400 MW, MARIB GTPS, PHASE-II.
PUBLIC ELECTRICITY CORPORATION, MINISTRY OF ELECTRICITY AND ENERGY, REPUBLIC OF YEMEN.

VOLUME: IIB & III.

TECHNICAL SPECIFICATION
FOR
SEWAGE TREATMENT PLANT

SPECIFICATION NO.: PE-TS-372-673-A001 Rev 01

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA, INDIA.

CONTENTS- VOLUME-IIB & III

VOLUME-IIB

SECTION - A

(SCOPE OF ENQUIRY)

1.0 SCOPE:

1.1 This specification is intended to cover design, engineering, manufacturing, painting, inspection & testing at manufacturer's works, complete with all accessories including start up, erection and commissioning spares, seaworthy packing, and delivery to CHA Godown Mumbai Port. In addition, the bidder's scope shall include supervision of erection and commissioning, site testing, trial run, performance demonstration for the **SEWAGE TREATMENT PLANT for 400 MW, MARIB GTPS, PHASE-II. PEC, MINISTRY OF ELECTRICITY AND ENERGY, REPUBLIC OF YEMEN.** The scope of supply shall fully cover the requirement of the Design Criteria and Technical Specification of this specification.

1.2 It is not the intent to specify all the details of the design & manufacture. However, the equipment shall conform in all respect to high standard of design, engineering & workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Purchaser, who will interpret the meaning of drawing & the specification & shall be entitled to reject any work or material, which is not in full accordance herewith.

1.3 The bidder's scope shall also include any other services, etc. if called for in the succeeding sections of the specification.

1.4 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

1.5 In case of any deviation / clarification, the Bidder shall indicate the same clause by clause in the deviation / clarification schedule. In the absence of the same it will be construed that the bid conform strictly to the specification.

1.6 General terms & conditions, instructions to the bidder and other attachments referred to elsewhere, made part of tender specification. The bidder shall be responsible for all governed by requirements stipulated hereinafter.

1.7 In case of any data/requirement stipulated in the drawing but not in the specification and vise-versa such data/requirement shall be deemed to be contained in both. Contradictions between drawings and specifications, if any, shall be brought to the attention of the BHEL / customer by the bidder and the correct requirement shall be obtained.

1.8 In the event of any conflict between two clauses of specification bidder has to point out those points in pre award stage in clarification format attached with the specification. In absence of the same BHEL / customer interpretation will prevail after award of contract during detailed engineering.

1.9 Deviations along with cost of withdrawal (positive or negative), if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

1.10 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and shipping release issue by BHEL/Customer.

1.11 BHEL's / Customer's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.

1.12 Bidder is required to depute his qualified personal to power station site to supervise in erection, commissioning, trial run and Performance demonstration as per BHEL requirement.

1.13 Unpriced copy of the price bid shall be furnished along with the technical bid. Unpriced schedule is enclosed in volume –III.

1.14 The omission of specific references to any component / accessory necessary for the proper performance of Sewage Treatment System shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of equipment at quoted prices.

SECTION - B
(PROJECT INFORMATION)

1.	**Owner**	PUBLIC ELECTRICITY CORPORATION, MINISTRY OF ELECTRICITY AND ENERGY , REPUBLIC OF YEMEN
2.	**Project**	400 MW MARIB GTPS PHASE-II
3.	**Owner's consultant**	The Kuljian corporation , Philadelphia , USA
4.	**Location**	Marib , Yemen
5.	**Nearest Airport**	El Rahaba Airport (SAH), Sana'a, Yemen
6.	**Nearest Railway Station**	No rail network in Yemen
7.	**Access to site**	a. Through sea: • Distance of site: From Aden Port (Gulf of Aden): 419 Km b. By Air : Sana'a Airport • Distance from site : 172 Km
8.	**Site data**	
A	**Altitude**	1100 m above Mean Sea Level
B	**Ambient Air Temperature**	45 ºC
C	**RELATIVE HUMIDITY**	
	Design Relative Humidity	60%
D	**RAINFALL**	
1.	Average Rainfall per annum	< 100 mm
E	**WIND VELOCITY & PRESSURE**	
1.	Max. Design Wind Velocity	120 km/h
2.	Max. Barometric Pressure Barometric Pressure at sea level	1023.6 mbar 887.7 mbar
F	**SEISMIC ZONE**	UBC 1997,Zone-2 A
9.0	Design Ambient temperature for Gas Turbine &	

A	Mechanical equipment	45 ºC
B	Design Ambient temperature of electrical equipment	50 ºC
10.0	Electrical Details	Refer attached Annexure-I

ANNEXURE - I

Electrical Power Sources and Equipment Voltage Rating

i. 400,000±10% Volts, 3-phase, 50 Hz, solidly grounded system.
ii. 33,000±10% Volts, 3-phase, 50 Hz, solidly grounded system.
iii. 6600±10% volts, 3-phase, 50 Hz, low resistance grounded system.
iv. 400±10% volts, 3-phase, 50 Hz, solidly grounded system
v. 230±10% volts, 1-phase, 50 Hz, (PH/N of 400 volt) for lighting, receptacles and small power
vi. AC 230 ± 5% volts, 50 Hz, 1-phase, for instrumentation and controls .
vii. 220V / 125 / 24 / 48V (+) 10% to (-) 15% volts (DC), ungrounded system

Electric Equipment Voltage Rating

AC Equipment Voltage Rating

i.	Motors larger than 250 kW	:	6.6 KV, 3-ph, 50 Hz
ii.	Motors less than and equal to 250 kW	:	400V, 3-ph, 50 Hz
iii.	Lighting with associated equipment	:	230V, 1-ph, 50 Hz
iv.	MOV motors	:	400V, 3-ph, 50 Hz

Frequency : 50 Hz ± 5%

Fault Level

i.	400,000 volts system	:	31.5KA for 3 sec. (In line with Phase - I)
ii.	33,000 volts system	:	31 kA for 3 sec. (In line with Phase - I)
iii.	6600 volts system	:	25 kA for 3 sec. (In line with Phase - I)
iv.	400 volts system	:	Min. 50 kA for 1 sec. in line with Phase-I to be uprated based on calculation to be submitted for Phase – II.
v.	220 VDC system	:	15 kA for 1sec

SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS

SECTION – C1

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

1. GENERAL

The **Sewage Treatment Plant** and associated accessories shall conform to the technical specification.

2. SCOPE OF SUPPLY (MECHANICAL)

Broad scope of work of this package includes all equipment and accessories for completion of the system in line with tender requirement.

Following are the broad scope of work in bidder's scope. In additional to the following please also refer the respective sections of electrical, C&I and civil for bidder's scope of work.

i. The Sewage Treatment Plant consisting of the following shall be in bidder's scope:-

a) Two numbers (2x100%) Septic tank over flow transfer pumps along with motors, accessories, instruments and valves. Please note that pumps shall be supplied with base plate & outlet pipe spool with valves, instruments and flanges mounted on the outlet pipe to facilitate the easy erection at site. The outlet pipe shall be of SS-304 material.

b) Two numbers (2x100%) Treated water transfer pumps with motors, accessories, instruments and valves. Please note that pumps shall be supplied with base plate & outlet pipe spool with valves, instruments and flanges mounted on the outlet pipe to facilitate the easy erection at site. The outlet pipe shall be of SS-304 material.

c) Two numbers (2x100 %) air blowers with, motors along with accessories & instruments mounted on a skid. The blowers should be housed in an acoustic hood. Please note that blower shall be skid mounted with valves, instruments and flanges mounted on the skid. The outlet pipe with diffusers shall be of SS-304 material. The prefabricated pipe & diffusers shall be supplied separately.

d) Air diffusers for Aerobic treatment chamber.

e) 600 m of 63 mm OD HDPE piping.

f) 650 nos of piping clamps for 63 mm OD HDPE Pipe.

g) Fittings, valves, instruments, accessories etc. as defined in the data sheet as required to meet the system requirement.

h) The equipment to be packed in crates with sea worthy packing as per Annexure F.

i) Painting and color code shall be decided during detailed engineering and shall subject to customer and BHEL approval.

j) Bidder to note that the equipment, valves, instruments indicated in the P&ID (PE-DG-372-673-A001) attached in the technical specification are minimum and same shall be in bidder's scope. During detailed engineering, bidder to furnish complete and detailed scheme in all respects including all valves, instruments, piping equipment's. Fittings etc. for smooth, safe, efficient and trouble free operation of the plant meeting the specification requirement.

k) Bidder to note that the pipe shall be supplied in pre-fabricated form. Bidder shall develop the isometric drawings for piping work and the pipe shall be tagged properly for easy co-relation and erection at site.

l) The complete STP shall be designed in such a way that items are mounted on skid to minimize the site erection work. The skid mounting possibility shall be exercised during detailed engineering and the same shall be finalize during detailed engineering by BHEL.

m) Supports for all the piping as per the requirement shall be in bidder's scope. Embedment plates with lugs shall also be provided by bidder as per system requirement.

n) All auxiliary structure (U-clamps, nuts, bolts etc.) for fixing pipes on pedestal or trestles.

o) All necessary flanges and counter flanges to interconnect the pipes.

p) All necessary drains, vents and sampling points, with valves, as specified and as required.

q) Start-up, erection and commissioning spares as required.

r) All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.

s) Finish paints for touch up painting of equipments after erection at site in sealed container.

t) Initial charge of all lubricants and grease.

3. SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical as per specification / details indicated in Section C2 (Specific Technical Requirement Electrical) and D2 (General Technical Requirement Electrical)

4. SCOPE OF SUPPLY (C&I)

Complete C&I as per specification / details indicated in Section C3 (Specific Technical Requirement C&I) and D3 (General Technical Requirement C&I)

5. SCOPE OF SUPPLY (CIVIL)

Total Civil is in BHEL's Scope of work, however detailed Civil Design Input drawings (equipment GA drawings indicating complete loading details) shall be provided by bidder.

6. SCOPE OF SERVICE

The bidder's scope also includes following services:

a) 07 man days of Supervision of Erection and commissioning including performance demonstration. Vendor shall depute the experienced & competent person who can complete the assigned job.
b) Performance Demonstration.
c) Painting as per enclosed painting schedule. However, any variation in the painting schedule as finally approved by customer shall be taken care by the bidder without any commercial and delivery implication. Color-coding scheme shall be provided to vendor during detailed engineering.
d) Touch up paint shall be done on site under bidder's supervision.
e) Third Party Inspections as applicable.

7. TERMINAL POINT:

a) Treated water line from Aerobic Treatment chamber upto N-Pit of DM Plant shall be in bidder's scope.

8. EXCLUSION

a) Potable water and service water upto the terminal point.
b) All Civil works
c) M.C.C. / Switch fuse feeder panels for the power plant and control cabling up to & beyond the battery limit (Refer electrical section for scope).
d) Air conditioning, ventilation & fire fighting facilities. However, bidder to furnish the requirement of the same after award of contract.

9. ERECTION AND COMMISSIONING SPARES

All the necessary commissioning spares shall be supplied as a part of base offer. Bidder will submit the list of commissioning spares for Sewage Treatment Plant along with the offer.

10. SEAWORTHY PACKING

To prevent damage to the equipment of the system during transit, seaworthy packing to be provided as per Technical specification for seaworthy packing and shipping instructions given in Section D-1.

11. QP AND SUB VENDOR APPROVAL

a) Requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/customer shall be binding on vendor in this regard. Any changes/additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial/delivery implication to BHEL/Owner. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/check lists etc. shall be submitted to Owner/BHEL for approval. All inspection & testing etc. shall be carried out accordingly.

b) Approved sub vendor list is enclosed elsewhere of this specification. However, any additional sub-vendor shall be subject to BHEL and Customer approval during detailed engineering.

12. DESIGN/CONSTRUCTION

In addition to the requirements of Section-C & D the following shall also be complied under scope of this specification:
The P&ID is enclosed herein in this section for bidder's compliance.
The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to customer and BHEL approval during detailed engineering.

13. DRAWING/DOCUEMNTS REQUIREMENT (Please refer electrical and C&I portion also)

After award of LOI, following drawing/documents shall be submitted by the bidder for BHEL/Customer approval. However, any additional drawing/documents if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial and delivery implication ton BHEL and customer.

