediate coat			Finish coat			Total DFT, in µm
		Primer paint	No. of coats	DFT in µm	Intermediate paint	No. of coats	DFT in µm	Finish paint (See note)	No. of coats	DFT in µm	
10	Shot Blasting to Sa 2 1/2 35 to 50 µm or Phospha -ting to coating weight of 16.15 gm per sq.m	Chemical resistant epoxide redoxide zinc phosphate priming paint AA 561 05	1	35	High build intermediate epoxy paint AA 561 12	1	75	Full gloss Polyurethane finishing paint AA 561 42	2	60	170

CORPORATE STANDARD

ANNEXURE-III

TYPICAL PAINTING SCHEDULE

PIPING, VESSELS, COLUMNS, EXCHANGERS, REACTORS, STRUCTURAL STEEL AND FIRE-FIGHTING SYSTEMS.

ITEM	OPERATING TEMPERATURE (°C)	SUBSTRATE	PAINT SYSTEM No.(Annexure-V)
PIPING, VESSELS, COLUMNS, EXCHANGERS, REACTORS etc.	<120	Carbon steel, low alloy steel	1
	<120	9% Ni steel	2
	120-200	Carbon steel, low alloy steel	3
	200-450	Carbon steel low alloy steel	4
	Ambient – 200	Stainless steel	5
	200-450	Stainless steel	6
	Ambient – 1100	Carbon steel, stainless steel	7*
STRUCTURAL STEEL, LADDERS, GRATINGS etc.	-	Carbon steel, low alloy steel	1
	-	Hot dip galvanized carbon steel	8**
FIRE FIGHTING SYSTEMS(above ground)	<120	Carbon steel	9

* Current experience with this polysiloxane coating is good but still very limited.

** This duplex system shall only be applied to hot dip galvanized steel in cases where access for future maintenance is difficult.

ANNEXURE-III (continued..)

ITEM		OPERAT-ING TEMPERA-TURE (°C)	SUBSTRATE	PAINT SYSTEM NUMBER (Annexure-V)
CRUDE OIL TANKS BOTTOM and LOWEST SHELL COURSE	INTERNAL Non-corrosive	<80	Carbon steel, low alloy steel	10*
	INTERNAL Corrosive	<80	Carbon steel, low alloy steel	11
CRUDE OIL TANKS ROOF and SHELL	INTERNAL	<80	Carbon steel, low alloy steel	10*
	EXTERNAL	<80	Carbon steel, low alloy steel	1
STORAGE TANKS	INTERNAL	<120	Carbon steel, low alloy steel	10*
	EXTERNAL	<120	Carbon steel Low alloy steel	1
		50-200	Stainless steel	5
	INTERNAL, Chemical Resistant	<60	Carbon steel, Low alloy steel	12
	INTERNAL Industrial water **	<80	Carbon steel, low alloy steel	11
LPG SPHERES and BULLETS	INTERNAL	<120	Carbon steel, low alloy steel	10
	EXTERNAL	<120	Carbon steel, low alloy steel	1
MOUNDED LPG STORAGE ***	EXTERNAL	Ambient	Carbon steel	13

* This treatment is a shop-applied temporary protection only. No further painting is required after construction.

** Primer is optional for use in industrial water tanks

*** For full details about this system, manufacturer's instructions may be followed.

CORPORATE STANDARD

Annexure-III (Continued…)

ITEM	OPERATING TEMPERATURE (° C)	SUBSTRATE	PAINT SYSTEM NUMBER (Annexure-V)
FURNACES, STACKS, FLARE STACKS And FLUE DUCTS	<120	Carbon steel, low alloy steel	1
	120-200	Carbon steel, Low alloy steel	3
	200-550	Carbon steel, Low alloy steel	14
	<400	Carbon steel, hot-dip galvanised*	15
	<200	Stainless	5
	200-450	Stainless	6
	Ambient-1100	Carbon steel, stainless steel	7**
OFF SHORE STRUCTURES, TIDAL ZONES	<120	Carbon steel, Low alloy steel	11
TOP SIDDE FACILITIES, EQUIPMENT and PIPING	<120	Carbon steel, Low alloy steel	9
	120-200	Carbon steel, Low alloy steel	3

* For long life time service (>20 years) a hot dip galvanised duplex system is preferred.