SL. NO.	BHEL DRG NO	DRG TITLE	No. of weeks/days for document submission from date of LOI / PO	DOCUMENT SIZE
1	PE-V10-372-673-A001	P&I Diagram for Sewage Treatment Plant	4 weeks	A1
2	PE-V10-372-673-A002	layout of Sewage Treatment Plant	4 weeks	A1
3	PE-V10-372-673-A003	Sub vendor list	5 weeks	A4
4	PE-V10-372-673-A004	Operation & Control Philosophy	4 weeks	A4
5	PE-V10-372-673-A005	Electrical load data	6 weeks	A4
6	PE-V10-372-673-A006	Mech. GA drawings of All Sewage Sumps And Tanks	8 weeks	A1
7	PE-V10-372-673-A007	Data sheet of all valves, instruments, pumps, motor and blowers	8 weeks	A4
8	PE-V10-372-673-A008	QAP for all valves, instruments, pumps, motor	8 weeks	A3

		and blowers		
9	PE-V10-372-673-A009	Instrument schedule	10 weeks	A3
10	PE-V10-372-673-A010	Valve schedule	10 weeks	A4
11	PE-V10-372-673-A011	Cable tray/trench & conduit routing diagram of STP	10 weeks	A3
12	PE-V10-372-673-A012	PLC details for STP (complete documentation as described in C&I deliverables)	10 weeks	A4
13	PE-V10-372-673-A013	QAP for PLC	12 weeks	A3
14	PE-V10-372-673-A014	Detailed Erection procedure.	12 weeks	A4
15	PE-V10-372-673-A015	Cable Schedule	12 weeks	A4
16	PE-V10-372-673-A016	Performance demonstration procedure for Sewage Treatment Plant	14 weeks	A4
17	PE-V10-372-673-A017	Engineering BOQ	14 weeks	A4
18	PE-V10-372-673-A018	O&M manual for Sewage Treatment Plant covering catalogue of all the items.	16 weeks	As applicable
19	PE-V10-372-673-A019	Sea worthy packing drawing and details.	16 weeks	A4
20	PE-V10-372-673-A020	List of Erection & Commissioning spares.	14 weeks	A4

Note:-

1. Detailed BOQ in every engineering drawing and document shall be provided by bidder.
2. Bidder to note that the Drawing documents submitted should be of highest quality with micro details as erection and commissioning has to be done by BHEL based on the drawings submitted by the bidder. Bidder to also provide packing drawings and details.
3. Drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalisations/ submissions of drawings.
4. Any other document/drawing required for STP by BHEL/customer, shall be provided by vendor without any implication.

14. DRAWING/DOCUEMNTS REQUIRED ALONG WITH THE BID (Please refer Electrical, C&I portion and Vol III also).

a) Clarification, if any, in the BHEL format in pre bid stage.
b) Any deviation in BHEL format with cost of withdrawal of deviation
c) Unprice Schedule duly filled.
d) List of Spares (Commissioning spares).
e) Electrical load data format (filled).
f) Compliance certificate.
g) Declaration sheet

Note-1: - Any item/work either supply of equipment or erection material which have not been specifically mentioned in but are necessary to complete the woks for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

Note-2: All major drawings/documents shall be approved by BHEL/CUSTOMER during detailed engineering stage. Successful bidder shall comply with the observations of the BHEL/CUSTOMER without price & delivery implication.

Note-3: Bidder to note that drg/doc submission shall be made through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link.

(http://124.124.36.198/wrenchwebaccess/login.aspx)

NOTE-4: Bidder to note that specific technical requirements as per Section – C will prevail over general Technical requirements given elsewhere in this specification.

15. DRAWING DOCUMENT DISTRIBUTION SCHEDULE

SNo.	Document	Total Copies	Distribution		
			Purchaser		
			HQ	SITE	Consultant
1	Approved drawings, documents etc.	20	6	8	6
2	Instruction manuals for erection and O&M	15	5	6	4
3	As built drawings	20	4	8	8

16. Miscellaneous requirements

a) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

b) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

c) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of drawing beyond one month will be to customer's account.

d) Bidder to submit the document (basic engineering documents like P&ID, layout and GA) within 04 weeks from the date of purchase order/LOI and subsequent revision in 07 days of comments. BHEL will take 2 weeks' time for observation on all drawing.

e) Vendor to attend regular meeting with BHEL and customer fortnightly in BHEL or customer office as decided during detailed engineering.

f) Latest version of all codes and standards to be followed.

g) Bidder can ask their clarification if any during pre-bid stage for clarity.

DATA SHEET -A OF STP

DATA SHEET – A

1	AIR BLOWER	
1.1	Number	Two (2x100%)
1.2	Type	Twin lobe type with acoustic hood
1.3	Pressure gauge	Two (nos) One per blower
a	Type	Bourdon Type
b	Make	a) A.N.Inst Narendrapur b) General Inst Consortium Mumbai / Goa c) Gluck Mumbai d) Goa Thermostatic Goa A With Imported Bourdon Tube For Pressure Gauge e) Manometer Mumbai f) Wika Pune
1.4	Capacity & Head	Minimum 30 cum/hr and 5 mwc or to suit the system requirement
1.5	Operating Speed	1500 rpm
1.6	Discharge Line (minimum)	50 NB
1.7	MOC of air blower	
a	Casing	Cast Iron Gr. FG 260 to IS 210
b	Shaft	Carbon Steel to EN 8
c	Base Frame	MS Common for Blower and motor. The same should be MS with epoxy coating.
1.8	Accessories for each blower	Suction Filter Suction and Discharge Silencer Companion Flange for Blower Spring Load relief valves Belt Guard and Filter hood Non Return Valve
1.9	Make	a) SWAN PNEUMATIC NOIDA b) EVEREST TRANSMISSION NEW DELHI c) KAY INTERNATIONAL NEW DELHI / SONEPAT d) EVEREST BLOWER BAHADURGARH
1.10	Spares for Blower	a) Set of Bearing – 1 Set b) Set of Oil Seal – 1 Set c) Suction Filter – 1 Set
1.11	Noise	85 dBA @ 1 m from blower
1.12	Inspection and Testing	As per the approved quality Plan
1.13	Motors	Two (One for each blower)
a	Type	As per motor Data Sheet.
2	OVER FLOW TRANSFER PUMP WITH MOTOR	
2.1	Number	Two (2X100%)
2.2	Type of pump	Submersible Non Clog Pump
2.3	Capacity & Head for Submersible pump	5 CuM/Hr (each) and Head 10 M
2.4	Make for Submersible pump with motor	a) Darling Pumps Pvt. Ltd Indore b) FLOWMORE LTD. c) SU MOTORS PVT. LTD. d) VARAT PUMP AND MACHINERY

		PVT. LTD. e) WPIL LIMITED
2.5	Delivery Size	50 NB
2.6	Operating Speed	1500 rpm
2.7	Flange Standard	DIN / equivalent
2.8	Minimum installation depth	1.5 m.
2.9	MOC	
a	Casing	2% Ni Cast Iron FG 260 IS 210
b	Line Shaft	SS 410
c	Pump shaft	SS 316
d	Impeller	SS-316
e	Base plate	MS with epoxy coating
2.10	Pump Accessories	Pump Motor with Cable Auto coupling with bend
2.11	Motors	Two (One for each pump)
a	Type of motor	As per motor Data Sheet.
2.12	Spares	a) Set of Bearing – 1 Set
3	TREATED WATER TRANSFER PUMPS WITH MOTOR	
3.1	Number	Two (2X100%)
3.2	Type of pump	Submersible Non Clog Pump
3.3	Capacity & Head for Submersible pump	5 CuM/Hr (each) and Head 50 M (or to suit the system requirement
3.4	Make for Submersible pump with motor	a) Darling Pumps Pvt. Ltd Indore b) FLOWMORE LTD. c) SU MOTORS PVT. LTD. d) VARAT PUMP AND MACHINERY PVT. LTD. e) WPIL LIMITED
3.5	Delivery Size	50 NB
3.6	Operating Speed	1500 rpm
3.7	Flange Standard	DIN / equivalent
3.8	Minimum installation depth	1.5 m.
3.9	MOC	
a	Casing	2% Ni Cast Iron FG 260 IS 210
b	Line Shaft	SS-304
c	Pump shaft	SS-304
d	Impeller	SS-316
e	Base plate	MS with epoxy coating.
3.10	Pump Accessories	Pump Motor with Cable Auto coupling with bend
3.11	Motors	Two (One for each pump)
a	Type of motor	As per motor Data Sheet.
3.12	Spares	a) Set of Bearing – 1 Set
4	PIPE AND FITTINGS	
4.1	HPDE Pipe	Size – 63 mm OD, Quantity – 600 m (in six numbers of coils of 100 meter each) Specification – PE 100-PN 10 carbon black quality suitable for both above ground and buried pipe protection Design Standard : ISO 4427
4.2	90 deg elbow of compression fittings	Size – suitable for 63 mm OD pipe, Quantity – 50 m Specification – PE 100-PN 10 carbon black quality suitable for both above

		ground and buried pipe protection Design Standard : ISO 4427
4.3	Compression Flange Adaptor	Size – suitable for 63 mm OD pipe, Quantity – 50 m Specification – PE 100-PN 10 carbon black quality suitable for both above ground and buried pipe protection Design Standard : ISO 4427 Drilling to meet system requirement & counter flange requirement.
4.4	Compression coupler	Size – suitable for 63 mm OD pipe, Quantity – 50 m Specification – PE 100-PN 10 carbon black quality suitable for both above ground and buried pipe protection Design Standard : ISO 4427
4.5	Compression T	Size – suitable for 63 mm OD pipe, Quantity – 50 m Specification – PE 100-PN 10 carbon black quality suitable for both above ground and buried pipe protection Design Standard : ISO 4427
5	VALVES	
5.1	GLOBE VALVES	
a	Type	STRAIGHT, RISING STEM , WITH OUTSIDE SCRES
b	Design standard	IS:778 CLASS 2
c	Make	Leader, Jalandhar H. Sarkar, Howrah Bankim & compony, Howrah
5.2	NON RETURN VALVE	
a	Type	SWING CHECK (REFLUX TYPE) OR DUAL PLATE TYPE AND FLANGED ENDS
b	Design standard	IS:778 CLASS 2
c	Make	Majestic Works, Mumbai BDK, Hubli H. Sarkar, Howrah Leader, jalandhar

NOTE : Vendor to please not that sub vendor listed above are indicative only and is subject to approval /acceptance by customer and BHEL during detail engineering. Bidder to propose his sub vendor list with back up documents (experience list, end user certificate as applicable) etc. The same shall subject to BHEL and customer approval during detail engineering stage without any commercial & delivery implication to BHEL and customer.

INDICATIVE SUB-VENDOR LIST

S. No	ITEM	SUPPLIERS	PLACE	SUB-VENDOR STATUS	QP / INSPN CAT	REMARKS
1	**SUBMERSIBLE PUMPS**	Darling Pumps Pvt. Ltd	Indore	A		
		FLOWMORE LTD.		A		
		SU MOTORS PVT. LTD.		A		
		VARAT PUMP AND MACHINERY PVT. LTD.		A		
		WPIL LIMITED				
2	**AIR BLOWERS**	SWAN PNEUMATIC	NOIDA	A		
		EVEREST TRANSMISSION	NEW DELHI	A		
		KAY INTERNATIONAL	NEW DELHI / SONEPAT	A		
		EVEREST BLOWER	BAHADURGARH	A		
3	**GATE / GLOBEVALVES UP TO 300 NB PN 10**	LEADER	JALANDHAR	A		
		H SARKAR	HOWRAH	A		
		BANKIM & COMPANY	HOWRAH	A		
4	**CHECK VALVE / NRV (LINED / UNLINED), FLAP TYPE SIZE UPTO 50 NB**	MAJESTIC WORKS	MUMBAI	A		
		BDK	HUBLI	A		
		H SARKAR	HOWRAH	A		
		LEADER (FOR CHECK VALVE ONLY)	JALANDHAR	A		
5	**MS PIPES (IS: 1239 & 3589)**	SAIL	ROURKELA.	A		
		JINDAL TUBES	GAZIABAD	A		UPTO 350 NB
		SURYA ROSHINI	BHADURGARH	A		UPTO 300 NB
		TISCO	JAMSHEDPUR	A		UPTO 150 NB
		WELSPUN	ANJAR	A		UPTO 400 NB
		MSL (FOR IS 3589)	RAIGAD	A		200 NB TO 500 NB
6	**METALLIC FITTINGS**	MS FITTINGS				KOLKATA
		SIDHARTHA & GAUTAM				FARIDABAD
		EBY				MUMBAI
		BHARAT FORGE				PUNE
		TUBE PRODUCTS				BARODA
		NITIN PROFILE				BARODA

7	**METALLIC FLANGES (IS 2064 GR B & SA 515/516 GR 60/70)** `	MOSHI ENGG. WORKS				MUMBAI
		ALLIANCE ENGG.				PUNE
		JAYA MBE				MUMBAI
		SIDHI FORGE				MUMBAI
8	**HDPE PIPES & Fittings**	DUTRON				
		ASTRAL	AHMEDABAD			
		GEORGE FISCHER	RATNAGIRI			
9	**LEVEL TRANSMITTER (GUIDED WAVE RADAR)**	K TECH	USA	A		
		E&H	GERMANY	A		
		EMERSON (SAB ROSEMOUNT)	SWEDEN	A		
		MAGNETROL	BELGIUM	A		
		EMERSON	DAMAN	A		
		CHEMTROL	GOA	DR		
10	**PRESSURE GUAGE**	A.N.INST	NARENDRAPUR	A		
		GENERAL INST CONSORTIUM	MUMBAI / GOA	A		
		GLUCK	MUMBAI	A		
		GOA THERMOSTATIC	GOA	A		WITH IMPORTED BOURDON TUBE FOR PRESSURE GAUGE
		MANOMETER	MUMBAI	A		
		WIKA	PUNE	DR		
11	**PRESSURE / DP TRANSMITTER**	EMERSON PROCESS MANAGEMENT	USA / DAMAN	A		
		FUJI ELECTRIC	JAPAN	A		
		HONEYWELL	USA	A		
		YOKOGAWA	JAPAN	A		
		ABB	ITALY / FARIDABAD	A		
12	**INST PIPE FITTINGS**	AURA INCORPORATED	NEW DELHI	A		
		HYD-AIR ENGG	MUMBAI	A		
		METPRESS ENGG	KOLKATA	A		
		PRECISION ENGG	MUMBAI	A		

		SWITZER INST	CHENNAI	A		
		VIKAS INDUSTRIAL	NOIDA	A		
13	**CONTROL PANEL**	PROCON INST	CHENNAI	A		
		CONTROL & SWGR CO	NOIDA	A		
		INDUSTRIAL CONTROLS & APPS	MUMBAI	A		
		PYROTECH	UDAIPUR	A		
		ELECMECH	AHEMDABAD	A		
		POSITRONICS	BARODA	A		
14	**JUNCTION BOXES**	BALIGA LIGHTING EQUIP	CHENNAI	A		
		CREATIVE INST	BANGLORE	A		
		DEVI POLY	CHENNAI	A		
		INFO CONTROL	BANGLORE	A		
		K.S.INTRUMENTS	BANGLORE	A		
		MANISHA ENTERPRISE	PUNE	A		
		SUCHITRA INDUSTRIES	BANGLORE	A		
15	**INST TUBE FITTINGS**	AURA INCORPORATED	NEW DELHI	A		
		HYD-AIR ENGG	MUMBAI	A		
		METPRESS ENGG	KOLKATA	A		
		PRECISION ENGG	MUMBAI	A		
		SWITZER INST	CHENNAI	A		
		VIKAS INDUSTRIAL	NOIDA	A		
16	**INSTRUMENT CABLE**	DELTON CABLES	FARIDABAD	A		
		PARAMOUNT CABLES	KHUSKHERA	A		
		RELIANCE	BANGLORE	A		
		POLYCAB	DAMAN	A		
		UNIVERSAL CABLES	SATNA	A		
		NICCO	KOLKATTA	A		
		CORDS	BHIWADI	A		
		INCAB	PUNE	A		
17	**SCREENED INSTRUMENT CABLE – PVC / FRLS**	PARAMOUNT CABLES	KHUSKHERA	A		
		POLYCAB	DAMAN	A		
		RELIANCE	BANGLORE	A		
		DELTON CABLES	FARIDABAD	A		
		CORDS	BHIWADI	A		
		UNIVERSAL CABLES	SATNA	A		
		INCAB	PUNE	A		

		NICCO CORPORATION LIMITED	KOLKATTA	A		
18	**CABLE LUGS**	CHETNA	MUMBAI	A		
		DOWELL	MUMBAI	A		
		ELECTRO BILLETS (3D)	VALSAD	A		
19	**PLC**	ABB	BANGALORE	A		
		GE FANUC	BANGALORE	A		
		L&T LTD	MUMBAI	A		
		ROCKWELL	GHAJIABAD	A		
		SIEMENS	NASIK	A		
		SCHNEIDER ELECTRIC	NEW DELHI	A		

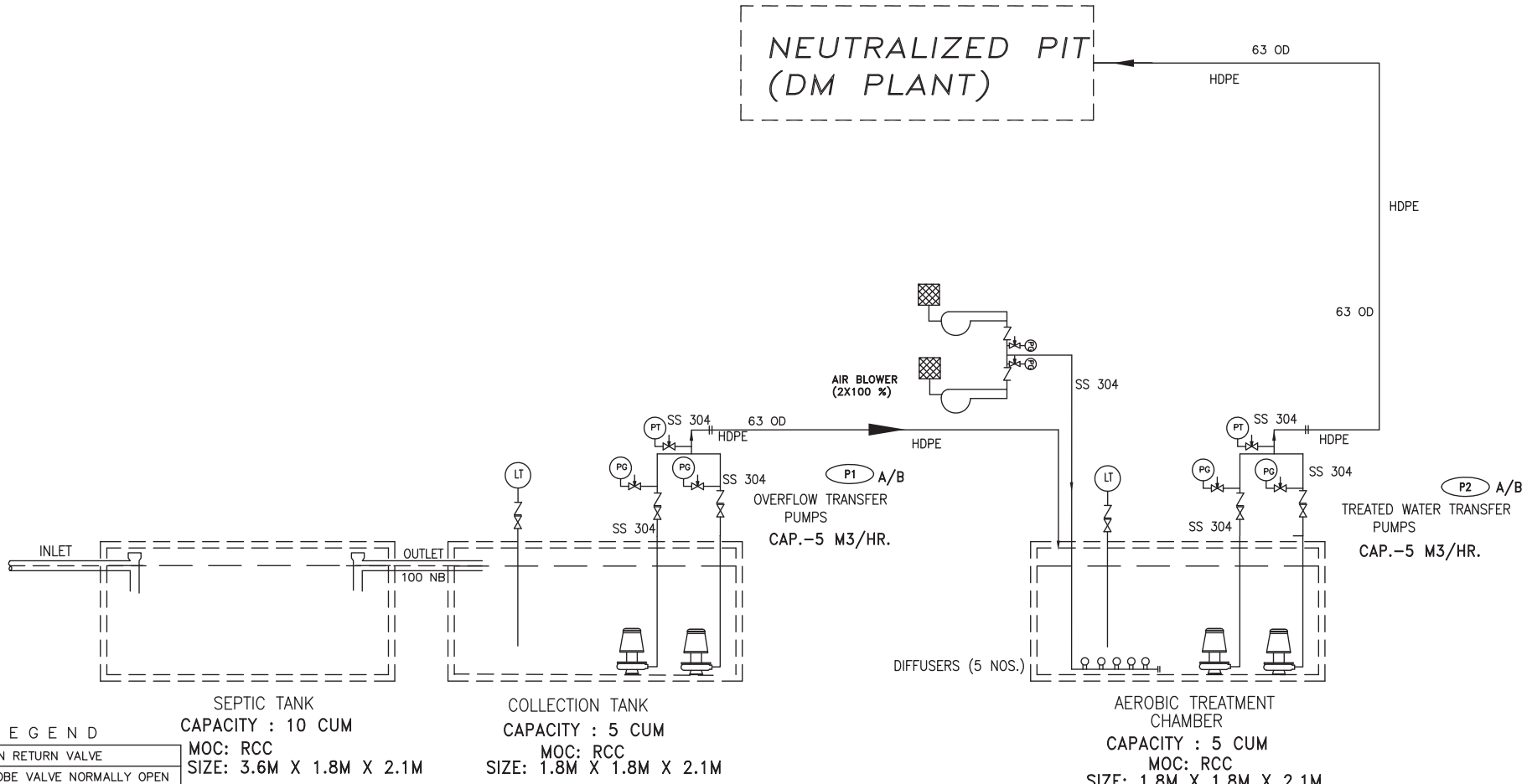
NOTE:

i) VENDOR TO PLEASE NOTE THAT FINAL SUB VENDOR SELECTED OUT OF THE ABOVE RECOMMENDED SUB VENDORS SUBJECT TO CUSTOMER APPROVAL DURING DETAILED ENGINEERING WITHOUT ANY TECHNICAL, COMMERCIAL AND DELIVERY IMPLICATIONS TO BHEL AND CUSTOMER.

ii) BIDDER TO ALSO CHECK THE LAWS AND REGULATIONS REGARDING SELECTING THE SUB VENDORS WHO CAN SUPPLY THE ITEMS TO MARIB, YEMEN.

iii) THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTROCTOR BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL, TECHNICAL AND DELIVERY IMPLICATION.

P&ID OF
SEWAGE TREATMENT PLANT



LEGEND

	NON RETURN VALVE
	GLOBE VALVE NORMALLY OPEN
	GLOBE VALVE NORMALLY CLOSED
	THREE WAY VALVE
	VENT TO ATMOSPHERE
	FUNNEL
PG	PRESSURE GAUGE
LT	LEVEL TRANSMITTER(RADAR TYPE)
M	MOTOR OPERATED (AC)
PT	PRESSURE TRANSMITTER
	AIR BLOWER WITH INTAKE FILTER
	SUBMERSIBLE PUMP

— — — — — — NOT IN BIDDER'S SCOPE

NOTE

1. SUBMERSIBLE PUMPS SHALL BE SUPPLIED WITH BASE PLATE & OUITLET PIPE SPOOL WITH VALVES, INSTRUMENTS AND FLANGES MOUNTED ON THE OUTLET PIPE TO FACILITATE THE EASY ERECTION AT SITE.. THE OUTLET PIPE SHALL BE OF SS 304.

REV.	DATE	ALTD	CHD	APPD

JOB NO. 372

STATUS CONTRACT

OWNER: PUBLIC ELECTRICITY CORPORATION(PEC)
MINISTRY OF ELECTRICITY AND ENERGY
SANA, REPUBLIC OF YEMEN

PROJECT: 400MW MARIB GAS TURBINE POWER STATION (PHASE-II)

CONSULTANT: THE KULJIAN CORPORATION
ENGINEERS * ARCHITECTS* CONSULTANTS
PHILADELPHIA, PA, U.S.A.