** Current experience with this polysiloxane coating is good but still very limited.

ANNEXURE-IV

TYPICAL PAINT SYSTEMS.

SYS. No.	SURFACE PREPARATION	PAINT SYSTEM		
		Primer	Inter-coat	Top-coat
1	Sa 2 ½	Alkyl zinc silicate DFT 75 microns	High build, epoxy sealer DFT 75 microns	High build, aliphatic polyurethane DFT 75 microns
2	Sa 2 ½	High build, polyamide cured, (zinc free) epoxy DFT 100 microns	-	High build, high solids, polyamide-cured epoxy DFT 100 microns
3	Sa 2 ½	Alkyl zinc silicate DFT 75 microns	-	2 coats silicone acrylic TDFT 60 microns
4	Sa 2 ½	Alkyl zinc silicate	-	2coats heat resistant, aluminium silicone TDFT 50 microns
5	Light sweep blast (steam clean if not possible)	Silicone Acrylic DFT 25 mic.	-	Silicone acrylic DFT 25 microns
6	Light sweep blast (steam clean if not possible)	Heat-resistant, Aluminium silicone DFT 25 micrones	-	Heat resistant, aluminium silicone DFT 25 microns
7	Carbon steel SA 2 ½ Stainless steel-sweep blast to surface profile of 40 microns		Polysiloxane DFT 125 microns	Polysiloxane DFT 125 microns
8.	Hot dip galvanized after light sweep blast	Zinc-rich epoxy primer DFT 40 mic.	-	High build, aliphatic polyurethane DFT 100 microns
9	Sa 2 ½	Alkyl zinc silicate DFT 75 microns	Polyamide cured, MIO pigmented, Epoxy tie coat DFT 40 mic.	2coats high solids Aluminium-pigmented epoxy TDFT 200 microns

CORPORATE STANDARD

Annexure-IV (Continued…)

SYS. No.	SURFACE PREPARATION	PAINT SYSTEM		
		Primer	Inter-coat	Top-coat
10	Sa 2 ½	Zinc-rich epoxy DFT 25 microns	-	-
11	Sa 2 ½	Polyamide-cured epoxy primer DFT 75 microns	-	Solvent-free high solids, amine-cured epoxy DFT 500 microns
12	Sa 2 ½	Amine cured, phenolic epoxy primer DFT 100 microns	Amine adduct-cured, Phenolic epoxy DFT 100 microns	High build, amine adduct-cured epoxy DFT 100 microns
13	Sa 2 ½	-	-	Solvent-free, high solids epoxy (hot applied) DFT 800 microns
14	SA 2 ½	Zinc silicate DFT 75 microns	-	Alkyl silicate Aluminium-pigmented DFT 40 microns
15	Hot dip galvanized (slightly sweep blast if aged)	Zinc-rich epoxy primer DFT 75 microns	Polyamide-cured, MIO pigmented, Epoxy tie coat DFT 40 mic.	High solids, Aluminum-pigmented epoxy DFT 100 microns

ANNEXURE-V.

LIST OF CORPORATE PAINT SPECIFICATION.

AA 561 01	ANTI-CORROSIVE PRIMING PAINT
AA 561 03	ETCH PRIMER
AA 561 05	CHEMICAL RESISTANT EPOXIDE RED OXIDE ZINC PHOSPHATE PRIMING PAINT
AA 561 07	CHEMICAL RESISTANT CHLORINATED RUBBER BASED PRIMING PAINT.
AA 561 11	ALKYD BASE RED OXIDE ZINC PHOSPHATE ANTI CORROSIVE PRIMING PAINT
AA 561 12	HIGH BUILD INTRMEDIATE EPOXY PAINT
AA 561 13	INORGANIC ETHYL ZINC SILICATE PRIMER
AA 561 14	EPOXY BASED ZINC RICH PRIMER -TWO PACK
AA 561 26	HIGH QUALITY FULL GLOSSY OUTDOOR FINISHING PAINT
AA 561 27	NON-YELLOWING FULL GLOSSY WHITE PAINT
AA 561 28	ALUMINIUM PAINT FOR GENERAL PURPOSES
AA 561 31	CHEMICAL RESISTANT EPOXIDE FINISHING PAINT
AA 561 32	OIL RESISTANT, AIR DRYING, SYNTHETIC ENAMEL
AA 561 34	HEAT RESISTANT AIR DRY ALUMINIUM PAINT - Gr. 2 (TEMPERATURE UPTO 400^0 C)
AA 561 35	HIGH BUILD BLACK COAL TAR EPOXIDE PAINT
AA 561 36	CHEMICAL RESISTANT CHLORINATED RUBBER BASED FINISHING PAINT .
AA 561 40	EXTRA HIGH BUILD BLACK COAL TAR EPOXIDE PAINT
AA 561 42	POLY URETHANE FINISHING PAINT
AA 561 43	TWO PACK, AIR DRYING, HEAT RESISTANT POLYSILOXANE PAINT.
AA 561 49	HEAT RESISTANT AIR DRY ALUMINIUM PAINT - Gr.1 (TEMPERATURE UPTO 600^0 C)
AA 561 59	EPOXY POLYESTER POWDER COATING MATERIAL
AA 561 60	EPOXY POWDER COATING MATERIAL