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
	DRN	RG		26.02.15
	DESN	RG		26.02.15
	CHD	SK		26.02.15
	APPD	JP		26.02.15

TITLE: P&ID FOR SEWAGE TREATMENT SYSTEM

CUSTOMER DRAWING NO. MARIB-II 12/2008-P-41200

BHEL DRAWING NO. PE-DG-372-673-A001

DEPT. SCALE

SIGN

DATE

SHEET 1 OF 1 REV. 01

QUALITY PLAN-MECHANICAL

QUALITY ASSURANCE

Items / Components \ Tests/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Pneumatic Test	Functional/operational Test	Bleeding resistance tests	Adhesion/ Spark Test	Performance Test	Other Test	All Test as per relevant Std/ Appd Data Sheets	Dynamic Balancing	Remarks
Diaphragm Valves	Y[a]				Y		Y[6]	Y[6]						Y[7]		
Butterfly Valves (Low Pressure)					Y		Y[6]		Y				Y[8]			
1. Body (Cast)	Y[a]		Y[b]													
2. Disc (Cast)	Y[a]		Y[b]													
3. Shaft	Y[a]		Y										Y[c]			
Rotary Blowers				Y	Y							Y		Y		
1. Casing	Y[a]		Y[b]				Y									
2. Rotor	Y[a]		Y										Y		Y	

QUALITY ASSURANCE

Notes:

1. Heat Treatment shall be done as per ASME code.
2. Bleeding Resistance tests shall be done by keeping the sample in 33% HCl, 48% NaOH and DM Water for 72 Hrs.
3. Hydro Test shall be conducted, before Rubber lining.
4. As per code requirements.
5. As per HIS, USA.
6. Hydro test of body before Rubber lining. Seat Leakage test for Actuator operated valves shall be done by closing the Valves with Job Actuator.
7. Tests on Rubber parts such as Diaphragms shall be done per batch of Rubber mix, such as Tensile, Hardness, Adhesion, Spark Test, Bleed Resistance test and Flex test. Life Cycle test for Diaphragms for 50000 cycles etc shall also be done.
8. Hydro Test of Body, Seat & Disc Strength shall be carried out in accordance with latest edition of AWWA C-504 Standard. Proof of Design Test in accordance with latest edition of AWWA C-504 Standard shall also be carried out, if not carried out earlier. Seat Leakage test for Actuator operated valves shall be done by closing the Valves with Job Actuator. Seat leakage test shall be carried out in both directions.

   a) One per Heat/Heat Treatment batch/Lot
   b) On machined surfaces only.
   c) UT shall be done for shafts with Dia 50 mm or above.

9. For all other Misc. items, refer Table on LP piping.

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-372-673-A001

MANUFACTURERS NAME & ADD

MANUFACTURING QUALITY PLAN

ITEM : Submersible Pumps for P.O Nr.: PW/PE/PG/NCH/P-77/13 Dt.: 05.06.2013 MODEL SUBMERSIBLE PUMPS

QP No: 1323105/Pump_QAP
REV No.: R0
DATE: 11.06.2013

PROJECT
END USER

PAGE 1 OF 2

MAIN SUPPLIER BHEL, Noida

SR. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
					M	B					M	B	N	
1	2	3	4	5	6		7	8	9	D*	10			
1.0	**Raw Material and Bought out Control**													
1.1a	Pump Casing	Physical Properties - Tensile Strength & Hardness / Chemical Composition	CR	Physical / Chemical Analysis	1 / Heat / Batch	1 / Heat / Batch	Appd. C S Drg.	APPROVED DRAWING/DATA SHEET	Lab Report	√	P	V	V	
1.1b	Impeller	Physical Properties - Tensile Strength, Yield Strength & Elongation Chemical Composition	CR	Physical / Chemical Analysis	1 / Heat / Batch	1 / Heat / Batch	Appd. C S Drg.	APPROVED DRAWING/DATA SHEET	Lab Report	√	P	V	V	
1.2	Heat treatment of Stainless Steel Castings	Heat Cycle	MA	Verification of HT chart	All batches	All batches	Appd. C S Drg.	APPROVED DRAWING/DATA SHEET	Corelated HT charts	√	P	V	V	
		IGC TEST	MA	CHEMICAL	1 SAMPLE/ HT BATCH		ASTM A 262	PRACTICE - "E"	TC	√	P	V	V	
1.3	Bars / forgings for pump and motor shafts	Physical/Chemical Properties	CR	Physical / Chemical Analysis	1/ Bar	1/ Bar	Appd. C S Drg.	APPROVED DRAWING/DATA SHEET	Mill TC or lab report	√	P	V	V	
		Dimensions	MA	Measurment	100%	100%	Manufacturers Drawing	Manufacturers Drawing	IR		P	V	V	
		Internal defects for 40 mm and above diameter	CR	UT	100%	100%	ASTM A-388	Refer Note 1	IR	√	P	V	V	
1.4	Cable Type: PVC insulated, multicore, copper conductor	Routine TC and acceptance TC as per IS 694/ IS 1554	MA	Measurement	100%	100%	Approved Datasheet / IS 694/ IS 1554	Approved Datasheet / IS 694/ IS 1554	IR & TC	√	P	V	V	Compliance cert. To be submitted by Kishor.
1.5	Bearings	Make, Bearing No., Surface finish	MA	Visual Examination	100%	100%	Manufacturers Std	Manufacturers Std	IR		P	V	V	
2.0	**Inprocess Control**													
2.1	All Components	Visual Defects	MA	Visual	100%	100%	Manufacturers Drawing	No harmful defects	Log book / IR		P			
		Dimensions	MA	Measurement	100%	100%	Manufacturers Drawing	Manufacturers Drawing	Log book / IR		P			
2.2	Pump discharge casing	Leak tightness	CR	Hydro test (Duration 30 minutes min.)	100%	100%	Refer Remark	No leakage	IR	√	P	V	V	Test Pr.2 x duty pts. Pr. OR 1.5 x shut off whichever is higher
	Motor Housing	Leak tightness	CR	Air test (Duration 30 minutes min.)	100%	100%	Air testing at 0.5 Kg / cm^2 (gauge pressure)	No leakage	IR	√	P	V	V	
2.3	Casing & Impeller (M/C surfaces)	Surface Defects	CR	DPT	100%	100%	ASTME 165	No Surface defect	IR	√	P	V	V	On machined surface only
2.4	Impeller	Static & Dynamic residual unbalance	CR	Static, Dynamic balancing	100%	100%	ISO : 1940	ISO 1940 Gr. 6.3	IR	√	P	V	V	
2.5	Pump & Motor Shaft	Surface Defects	CR	DPT	100%	100%	ASTME 165	No Surface defect	IR	√	P	V	V	On machined surface only
3.0	**Sub-Assembly, Assembly Control**													
3.1	Pump, Motor, Rotor	Eccentricity	MA	Measurement	100%	100%	Manufacturers Drawing	Manufacturers Drawing	Log book / IR		P	V	V	
3.2	Pump and Motor assembly	Completeness, correctness	MA	Visual Examination	100%	100%	Manufacturers Drawing	Manufacturers Drawing	IR		P	V	V	

BHEL
CONTRACTOR
TURE

LEGEND: RECORDS IDENTIFIED WITH "TICK1( ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION
** M: MANUFACTURER/SUB CONTRACTOR
B: BHEL, N : CUSTOMER
P : PERFORM W: WITNESS V : VERIFICATION AS APPROPRIATE

BHEL DOC No. PE-V8-307-172-N005

NAME AND SIGN OF APPROVING AUTHORITY AND SEAL

ENGG DIV / QA & I

30

MANUFACTURERS NAME & ADD

MANUFACTURING QUALITY PLAN

ITEM : Submersible Pumps for P.O Nr.: PW/PE/PG/NCH/P-77/13 Dt.: 05.06.2013 MODEL SUBMERSIBLE PUMPS

QP No: 1323105/Pump_QAP
REV No.: R0
DATE: 11.06.2013

PROJECT
END USER

PAGE 2 OF 2

MAIN SUPPLIER: BHEL, Noida

SR. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
					M	B					M	B	N	
1	2	3	4	5	6		7	8	9	D*	10			
4.0	**Final Inspection, Test, Packing, Despatch Control**													
4.1	Pump set (Pump+ Motor)	Q Vs Head Q Vs Power Q Vs Efficiency Noise & Vibration	CR	Performance test	100%	1 Pump Per type	ENCLOSED TEST PROCEDURE	Tech. Spec., Appd. Data Sheet, Appd. Curves, HIS	Performance test record, Plotted Curves	√	P	W	V	Witnessing by BHEL pump per type
4.2	Routine Test on motor	HV, IR, Locked Rotor, No Load,Make,type,rating	CR	Electrical tests	100%	1 Pump Per type	IS 325	Approved Data Sheet	IR	√	P	W	V	Wdg resistance ** Degree of protection shall be IP 68 HV at 2.5 KV ac for 1 minutes
4.3	Strip down after Performance test	Undue wear, tear and breakages	CR	Visual examination of Casing & Impeller after stripping	1 / type	1 / type	Undue wer, tear and breakages	No undue wear, tear and breakages	IR	√	P	V	V	Witnessing one no. of each type by BHEL
4.4	Complete Pump	Completeness, Correctness, Workmanship and finish, overall dimensions	MA	Visual examination	100%	100%	Approved G.A. drawing	Approved G.A. drawing	IR	√	P	V	V	Compliance report for accessories will be submitted.
4.5	Completion of all stages	Completion	MA	Verification of IR's TC's	100%	100%	Approved QP	Approved QP	IR	√	P	V	V	
4.6	Painting	Surface Preparation		Visual examination	100%	100%	Approved DataSheet		IR		P	V		
		Uniformity and thickness		Visual Measurement	100%	100%	As per Painting Schedule	As per Painting Schedule	IR		P	W	V	
4.7	Wooden Packing	Soundness, Aesthetic		Visual	100%	100%	Manufacturer's Standard	Manufacturer's Standard	IR		P			Compliance report by KPPL

Note : For accessories and bought out items, KISHOR will submit Compliance for review.

1. For UT test on shaft, acceptance criteria : Defect echo < 20 % full screen height when back wall echo set @ 100 % screen height. Reduction in back wall echo to be <20%

Defect height > 20 % of FSH is not acceptable, also loss in back wall echo > 20 % not acceptable

2. IP 68 protection certificate for test conducted on similar motor shall be submitted for review

3. Compliance for provision of thermic switch for over heating protection of winding, reverse rotation protection device shall be submitted by KPPL

BHEL
CONTRACTOR
RE

LEGEND: RECORDS IDENTIFIED WITH "TICK" ( ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION
** M: MANUFACTURER/SUB CONTRACTOR
B: BHEL, N : CUSTOMER
P : PERFORM W: WITNESS V : VERIFICATION AS APPROPRIATE
** Motor IR to be checked before pump is tested and after pump is tested

BHEL DOC No.: PE-V8-307-172-N005

NAME AND SIGN OF APPROVING AUTHORITY AND SEAL

ENGG DIV / QA & I

MANUFACTURING QUALITY PLAN

SUPPLIER NAME & ADD	MANUFACTURERS NAME & ADD	ITEM : Composite Control Panel for Submersible Pumps for P.O Nr.: PW/PE/PG/NCH/P-77/13 Dt. 05.06.2013	QP No: 1323105/PANEL_QAP REV No.: R0 DATE: 10.07.2013 PAGE 1 OF1	PROJECT MAIN SUPPLIER:
	Anmey Controls, Bhosari Pune			

SR. NO	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CATE-GORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY M	AGENCY B	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9	10			
1	FINAL INSPECTION											
1	COMPLETE CONTROL PANEL	WORKMANSHIP AND FINISH PAINT SHADE	MA	VISUAL	100%	TANGEDCO / APPROVED DRAWING / RELEVANT IS	TANGEDCO SPECIFICATION / APPROVED DRAWING	INSPECTION REPORT	P	V	V	
		ADHESION	MA	VISUAL	100%	TANGEDCO SPECIFICATION / APPROVED DRAWING / RELEVANT IS	TANGEDCO SPECIFICATION / APPROVED DRAWING	INSPECTION REPORT	P	W	V	
		THICKNESS	MA	VISUAL	100%	TANGEDCO SPECIFICATION / APPROVED DRAWING / RELEVANT IS	TANGEDCO SPECIFICATION / APPROVED DRAWING	INSPECTION REPORT	P	W	V	
		DEGREE OF PROTECTION BY PAPER INSERTION	MA	VISUAL	100%	TANGEDCO SPECIFICATION / APPROVED DRAWING / RELEVANT IS	TANGEDCO SPECIFICATION / APPROVED DRAWING	INSPECTION REPORT	P	W	V	
		WIRING LAYOUT	MA	VISUAL	100%	- DO -	- DO -	- DO -	P	W	V	
		COMPONENT LAYOUT FITTING ACCESSIBILITY & SAFETY	MA	VISUAL	100%	- DO -	- DO -	- DO -	P	W	V	
		COMPONENT IDENTIFICATION (MARKING / NAME PLATES)	MA	VISUAL	100%	TANGEDCO SPECIFICATION / APPROVED DRAWING / RELEVANT IS	TANGEDCO SPECIFICATION / APPROVED DRAWING / RELEVANT IS	- DO -	P	W	V	
		PROPER WIRE TERMINATION	MA	PULLING MANUALLY	SAMPLE	- DO -	NO LOOSE CONNECTIONS. ALL TERMINATIONS TO BE LUGGED	- DO -	P	W	V	
		DOOR AND LOCK FUNCTIONING	MA	OPERATION	100%	- DO -	NO MISMATCH	- DO -	P	W	V	
		OVERALL DIMENSIONS	MA	MEASUREMEN	SAMPLE	- DO -	APPROVED DRAWING	- DO -	P	W	V	
		CONTINUITY	CR	ELECT	100%	CUSTOMER SPECIFICATION / APPROVED DRAWING	CUSTOMER SPECIFICATION / APPROVED DRAWING	- DO -	P	W	V	
		IR. / HV	CR	ELECT	100%	HV test 2. 5 kv for Power & 1.5 Kv for Control , 1 Mohm at 500 V		- DO -	P	W	V	THESE TESTS TO BE DONE BEFORE OPERATIONAL TEST
		OPERATION LOCK ETC	CR	ELEC OPERATION & FUNCTION IN ENERGISED CONDITION	1/TYPE	TANGEDCO APPROVED DRAWING & SPECIFICATION		- DO -	P	W	V	
		EARTHING OF MOTOR BODY	MA	VISUAL	100%	- DO -	- DO -	- DO -	P	W	V	

Note : Pump shall be packed in wooden packing.

BHEL
CONTRACTOR
RE

LEGEND: RECORDS IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION
** M: MANUFACTURER / SUPPLIER TO BHEL
B: BHEL N: CUSTOMER
P : PERFORM W: WITNESS V : VERIFICATION AS APPROPRIATE

BHEL DOC No.: PE-V8-307-172-N005

NAME AND SIGN OF APPROVING AUTHORITY AND SEAL

SECTION – C2

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

ELECTRICAL EQUIPMENT SEPCIFICATION FOR SEWAGE TREATMENT PLANT

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure–I to Section – C [Electrical Scope between BHEL & Vendor].

1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.

1.3 Bidder shall furnish all 400V AC loads required for the system such as motor feeders, supply feeders in PEM format along with the offer.

1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.

1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage. The same shall be subject to approval without any commercial implications.

1.6 Technical requirements shall be as per specifications listed in Clause 4.1, 4.2, 4.3 & 4.4 below.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

a) A copy of this sheet “Electrical Equipment Specification for Sewage Treatment Plant” and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
b) List of Erection and Commissioning spares.
c) List of Erection & Maintenance tools & tackles.
d) Electrical load requirement in the load data format.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

4.1 Electrical Scope Matrix between BHEL & vendor (Annexure-I).
4.2 Technical specification and Data Sheets for 400V Electric Motors.
4.3 Technical Specification for Miscellaneous electrical item
4.4 Quality Plan for motors.
4.5 Load data format (Annexure-II).

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: MARIB 400MW GTPS PROJECT, PHASE-II

PACKAGE: SEWAGE TREATMENT PLANT
(Civil in BHEL scope)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	400V MCC	BHEL	BHEL	1. BHEL will provide single phase 230 V AC(supply feeder)/ 400V, 3-phase 4-wire supply based on load data provided by vendor for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor. Any other local panels if required shall be in vendor scope. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC based system, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL BHEL* BHEL	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by BHEL*.
4	Any special type of cable like compensating, co-axial, prefab, MICC etc.	Vendor	BHEL*	
5	Cable trays, accessories & cable trays supporting system within sewage treatment plant battery limit	Vendor	BHEL*	Cable trays shall be of tough FRP . Drawings shall be subject to customer/BHEL approval at contract stage without any price implication.
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	BHEL*	1. Cable glands shall be Double compression type, tinned brass,shrouded, complete with necessary armour clamp and tapered washers etc. (suitable for selected cable size). 2. Heavy duty tinned copper lugs (suitable for selected cable size). Lugs for power cables shall be of compression type, whereas lugs for control cables shall be of insulated terminal crimping type.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	BHEL*	Conduits shall be of rigid steel, hot- dip galvanized, furnished in standard lengths threaded at both ends. Minimum diameter of conduits shall be 20 mm. All conduits shall be heavy duty suitable for electrical installation.

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
				Flexible conduits where required, near equipment terminations, shall be made with bright, cold rolled, annealed and electro- galvanized mild steel strips. In corrosive areas epoxy coated conduits shall be provided.Makes of conduits shall be subject to customer/BHEL approval at contract stage.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	BHEL	BHEL	
10	Below grade grounding	BHEL	BHEL	
11	LT Motors with base plate and foundation hardware	Vendor	BHEL*	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Junction boxes	Vendor	BHEL *	Wherever required as per system requirement
13	E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	BHEL*	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

For skid mounted system (if applicable), 2 nos. (1W+1S) supply of 400V, 3 phase 4-wire AC shall be provided by BHEL. Complete electrical distribution for the skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope.

FURTHER THE CABEL REQUIRED INSIDE THE SKID SHALL BE IN BIDDERS SCOPE.

BHEL* means E & C by BHEL and supervision by vendor.

DATA SHEET A FOR MOTORS

8.8.5 Specified Design Data

SECTION : ELECTRIC MOTORS		
8.8.5.1 AC Motors		
Rated Voltage		
Less than and equal to 250 kW	V	400
Larger than 250 kW	V	6600 V
Rated Frequency	Hz	50
Voltage variation		±10%
Frequency Variation		±5%
Absolute sum of variation		10%
Rated Voltage for DC Motors	V	220 V ±10% to -15% (125 +10% to -15% if GTG supplier's standard)
Class of Insulation for all Motors		Class 'F' with temperature Limited to Class 'B'
Starting Current		6 times FLC.
Degree of protection		IP 44/IP W 55
Method of cooling		TEFC/CACA
Fault withstand capability of terminal box		Fault current for 0.2 sec. for breaker controlled motors
No. of consecutive hot starts with initial temperature of motor at final steady working temperature		Two
No.of hourly starts uniformly distributed from final temperature		Three (3)

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
BIDDER TO FOLLOW FOLLOWING ELECTRICAL LOAD DETAILS																		ANNEXURE-II
Septic Tank overflow transfer pump		1.5 KW	2	1	1	D	U	NA	1		Near							
Treated water transfer pump		7.5 KW	2	1	1	D	U	NA	1		Switchgear							
Air Blower		1.5 KW	2	1	1	D	U	NA	1		Building							
UPS		1 KVA	1	1	-	E		NA	C		/							

NOTES:
1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (DC): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.		ORIGINATING AGENCY		PEM (MAUX)	
	PROJECT TITLE	MARIB 400MW GTPS, PH-II	NAME		DATA FILLED UP ON	
	SYSTEM	SEWAGE TREATMENT PLANT	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 01	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

UNITCABLENO	FROM	TO	PURPOSE	REMARKS	CABLESIZE	PATHCABLENO

SECTION – C3

SPECIFIC TECHNICAL REQUIREMENTS (CONTROL AND INSTRUMENTATION)

	SPECIFIC TECHNICAL REQUIREMENT	SPECIFICATION NO.
		VOLUME **II-B**
		SECTION
		REV. NO. 01 DATE: 09/09/2014
		SHEET 1 OF 1

1. Bidder to include Field instrumentation and Field Junction Box (JB's), in his scope of supply. Field instrument specification and Data Sheet are given elsewhere in this spec.

2. All field cabling for instruments/motor/pump/blower to JB is in bidder's scope and details are given elsewhere in this spec. JB to PLC shall be provided by BHEL as free issue whereas cable schedule, cable interconnections and wiring diagram for the same shall be in bidders' scope.

3. Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware as per instrument installation diagram shall be in bidder's scope.

4. All manual valves at pump discharge shall be provided with Open and Close Limit Switches.

5. PLC control system as defined in the enclosed specs and DATA Sheets shall be in bidder scope. The PLC system shall comprise of (i) PLC based local panel (ii) UPS Power supply (iii) Operator interface in the form of CRT, keyboard and OWS along with required furniture.

6. The redundant I/O's shall be provided for all Controls.

7. PLC shall have the facility to synchronize its time with BHEL supplied GPS. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by bidder. The cable connecting PLC and GPS shall be in BHEL scope.

8. PLC shall be connected to DCS through serial link with MODBUS connection on TCP/IP Protocol compliant for monitoring. Dual redundant fibre optic cable from PLC to DCS shall be in bidders' scope. For bidding purpose bidder to consider 300 meters approximate distance between PLC and DCS. Necessary Patch Chord/ Converters, LIU at PLC end, shall be in bidder scope.

9. All furniture (tables, chairs etc.) required for PLC operator HMI shall be in bidder's scope. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.

SECTION – D

GENERAL TECHNICAL REQUIREMENTS

SECTION-D1

GENERAL TECHNICAL REQUIREMENT (MECHANICAL)

GENERAL

The scope covers the basis of design, system philosophy, equipment selection and Control Philosophy of **SEWAGE TREATMENT PLANT** for **400 MW MARIB GAS TURBINE POWER STATION PHASE II REPUBLIC OF YEMEN.**

1.0 SEWAGE TREATMENT PLANT (Ref. Drg. no. PE-DG- 372-673-A001)

Plant sewerage is collected in a septic tank. Overflow from the septic tank is collected in a collection chamber From the collection chamber overflow is pumped to the aerobic treatment chamber by means of 2x100 % overflow transfer pumps. Extended aeration is done in the aerobic treatment chamber with the help of air supply from blowers. The treated water after aerobic treatment is transferred to the N-Pit (DM Plant) by means of 2X100% treated water transfer pumps.

2.0 Control Philosophy.

The interlocks required for operation of pumps in various systems shall be PLC based.

The control of all pumps and blower is PLC based. In addition, each pump will be provided with one local start/stop push button (lockable type) stations. Suitable weather protection shall be provided for LSSPB (Local start stop push button) located near each pump. The PLC and UPS for STP Plant shall be placed in Equipment Room 6.2 Mt and battery for the system shall be in battery room at 6.2 MT, SWGR Control Building. The OWS for PLC shall be placed in Computer Room at 6.2 Mt, SWGR Control Building. The distance between PLC and Pump shall be 100 Mt. The system shall have automatic operation described below.

The sewage waste from buildings is collected in a septic tank through gravity. The overflow from septic tank is collected in a collection tank. Once the level in the collection tank is high, one out of the two overflow transfer pumps (1W+1S) shall start auto and the waste is transferred to aerobic treatment chamber. Overflow transfer pumps shall be interlocked when level is low and high via level transmitter. (Please refer attached P&ID of Sewage Treatment Plant)

The aerobic process in the aerobic treatment chamber is a batch process. Once the waste enters the aerobic treatment chamber, one out of the two Air blowers (1W +1S) shall be started automatically. The batch timing is around 8 hours. Once the process is completed after 8 hours, Air blowers shall be stopped automatically and one out of the two Treated water Transfer Pumps (1W+1S) shall start automatically. Treated water transfer pumps shall be interlocked when level is low and high via level transmitter.

Local Indication/Alarm of tank levels shall also be provided for operation of LSSPB.

ON/OFF/TRIP interlocks for submersible pumps and air blower shall be provided by providing suitable arrangement to meet the system requirement.

3.0 Sewage Treatment Plant is designed for the following sewage flow rate and characteristics:

Flow Rate : 0.5 m3/hr.
BOD : 300 mg/l

4.0 Effluent from Sewage Treatment Plant shall meet the following norms-

Parameter	Maximum value
BOD	20 ppm

GENERAL TECHNICAL REQUIREMENT FOR

SUBMERSIBLE PUMP

CLAUSE NO.	TECHNICAL REQUIREMENTS

SUBMERSIBLE PUMPS

1.00.00 SCOPE

1.01.00 This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's / sub-vendor's delivery to side, of submersible pumps.

2.00.00 CODES AND STANDARD

The design manufacture and performance of submersible pumps shall be comply with all currently applicable statues, regulation, and safely codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable Indian standards listed below other Nation Standards are acceptable, if they are established to be equal or superior to the listed standards. Nothing in these specifications shall be construed to relieve the contractor of this responsibility.