TABLE - II
Estimated Service Life Years, Before First Maintenance Painting)
of Paint Protective Coating, Galvanizing and Zinc-Rich Systems.

Sl. No.	Number of coats	Coating system	Surf. Prep SSPC *	Minimum DFT mill or microns.	Maint.sched	Sea coast Maint.	Sea coast Heavy Industrial	Caustic	Acid	Fresh water Immersion	Salt water / Brine immersion	Ammonia	Chlorine	Solvents / Gasoline	Mild	Moderate	severe	Dry heat resistance °C
1	2	Alkyd primer/top	2/3	4.0 100	I	1	1	0.5	0.5	N	N	0.5	0.5	0.5	3	2	1	66-94
2	3	Alkyd primer/top	2/3	6.0 150	I	2	2	1	1	N	N	1	1	1	6	4	2	66-94
3	2	Alkyd primer/ silicone alkyd	6	4.0 100	I	2.5	2.5	1	1	N	N	1	1	1	7	5	2.5	149-177
4	2	Universal primer /HB epoxy	2/3	6.0 150	I	4	3	3	2	N	N	3	2	3	7	5	3	121-149
5	3	Universal primer/ HB epoxy/ Acrylic polyurethane	2/3	7.5 180	I	5	3	3	3	N	N	3	3	3	9	6	4	149
6	2	Epoxy primer / HB epoxy	2.3	6.0 150	I	4	3	3	2	N	N	3	2	3	7	5	3	121-149
7	2	Epoxy zinc/ HB epoxy/ Acrylic polyurethane	6	7.0 175	I P	6 9	3 4.5	3 4.5	4 6	N N	N N	3 4.5	4 6	5 7.5	11 16.5	8 12	5 7.5	149
8	3	Epoxy zinc/HB Epoxy / Acr. Ure	10	9.0 225	I P	8 12	6 9	6 9	7 10.5	N N	N N	6 9	7 10.5	6 9	15 19.5	10 15	7 10.5	149

* Rust grades as per SSPC Vis-2 or SSPC D- 610:

ANNEXURE-5

Technical Datasheets

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING & SYSTEMS DIVISION
HYDERABAD-32

DOUBLE HEADED HYDRANT VALVE WITH STAND POST

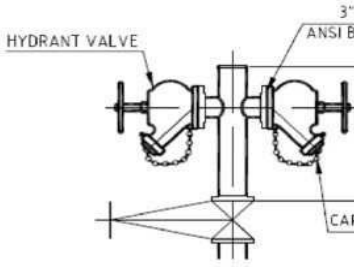
1. Code/standard : as per IS:5290 , Type-A
2. Type : Standpost type without pumper connection
3. Valve Type : Female oblique type with outlets angled towards ground
4. Valve Size : Inlet of 80 NB flange and Outlet of 63 mm instantaneous female coupling
5. Flow test : 900 LPM at minimum 7kg/cm^2 g

6. Material of Construction for valve

Hydrant valve

a) Body : SS 304
b) Spindle : SS 304
c) Bonnet : SS 304
d) Stop Valve : SS 304
e) Spring : SS 304
f) Chain : GI
g) End Connection : As per ANSI B 16.5 150#