2.01.00 **List of Applicable Indian Standards**

IS:8034	-	Submersible pumps for clear cold fresh water
IS:5120	-	Technical requirement of Rotodynamic Special Purpose pumps.

In case of any contradiction with aforesaid standards and the stipulations as per technical specification as specified hereinafter the stipulation of the technical specification shall prevail.

3.00.00 DESIGN AND PERFORMANCE REQUIREMENTS

a) The pump shall be of single stage mono - block type with non-clog design.

b) Components of Identical pumps shall be interchangeable.

c) Pumps shall have a continuously rising head characteristic.

4.00.00 MOTOR RATING

Continuous motor rating (at 50 deg. C ambient) for pumps shall be at least ten percent (10%) above the maximum load demand of the driven equipment in the complete operating range to take care of the system frequency variations.

5.00.00 FEATURES OF CONSTRUCTION

a) Pumps shall be of Submersible, wet pit type.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	b) Pumps shall be able to pass through solids upto 40 mm and capable of handling waste water which may contain, sludge, plastic solids etc. c) Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc. d) Pumps shall be portable type and capable of using in any sump as and when required. Pump shall be provided with required stool, flexible, hoses chain connection etc. for easy installation, removal and maintenance. Adequate length of chain required for lowering the pump into the sump and flexible type discharge pipe shall be provided. e) Impeller Impeller type shall be open/semi-closed type/closed as indicated elsewhere. Enclosed impellers shall be equipped with seal rings on their hubs. In case of open impeller, the pump shall be design to take care of the additional thrust produced.
6.00.00	**MOTOR** i) Motor shall be coupled directly to the impeller shaft. ii) The motor shall be suitable for operation when submersed in water. The housing shall have required degree of protection. iii) Necessary arrangement to be made to make cable entry absolutely water tight, with cores cast in insulation along with cable gland 'O' ring seat. iv) Built in temperature sensors are to be provided to enable tipping of motor if temperature rises above the design temperature limit. These sensors are to be used directly in the circuiting of control panel. The control circuit should trip the motor if the temperature rises beyond safe limits. v) Moisture sensors are to be embedded in motor chamber to trip the motor in case of moisture entry in motor due to failure of pump mechanical seal. vi) Motor shall be oil filled/oil lubricated or water filled type. Pressure equalizing diaphragm and sand guards with seal shall be provided to prevent the water and sand entering the motor. vii) Power supply to the motor and control connections shall be preferably combined in one cable and shall be flexible copper conductor PVC insulated, armored and overall hard grade PVC sheathed, and suitable for under water service. The cable gland shall be properly sealed to prevent entry of pumped liquid the motor. Length of the cable shall be of suitable for site conditions. The cable shall be terminated on the control panel with necessary facility to terminate with the power receptacle.

CLAUSE NO.	TECHNICAL REQUIREMENTS

viii) For pumps which are specified under portable application, Cable shall be suitable for continuous winding/un winding duty on a cable reeling drum and shall be installed on a trolley mounted on wheels. Associated control panel is also to be mounted on the trolley.

ix) Water level controller shall be provided which should be with two level controls, high to start and low to stop.

7.00.00 EQUIPMENT DATA SHEET

Type of pump	:	Submersible type fixed inside pits/ sump with guides /lifting chains
Type of Working Fluid	:	Drains with particle size upto 40 mm
Type of impeller	:	Open
Type of lubrication	:	Self / Grease / Oil
Speed	:	Preferably 1500 rpm (maximum)

Material of Construction

a)	Casing	:	2% Nickel Cast Iron, IS:210 Grade FG 260;
b)	Impeller	:	SS-316
c)	Shaft	:	SS- 410
d)	Bolts & nuts	:	SS-316
e)	Accessories	:	Suction Strainer, Pump stand, Adaptors for discharge flange, Level measuring devices/ Controllers, Lifting hook & chain handle to agitate debris etc, Discharge hose connected with piping upto the drains etc.

f) The discharge, suction /column pipes shall be heavy grade Carbon steel externaly lined with epoxy or galvanised.

PAINTING REQUIREMENT

(PEC TENDER NO.: 12/2008)

VOLUME IV

SECTION 7.6

CLEANING, PROTECTIVE COATING AND PAINTING

(PEC TENDER NO.: 12/2008)

Table of Contents

7.6.0 CLEANING, PROTECTIVE COATING AND PAINTING

7.6.1 General

This specification covers the general requirements related to the cleaning protective coating and painting of equipment, components and system. The components and/or equipment shall be mechanically and /or chemically cleaned during the following stages of the Contract.

- Cleaning in workshop
- Cleaning before painting and/or corrosion protection (application of prime coat)
- Cleaning before erection and during installation.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturer's works or at site, as appropriate.

For cleaning in workshop and before painting mechanical cleaning as opposed to alternative chemical cleaning is the preferred method for works cleaning except where this is precluded by design or access considerations.

Machined surfaces shall be protected during the cleaning operations.

In the event of the surfaces not being cleaned to the purchaser's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the supplier's sole expense.

For reclining small areas, hand cleaning by wire brushing may be permitted. Wire brushes used on austenitic steel bristles.

Austenitic stainless steels, copper and aluminium alloys, cast iron, bimetallic and metallic/plastic items, and components fabricated by spot welding or riveting shall not be chemically cleaned. All weld areas shall be suitably stress relieved before chemical cleaning.

Codes and Standards

Internationally recognized codes and standards with purchasers approval shall be followed for the work covered by this contract.

Surface Preparation Standards

The following standards shall be followed for surface preparations:

- Swedish standard Institution - SIS-05 5900-1967 (Surface preparation standards for painting steel surfaces).
- Steel structures painting council, U.S.A. (Surface Preparation Specifications (SSPC-SP).
- British Standards Institution (Surface Finish of Blast cleaned steel for painting) BS-4232.
- National Association of Corrosion Engineers, U.S.A. (NACE).
- Various international standards equivalent to Swedish standard for surface preparation are given in Table-1.

The contractor shall arrange, at his own cost, to keep a set of latest edition of the above standards and codes at site.

The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following:

a) Proper storage to avoid exposure as well as extremes of temperature.
b) Surface preparation prior to painting.
c) Mixing and thinning
d) Application of paints and the recommended limit on time intervals between coats.
e) Shelf life for storage.

Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the Engineer, who may, however, at his discretion authorise in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

Equipment

All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipment, scaffolding materials, shot/sand blasting equipment & air compressors etc. shall be arranged by the contractor at the site in sufficient quantity at his own cost. He shall arrange at his own cost, for suitable paint thickness measuring instrument like Elkometers acceptable to the Engineer (with calibration facilities).

Mechanical mixing shall be used for paint mixing operations in case of two pack systems except that the Engineer may allow the hand mixing of small quantities at his discretion.

7.6.2 Mechanical Cleaning at Manufacturer's Works

Mechanical cleaning shall preferably be carried out by abrasive blasting. The Owner is prepared to consider alternative methods provided they achieve the necessary surface condition.

Surface condition:

The Metal surfaces shall be clean and free of mill scale, rust, dirt, grease and any other deleterious matter.

Where metal surfaces are to be painted the surface profiles shall conform with the painting specification requirements.

Where this does not apply surfaces shall have a surface texture not coarser than Grade 80 abrasive paper.

Abrasives:

Abrasives containing silica, silicates or slag residues shall not be used for water/steam side surfaces of plant except for cleaning sand castings, where hydro blasting with sand may be used.

For austenitic materials only, abrasives containing 98% or more of aluminia, $Al_2 O_3$, shall be used.

Removal of abrasive and debris:

After cleaning, abrasive and debris shall be thoroughly removed from components.

7.6.3 Alternative Chemical Cleaning at Manufacturer's Works

The procedure shall comprise:

Pre-treatment
Acid treatment

To achieve cleanliness equivalent to that specified for mechanical cleaning. The procedure to be adopted must meet with the purchaser's approval.

7.6.4 Protection at Manufacturer's Works

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

All water, air and steam side surfaces shall be protected by the application of approved water soluble corrosion inhibitors, or vapour phase inhibitors that can be subsequently removed by site water washing or steam blowing.

The rate of application of volatile corrosion inhibitors shall be at least 10 grams per square metre or 35 grams per cubic metre, whichever is the greater, except for pipes up to 300 mm diameter for which the minimum application rates shall be 5 grams per square metre.

Immediately after the protective treatment has been applied all vessels and pipes shall be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surrounds. Cylindrical plugs shall not be driven into the ends of pipes. These protective covers shall not be removed until immediately before final connection is made to the associated equipment.

7.6.5 Weather Conditions

Painting shall be done only when the surface temperature is above 5°C. surface temperature must be at least 3°C above dewpoint to ensure that condensation does not occur on the surface.

Reasonable protection against precipitation, corrosive fumes and vapours shall be exercised for the painting of outdoor parts.

Precautions shall also be taken against solar radiation to ensure that the specified dry film thickness of priming or finish coats is obtained.

Any prime coat exposed to excess humidity, rain, dust etc., before drying, shall be permitted to dry and the damaged area of primer shall be removed and the surface prepared and primed again.

Sheltered or unventilated horizontal surfaces on which dew may collect require more protection, and to achieve this an additional top coat of paint shall be applied.

7.6.6 Surface Preparation

In preparing any surface to be coated, all loose paint, dirt, grease, rust, scale, weld slag or spatter or any other extraneous material shall be removed and defects repaired, so as to obtain a clean, dry, even surface to receive the priming or finishing coat (s) as called for in the

painting schedules. Sharp edges should be rounded, especially when tank linings have to be applied.

All machined surfaces, including flange faces, shall be suitably covered to prevent damage during surface preparation.

All surfaces should be blast cleaned whenever possible.

Surface preparation methods

Bare steel surfaces should be prepared by one of the methods described below in order of preference and in accordance with Swedish Standard SIS 05 59 00 or Steel Structures Painting Council, SSPC, Vis 1, or DIN 55928, section 4.

(a) White metal blast cleaning: Sa 3 or SSPC - SP 5

Sa 3 Blast cleaning to bare metal. Mill scale, rust and foreign matter must be removed completely. Subsequently, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. It must then have a uniform metallic colour and correspond in appearance to the prints designated Sa 3.

(b) Near white metal blast cleaning Sa 2 1/2 or SSPC - SP 10

Sa 2 1/2. Very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are slight imperfections in the form of spots or stripes. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It must then correspond in appearance to the prints designated sa 2 1/2.

Mechanical cleaning should only be used when procedures (a) and (b) are not practicable.

(c) Commercial Blast Cleaning Sa 2

Sa 2 Blast cleaning until atleast two-thirds of each element of surface area is free of all visible residues. This method of Blasing is suitable for steel required to be painted with conventional paints for exposure to mildly corrosive atmesphere for longer life of the paint systems.

(d) Near white metal blast cleaning P Sa 2 1/2 DIN 55928

Very thorough blast cleaning. Very adhesive coatings remain. From all other surface mill scale and rust are to be removed to such an extent that the only traces remaining are slight imperfections in the form of spots or stripes. Further treatment see Sub b).

The adhesivity of residual coatings in the transition zone has to be tested even after the application of the primer.

(e) very thorough mechanical scraping and wire burshing St 3

St 3 very thorough scraping and wire-burshing - machine brushing - grinding - etc. are to be preferred. Surface preparation as for st 2. But much more thoroughly. After the removal of dust, the surface must have a pronounced metallic sheen and correspond to the prints designated St. 3.

(f) Thorough scraping and wire brushing: St 2

St 2 Thorough scraping and wire-brushing - machine brushing - grinding - etc. The treatment shall remove loose mill scale, rust and foreign matter. Subsequently, the surface is cleaned

with a vacuum cleaner, clean dry compressed air or a clean brush. It should then have a faint metallic sheen. The appearance must correspond to the prints designated St 2.