Typical details of Hydrant Stand post



7. **Stand post**

Type : Wet barrel, vertical stand-post without pumper cc
MOC : 150 NB Carbon steel pipe as per ASTM A 106, GR.I
Inlet connection : 150 NB flanged as per ANSI B16.5 , 150 # SORF
Outlet connection : 2 x 80 NB flanged as per ANSI B16.5. 150 # SOFF
Flanges : Carbon Steel as per ASTM A 105, Drilling as per ANSI B 16.5 150#

8. Hydraulic Test Pressure

a) Body : 21 kg/cm^{2}g
b) Seat : 14 kg/cm^{2}g

9. Valve End Connection

a) Inlet connection : Flat Faced, Flanged, only Drilling and OD as per ANSI B 16.5

b) Outlet connection : Female Instantaneous Coupling with Blank Cap & Chain

10. Painting : **valve outside:**
valve shall be painted signal red shade no. 537 as per IS:5

Hand wheel shall be painted black as per IS:2932

Standpost and its arm (outside)
3 coats of anti-corrosive signal red paint shade no. 537 as per IS:5

Standpost and its arm (inside)
3 coats of chlorinated rubber based resin paint or zic chromate paint over 2 coats of red oxide zinc chromate primer or single coat of aluminium paint

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING & SYSTEMS DIVISION
HYDERABAD-32

FRP HOSE BOX

1. Type	:	Double door, Type-2
2. Size	:	900 x 600 x 250 mm (for accomodating Two hoses of 15 m long and one branch pipe with nozzle)
3. MOC	:	FRP & 3 mm thick glass panel in front door with lock & two keys.
4. Other Requirements & accessories	:	-Cabinet to have double door having toughened glass panel (3 mm) with rubber lining and marked `Fire' on it in 80 mm size letters. -lock with duplicate keys kept wired in a break glass key cabinet in the hose box itself. -small hammer with GI chain - drain holes to prevent water accumulation -Clamp for holding branch pipe to be provided. - any additional bolts/fasteners/erection hardware as required for pedestal mounting.
5. Mounting	:	Pedestal mounting. Suitable stand for pedestal mounting alongwith insert plate and erection hardware to be considered by bidder.
6. Painting:	:	outside: Two coats of Fire Red Paint Synthetic enamel paint over two coats of Red oxide Primer. inside: Two coats of White Synthetic enamel paint over two coats of Red oxide Primer

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING & SYSTEMS DIVISION
HYDERABAD-32

FIRE HOSE WITH COUPLING

1. Type	:	Reinforced Rubber lined fire hose
2. Code	:	IS 636 , Type-3
3. Application	:	Hydrant System
4. Size & Length	:	63 mm dia x 15 Meter length
5. Working Pressure	:	15 kg/cm^{2}g (max.)
6. Test Pressure	:	21 kg/cm^{2}g
7. Burst Pressure	:	35 kg/cm^{2}g
8. Coupling	:	Instantaneous spring lock type male/female coupling of SS 304 construction at both sides as per IS:903
9. Marking	:	a) Type of the hose b) Size of the hose c) Length of the hose d) Manufacturer's name or trade-mark or both e) Month and year of manufacture. f) ISI marking

BRANCH PIPE WITH NOZZLE

A. TRIPLE PURPOSE NOZZLE

1. Standard	:	IS:2871
2. Application	:	Fire fighting
3. Size	:	63 mm dia. Male instantaneous inlet universal outlet
4. Outlet	:	Hollow jet, Spray and Shut Off
5. Material of Construction		
a) Body	:	SS 304 (IS:3444, Gr 1)
b) Nozzle	:	SS 304 (IS:3444, Gr 1)
c) Washer	:	Rubber IS:937
d) Finish	:	Natural finish
e) Diffuser	:	SS 304 (IS:3444, Gr 1)
6. Working Pressure	:	5 kg/cm^{2}g (Min) and 12 kg/cm^{2}g (Max)
7. Hydraulic Test Pressure	:	21 Kg/cm2g (For 2.5 Minutes)
8. Marking	:	Manufacturer's name Year of manufacturing etc.