Table-1 (Surface Preparation Standards)

Surface preparation method	SIS 055900	DIN 55928, Part 4	BS 4232 only for blasting	SSPC-Vis
blasting acc.to item (a)	Sa 3	first quality	white metal	SP 5
blasting acc. to item (b)	Sa 2 1/2	second quality	near white	SP 10
blasting acc.to item (c)	Sa 2	Third quality	Commercial Blast	SP 6
derusting acc to item (f)	St 2	–	Hand tool/ power tool Cleaning	SP 2
acc. to items (e)	St 3	–	Power tool Cleaning	SP 3
Flame jet cleaning	F1	–	Flame cleaning	SP 4
Pickling	Be	–	Pickling	

Steel structures to be blast cleaned have to be free of pitting and other severely corroded places in accordance with B.S. 4232 and SIS 055900.

The abrasives used for blast-cleaning shall be graded flint, grit, shot or silica sand and shall be such that they will produce an average keying profile on the blast-cleaned surface of not more than 40 microns.

An air pressure of 7 bar g at the nozzle shall be used.

After blast-cleaning, all accumulated grit, sand, dust, etc., must be removed leaving the surface clean, dry and free of mill scale, rust grease and other foreign matter.

In the event of rusting after completion of the surface preparation, the surface must be cleaned again in the manner specified.

Oil, grease, soil, cement, salts, acids or other corrosive chemicals shall be cleaned from steel surfaces, by the use of solvents, emulsions or cleaning compounds. The final wiping shall be with clean solvent and clean rags or brushes. There shall be no detrimental residue left on the surface.

Primed areas which suffer damage must be spot blasted on site to a degree of cleanliness P Sa 2 1/2 before touching up.

Protective coating must be applied as quickly as possible after the completion of surface preparation no matter what cleaning method has been used.

No blast-cleaned surface shall be allowed to remain uncoated overnight.

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil etc. before the first coat of paint is applied on site. Shop primer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming.

Concrete: If a protective coating is required, concrete shall be allowed to cure before painting.

7.6.7 Rub Down and Touch up of Primer

The shop coated surfaces shall be rubbed down thoroughly with emery paper to remove all dust, rust and other foreign matters, washed, degreased, then cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry before applying a coat of primer. The compatibility between shop coat and field primer should be ascertained from the paint manufacturer. In case degreasing with white spirit is not effective, the surface should be finally wiped clean with aromatic solvent like xylol or light naphtha.

7.6.8 Non Compatible Shop Coat Primer

The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc., the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer.

Shop coated (coated with primer & finishing coat) equipment shall not be repainted unless paint is damaged.

Shop primed equipment and surfaces shall only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer shall be completely removed before application of selected paint system for particular environment.

For package units/equipment, shop primer shall be as per the paint system given for particular environment.

In case of existing paint, compatibility between finishing coat and new selected finish coat shall be ascertained before application of finish coat. In case the coat is selected for upgrading existing alkyd coating to high performance coating, then surface preparation can be by manual/ mechanical means to remove loose rust, peeled off/damaged paint, but sound old coating need not be removed. It should be touched with red oxide zinc chromate primer wherever it has peeled of before application of tie coat. The tie coat shall be applied after 7 days of curing of red oxide zinc chromate primer. If new paint system is not suitable to upgrade existing coating then complete paint shall be removed by mechanical or blast cleaning before application of new coating system.

7.6.9 Paint Materials

Plant and equipment shall be painted according to the colour scheme followed in Phase-I

7.6.10 Storage

All paints and painting material shall be stored only in rooms to be provided by the contractor and approved by Engineer for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separated from adjacent buildings. A signboard bearing the words "PAINT STORAGE - NO NAKED LIGHT - HIGHLY INFLAMMABLE - DANGER - NO SMOKING" shall be clearly displayed outside. All paints should be stored in the safest manner so that no container rolls down and causes accidents. The shelf life of the paints should be ensured so that the paint materials are not in storage and use after the date of expiry.

7.6.11 Preparation of Coating Materials

All container shall remain un-opened until required for use.

Primers and paints which have livered, gelled or otherwise deteriorated shall not be used.

The oldest primer or paint of each kind shall be used first.

All ingredients in any container shall be thoroughly mixed before use, and shall be agitated frequently during application to keep the primer in suspension.

Primer or paint mixed in the original container shall not be transferred until all settled pigment is incorporated into the body of the liquid.

Mixing in open containers shall be done in a well ventilated area.

Primer or paint shall be mixed in a manner ensuring the breakdown of all lumps, complete dispersion of pigment and uniform composition.

Two-component primers shall be mixed in accordance with the manufacturer's instructions.

Thinners shall not be added to primers or paints unless necessary for proper application according to the manufacturer's instructions.

When use of thinners is permitted, it must be added to the primer or paint during mixing.

7.6.12 Application

Health and safety of work

The supplier has to check all painting work to be carried out according to the specification of the paint supplier further to all relevant prescriptions and regulations concerning the health and safety of work.

The paint supplier has to present a written specification including at least the flash point of the paints, ventilation requirements, handling precautions such as inhalation, eye and skin protection, and first aid procedure, storage requirements, spill or leak procedure, fire precaution, waste disposal.

7.6.13 Safety Requirements

Protection of the blast cleaner operator's eyes and respiratory system should be given prime consideration in any open blast cleaning operation. Airfed helmets, respiratory filters, air conditioned hoods etc. should be provided in sufficient number to the blast cleaning operators to avoid the harmful effect of blast cleaning abrasives. Also, an automatic shut-off device which will shut-off the air supply to the blasting machine should be installed which will prevent the dangerous whipping of an operating blast hose if an operator becomes disabled.

Methods

Temporary corrosion protections are to be completely removed prior to applying the definite one.

All prime coatings shall be applied by brush or airless spray or a combination of these methods, as approved by the coating manufacturer.

All doors, windows, stairways, handrails (if painted), bolts, flanges and equipment supports shall be finish painted by brush.

Spray guns should not be used outside in windy weather or near surfaces of a contrasting colour unless the latter is properly protected.

All cold-spray painting shall be done using standard equipment in accordance with accepted standards and methods.

Care has to be taken not to connect spraying devices for nitro and backelite paints simultaneously to oil based paints.

Paint applied to items that are not be painted shall be removed at the supplier's expense, leaving the surface clean, unstained and undamaged.

7.6.14 Dry Film Thickness (DFT)

To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats shall not be of the same colour.

Each coat of paint shall be allowed to harden before the next is applied. For epoxy paint the hardening time normally is 12-14 hours. Suppliers' recommendations regarding hardening time of epoxy paints must be followed.

Particular attention must be paid to full film thickness at edges.

The minimum total dry film thickness of the paint systems shall be as recommended in the following table. The dft is given in microns (millionths of a metre).

7.6.15 Protective Coatings and Paint Systems

The type and number of protective coats for any item requiring painting are to be in accordance in the attached tables "Paint Systems" (Annex-1).

Alternative to the 'paint system' specified, are to be presented on the schedule Departure from Specification, as indicated elsewhere.

Generally, all parts shall receive the specified prime coat (s) at the supplier's works to ensure that no corrosion occurs during transport to the site and storage at the site.

Parts which cannot be damaged during transport shall receive the full number of coats.

7.6.16 Colour Code for Piping

The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it. The colour coding for the identification of pipelines should comply with the requirements of Phase-I.

Ground Colour shall be applied throughout the entire length for uninsulated pipes. For insulated pipes, on the metal cladding or on the pipes of material such as non-ferrous metals, austenitic stainless steel etc. Ground colour coating of minimum 2m length or of adequate length not to be mistaken as colour band shall be applied at places requiring colour bands. Colour band(s) shall be applied at the following location.

a. At battery limit points
b. Intersection points & change of direction points in piping ways.
c. Other points, such as midway of each piping way, near valves, junction joints of service appliances, walls, on either side of pipe culverts.
d. For long stretch/yard piping at 50 M interval.
e. At start and terminating points.

Identification Sign

Flow direction shall be indicated by an arrow in the location stated in Para a,b,c & d and as directed by Engineer.

Colours of arrows shall be black or white and in contrast to the colour on which they are superimposed. The size of the arrows shall confirm to relevant standards.

Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by Engineer.

Colour Bands

The width of colour band shall conform to the requirements of Phase-I

Whenever it is required by the Engineer to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes shall be made as per the requirements of Phase-I

7.6.17 Identification of Vessels, Piping etc.

Equipment number shall be stenciled in black or white on each vessel, column, equipment & machinery (insulated or uninsulated) after painting. Line number in black or white shall be stenciled on all the pipe lines of more than one location as directed by Engineer, size of letters printed shall be as per applicable codes & standards

Identification of storage tanks: The storage tanks shall be marked as detailed in the respective drawing.

7.6.18 Inspection and Testing

All painting materials including primers and thinners brought to site by the contractor for application shall be procured directly from manufacturer as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

Engineer at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batchwise test of wet paints for physical & chemical analysis. All costs thereof shall be borne by the contractor.

The paints shall be tested as per applicable codes & standards approved by the Owner.

The painting work shall be subject to inspection by Engineer at all times. In particular, following stagewise inspection shall be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

a. Surface preparation
b. Primer application
c. Each coat of paint

In addition to above, record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra coat to owner.

7.6.19 Primer Application

After surface preparation, the primer should be worked by brush application to cover the crevices, corners, sharp edges etc. in the presence of inspector nominated by Engineer.

The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer before application of successive coats.

The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Elcometer for measuring the Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting, Holiday detectors and pinhole detectors for checking the painted surface discontinuities should be provided by the contractor.

At the request of Engineer, the contractor shall make arrangements for paint manufacturer to provide expert technical service at site as and when required. This service should be free of cost and without any obligation to the Purchaser, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations.

Final inspection shall include measurement of paint dry film thickness, check of finish and workmanship. The thickness should be measured at as many points/locations as decided by the Engineer and shall be within + 10% of the dry film thickness.

7.6.20 Guarantee

The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work.

The contractor shall produce test reports from the manufacturer regarding the quality of theparticular batch of paint supplied. The Engineer shall have the right to test wet samples of paint at random for quality of the same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

7.6.21 Scope of areas to be Painted and Painting Systems

The paint system adopted shall be suitable for Coastal and Marine environment as given in Annex - 1.

Primers and finish coats for any particular paint system shall be from same manufacturer in order to ensure compatibility.

7.6.22 Galvanizing

Galvanizing works shall conform in all respect to applicable standards and shall be performed by the hot dip process, unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed in accordance with applicable standards.

Vent-holes and drain-holes should be provided to avoid high internal pressures and air-locks during immersion, which may cause explosions, and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. The welds and the surrounding metal should be cleaned separately, preferably by blast-cleaning, because the usual preliminary pickling cannot be relied on to remove the welding slag.

All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with relevant applicable standards. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from paint, oil, grease and similar contaminants. The weight of zinc coating per unit area has to be noted in the manufacturing documents.

Structural steel items shall be initially grit-blasted to B.S. 4232, second quality, (Sa 21/2) or by pickling in a bath and the minimum average coating weight on steel sections 5 mm thick and over shall be 900 g/m^2.

On removal from the galvanizing bath, the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross.

Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor is achieved. care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Bolts, nuts and washers, including general grade high-tensile friction grip bolts shall be hot dip galvanized and subsequenty centrifuged. Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger-turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of galvanized high-tensile friction-grip bolt after the bolt has been inserted through the steelwork, must be allowed to come into contact with the mating faces of the steelwork,. A local remelting of the galvanized parts to achieve the nuts to be finger turned on the bolt is to be done as per the relevant standards.

Protected slings must be used for offloading and erection. Galvanized work which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored in accordance with relevant standards.

- Cleaning the area of any weld slag rust and other inpurities and by thorough wire brushing to give a metallic clean surface.

- application of suitable number of coats of zinc-rich paint containing more than 90 % w/w of zinc in dried film. The dry film thickness shall exceed at least 50 % the thickness of the desired galvanization. In case of application of a low melting point zinc alloy repair rod, the rods shall be in accordance with applicable codes, the thickness of the alloy shall be at least as of the desired galvanization.

The restored area is not to exceed 1 % of the galvanized surface.

Surface restoration of parts in contact with drinking water is not allowed and the quality of the galvanization is to be in accordance with relevant standards.

After fixing, bolt heads, washers and nuts shall receive two coats of zinc-rich paint. Connections between galvanized surfaces and copper, copper alloy or aluminum surfaces shall be protected by suitable preferably hydrophobe tape wrappings to the owner's approval.