ANNEXURE-6 : SUB VENDOR LIST

Item Code : 05AQ	**Description :** HYDRANT/LANDING VALVE		
Supplier Code	Supplier Name	Country	Description
Approved Suppliers			
A077	ASCO STRUMECH PVT.LTD.		
N214	NEWAGE FIREFIGHTING CO,LTD.		
3646	SUKAN EQUIPMENTS PVT LTD	REV 4	

Item Code : 05AF	**Description :** HOSE DELIVERY		
Supplier Code	Supplier Name		Description
Approved Suppliers			
C149	CHHATARIYA RUBBER & CHEMICAL INDUSTIRIES		
N215	NEWAGE FIRE PROTECTION INDUSTRIES P LTD		
N214	NEWAGE FIREFIGHTING CO,LTD.		
3646	SUKAN EQUIPMENTS PVT LTD	REV 4	
3651	INDUSTRIAL COMMERCIAL CORPORATION	REV 4	

Item Code : 05AK	**Description :** BRANCH PIPES		
Supplier Code	Supplier Name		Description
Approved Suppliers			
N214	NEWAGE FIREFIGHTING CO,LTD.		
S313	SHAH BHOGILAL JETHALAL & BROTHERS		
N215	Newage Fire Protection Ind Pvt		
3646	SUKAN EQUIPMENTS PVT LTD	REV 4	

Note: For HOSE BOX, Bidder can consider any reputed MAKE, subject to BHEL/End customer approval during detail engg. stage.

Annexure-7

GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.
2. Each page of QAP shall contain the following information.

   a) Vendor's name & address.
   b) Customer: BHEL, Hyderabad.
   c) Project.
   d) BHEL Product Standard Number/revision number as referred in P.O.
   e) BHEL Purchase Order Number & Date.
   f) Product as per P.O. description.
   g) QAP Number (unique and shall not repeat)/revision number/date.
   h) Page number and number of pages

3. QAP shall contain four parts / stages as follows.

A) Raw materials and bought out items.
B) Inprocess Control / Inspection.
C) Final assembly, Inspection & Testing.
D) Painting, preservation & packing.

4. Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc).
5. Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc), Hydrostatic test, calibration check etc.)
6. Under 'Class', indicate minor, major or critical depending on the importance of characteristic.
7. Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.)
8. Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)
9. Under 'Reference document' and 'Acceptance norms', appropriate National & International standards, BHEL standards, approved drg references etc should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practise etc". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.
10. Under 'Format of record', indicate appropriately supplier's Test certificate, calibration certificate, lab report, inspection report etc.
11. Please refer 'Agency' in QAP format.
    "Under P: Perform, W: Witness, V: Verify
    Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR
    2: (Vendor / Sub vendor)
    Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, under Witness (W) column use 1. Under 'Verify' column, use code1
12. Under 'D' please put (4 Tick) against each characteristic where vendor proposes to submit test certificate/report etc OR as required as per BHEL Spec.
13. Vendor's signature & stamp should be available on each page of QAP.

14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drgs.

15. The following operations/characteristics/check points may be included (**AS APPROPRIATE)**

a) Visual check
b) Dimensional check
c) Mechanical and Chemical properties.
d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc as the case may be.)
e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peeloff test etc.
f) Check for correctness for all components mounted as per General arrangement Drg, Bill Of Materials (BOM), etc for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.
g) Verification of test certificate for protection class for the enclosures.
h) Mechanical functioning of switches.
i) Continuity of earthing and provision of earth points.
j) Colour coding of wiring, size, tightness & dressing of wiring.
k) Review of test certificates of assembled items, raw materials, internal test reports etc.
l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.
m) PQR, WPS, Welder Qualification Record, welding records (fitup, DP) etc.
n) Material identification (for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc)
o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non Destructive Tests.
p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Preece Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)
q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole.
r) Packing and Preservation.

VENDOR'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN**	QP. NO.:
	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT:	BHEL P.O.NO.: P.O.DATE: BHEL SPEC: REV:	REV NO: DATE: PAGE 1 OF 1

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
									D	P	W	V	
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**												
2.0	**INPROCESS INSPECTION**												
3.0	**FINAL INSPECTION & TESTING**												
4.0	**PRESERVATION & PACKING**												

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL /BHEL's TPIA(BHEL NOMINATED INSPECTION AGENCY) 2 FOR VENDOR/SUB VENDOR & 3 BHEL's CUSTOMER AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.	PREPARED BY VENDOR'S SIGNATURE & STAMP	APPROVED BY BHEL QA SIGNATURE & STAMP	APPROVED BY CUSTOMER'S SIGNATURE & STAMP