7.6.23 Sprayed Metal Coatings

Corrosion protection may be also achieved by spraying of suitable metals as zinc and/or aluminium on the surfaces of structures. For special cases tin, copper, lead can be used as well. Methods of surface preparation have to conform to relevant applicable standards. A proper treatment of the surface followed by an immediate spraying is to apply to ensure adhesion of the sprayed metal. The surface has to be clean, free of impurities, rust, millscale and rough enough to have binding properties to ensure good enticulation with the sprayed layer. Suitable roughness can be achieved by blast cleaning acc. to BS 4232. Welds are to be cleaned and prepared with special care. All surfaces to be treated have to be dry and accessible.

Application of coatings, requirements for thickness, adhesion, composition of coating metals, and subsequent treatment have to conform to relevant standards.

Testing of the spray coated layer are to be carried out in accordance with relevant standards.

The contractor has to specify the type, composition and thickness of the sprayed metal and of the sealing coating acc. to relevant applicable standards including the corresponding warranties and tests if sprayed metal coating will be applied.

7.6.24 Safety of Work

All precautions connected with this type of application of corrosion protection have to be in accordance with relevant standards.

Sprayed, unfused coating of metals and metallic compounds applied by combustion gas flame, plasma arc, detonation and similar processes, and the preparation of components, spraying techniques, sealing, finishing and inspection shall be according to relevant standards.

The hot galvanized surface has to be cleaned before the application of the coats to remove corrosion products, dirt, dust, grease.

The cleaning can be achieved by

- brush off
- washing with 1 - 1.5 % ammonia water with up to 0.1 % detergent added and followed by wet grinding using e.g. scotch britt to turn the foam to grey color,
- steam blasting,

ANNEX - 1

PAINT SYSTEM - COASTAL AND MARINE ENVIRONMENT

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM COAT	NO. OF COATS	GENERIC TYPE	PER COAT MICRONS Dft	APPLICATION IN SHOP	APPLICATION ON SITE
1	Structural steel work, piping (oil + water), tanks outside surface, transmiss, towers, cranes, steel floors, galleries, stairways, outdoor.	upto 130°C	Sa 2½	Prime	2	P6	35	x	
							35	x	
				Intermediate	1	P7	100		x
				Finish	1	F2	50		x
						Total min. dft	**220**		
2	Structural steel work, piping, indoor and outdoor	130 to 200°C	Sa 2½	Prime	1	F9	75	x	
				Intermediate	1	F9	20		x
				Finish	2	F11	20		x
							20		x
						Total min. dft	**135**		
3	Structural steelwork, piping, uninsulated carbon steel, indoor and outdoor	200 to 400°C	Sa 3	Prime	1	F9	75	x	

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM COAT	NO. OF COATS	GENERIC TYPE	PER COAT MICRONS Dft	APPLICATION IN SHOP	APPLICATION ON SITE
				Intermediate	1	F12	20		x
				Finish	1	F12	**20** **115**		x
4	Structural steel work, piping (oil + water), tanks, indoor	upto 130°C	Sa 2½	Prime	2	P6	35 35	x x	
				Finish	1	F6	100		x
						Total min. dft	**170**		
5 (a)	Structural steel work in the battery rooms,	Ambient	Sa 3	Prime	2	P8	30 30	x x	
				Finish	2	F6	100 100		x x
						Total min. dft	**260**		
(b)	Uninsulated - equipment, tanks and piping etc.	upto 80°C	Sa 3	Prime	2	P3	35 35	x x	
				Finish	2	F6	100 100		x x
						Total min. dft	**270**		

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS	GENERIC TYPE		IN SHOP	ON SITE
6	Steel tanks inside surface (total) for oil storage	normal	Sa 2½	Prime	2	P3	35	x	
							35	x	
				Finish	2	F6	100		x
							100		x
						Total min. dft	**270**		
7	Steel tanks inside surface (total) for water storage (potable and distilled water)	normal	Sa 2½	Prime	2	P2	50	x	
							50	x	
				Finish	2	F3	30		x
							30		x
						Total min. dft	**160**		
8	Cast iron water pipe lines-outside surface, buried in the soil	upto 60°C	Sa 3	Prime	2	P8	30	x	
							30	x	
				Finish	3	F7	125		x
							125		x
							125		x
						Total min. dft	**435**		
9	Steel pipes inside surface such as cooling water lines	upto 60°C	Sa 2½	Finish	4	F7	125		x
							125		x
							125		x
							125		x
						Total min. dft	**500**		

PROJECT	SUBJECT	TENDER DOC. NO.	REV	SECTION
REPUBLIC OF YEMEN PEC – ME 400 MW MARIB GTPS – II	TENDER DOCUMENT FOR ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC)	7195-GE-SPC-700-001	C	7.6 SHEET NO. 19

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS	GENERIC TYPE		IN SHOP	ON SITE
10	Water pipelines - outside surface, indoor	upto 60°C	Sa 3	Prime	2	P2	50	x	
							50	x	
				Finish	3	F3	30		x
							30		x
							30		x
						Total min. dft	**190**		
11	Oil pipelines - outside surface, above ground	upto 90°C	Sa 3	Prime	2	P3	50	x	
							50	x	
				Finish	2	F6	100		x
							100		x
						Total min. dft	**300**		

* For Details of Primer and Finish coats, refer Annex to paint systems.

6.12 Colours

6.12.1 The finish colours of components shall be those defined in the following table (preliminary), except for those components whose finishing colour has a technical or security function (heat dissipation, caution, etc). Appendix D attached also includes finish colours of miscellaneous items. In case of two different colours being specified for the same item (according to 6.12 and Appendix D) it shall be the Owner to decide which colour to apply.

COMPONENT	COLOR
Mechanical	
Sampling racks	Grey RAL 7035
Pumps	Green RAL 6002
Compressors	Blue RAL 5014
Supports	Grey RAL 7035
Valves and piping without insulation and with maximum operating temperature of 120 ºC (except for FP service)	Identification colour (6.12.2)
Tanks	Beige RAL 1001 or defined by the Purchaser
Insides of tanks to be painted (according to data sheet indications)	Light colour
Chillers and heaters	Blue RAL 5002
Cranes, hoisting equipment with their beams and rails	
Cranes	Yellow RAL 1004
Hoisting equipment and associated motors	Blue RAL 5009
Ventilation equipment (including supports and accessories)	Grey RAL 7032
Valve actuators	Grey RAL 7032
Turbine	Defined by Supplier

COMPONENT	COLOR
Stack and hot structures (without insulation)	Defined by Supplier
Hot valves without insulation	Aluminum RAL 9006
Above-ground gas piping	Yellow RAL 1021
Fire protection equipment, piping and valves	Red RAL 3000
Remaining equipment	Grey RAL 7035
Mechanical equipment structures and foundations	Grey RAL 7035 or as supported equipment
Electrical	
Main control room panels and cabinets	Beige RAL 1015
Electronics, energy and communications room panels and cabinets	Light beige RAL 1015
Auxiliary transformer earthing resistance cabinet	Light beige RAL 1015
Cabinets (switchgear, power centers, MCC, lighting and direct service centers, emergency centre, dc, UPS)	Light beige RAL 1015
Local panels and cabinets	Light beige RAL 1015
Motors	Blue RAL 5010
Power generator	Defined by Supplier
Transformers	Grey RAL 7030
Remaining cabinets	Light beige RAL 1015
Remaining structures and electrical equipment foundations	Grey RAL 7035 or as supported equipment
Civil	
Metallic structures	Grey RAL 7035
Handrails (except for galvanized ones)	Grey RAL 7035
Instrumentation	

GREEN BELT PROJECT, ARRANGED BY UTE MAUCKERT W725 / H. G. MEIER W721 / R. LUCÉ W721

UMA STEAM TURBINE BUILDING
("A" ONLY VALID FOR UMA)

UMB GAS TURBINE BUILDING
("B" ONLY VALID FOR UMB)

DADO WALL (SOLID CONSTRUCTION)		RAL	1001	BEIGE
IF BRICKWORK				RED BROWN
WALL CLADDING (TRAPEZOIDAL METAL SHEETS)		RAL	1013	OYSTER WHITE
ROOF CLADDING (TRAPEZOIDAL METAL SHEETS)		RAL	9010	PURE WHITE
GUTTER		RAL	9010	PURE WHITE
RAINWATER DOWN PIPES		RAL	1013	OYSTER WHITE
LOUVERS IN WALL CLADDING		RAL	1013	OYSTER WHITE
LOUVERS IN DADO WALL		RAL	1001	BEIGE
STEEL DOORS		RAL	1017	SAFFRON YELLOW
ROLLER SHUTTER; SLIDING DOORS		RAL	1017	SAFFRON YELLOW
AIR INTAKE FILTER HOUSE	"B"	RAL	5018	TURQUOISE BLUE
STEEL DOORS IN AIR INTAKE FILTER HOUSE	"B"	RAL	5018	TURQUOISE BLUE
STEEL STAIRS				GALVANIZED
STEEL PLATFORMS				GALVANIZED
HAND RAILS				GALVANIZED
GRATINGS				GALVANIZED
CAT LADDERS				GALVANIZED
MAIN STEEL STRUCTURE		RAL	5007	BRILLANT BLUE
INTERNAL STEEL STRUCTURE		RAL	5007	BRILLANT BLUE
INTERNAL WALLS		RAL	9002	GREY WHITE
INTERNAL CEILINGS		RAL	9010	PURE WHITE
INTERNAL FLOORS		RAL	7023	CONCRETE GREY
CRANES		RAL	1017	SAFFRON YELLOW
AIR DUCTS GABLE END OF TURBINE BUILDING		RAL	7035	LIGHT GREY

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GT PURGE PACKAGE	"B"	RAL	6010		GRASS GREEN
GT NOx-WATER PACKAGE	"B"	RAL	6010		GRASS GREEN
AIR INTAKE DUCTS GASTURBINE (INSIDE)	"B"				GALVANIZED
ST (SOUND ENCLOSURE)	"A"				GALVANIZED
ST CASING (INCLUSIVE COMPONENTS)	"A"	RAL	7030		STONE GREY
ST OIL SUPPLY UNIT	"A"	RAL	8001		OCHER BROWN
CONDENSER COVERINGS AND COMPONENTS		RAL	6010		GRASS GREEN
GENERATOR (FROM MÜLHEIM AND CHARLOTTE)		RAL	1017		SAFFRON YELLOW
GENERATOR (FROM ERFURT)		RAL	7030		STONE GREY
VENTILATION SYSTEM (INCL. AIR DUCTS)					GALVANIZED
GENERAL					
GALVANIZED STEEL (IF OTHERWISE REQUIRED USE COLOUR OF MAIN STEEL STRUCTURE)					WITHOUT PAINTING
STAINLESS STEEL					WITHOUT PAINTING
ALUMINIUM AND PLASTICS					WITHOUT PAINTING
TANKS		RAL	7035		LIGHT GREY
COMPONENTS WITH FINAL FINISH					DEPENDS ON SUPPLIER
FIRE PROTECTION SYSTEM (GENERAL)		RAL	3000		FLAME RED
PIPING FOR PROCESS SERVICES, EXTERIOR AND INTERIOR		RAL	7035		LIGHT GREY
HV-TRANSFORMERS		RAL	7032		PEBBLE GREY
LV-TRANSFORMER HOUSING		RAL	7032		PEBBLE GREY
PCC CONTAINER	"B"	RAL	1015		LIGHT IVORY
MV/LV SWITCHGEARS		RAL	7032		PEBBLE GREY
HV/LV MOTORS; ACC. MANUFACTURER STANDARD					
ELECRICAL / CONTROL ENCLOSURES; MANUFACTURER STANDARD; PEEFERABLY	ACC.	RAL	7032		PEBBLE GREY
GENERATOR BUS DUCTS		RAL	9010		PURE WHITE

1. General

This standard specifies the colours and methods for the identification of pipelines according to the medium.

2. Siemens PG Standard

The Siemens /PG Standard is based on DIN 2403 (1984).

The media through pipelines are divided into groups in accordance with their general properties, and their basic identification colours are given in following table:

Pipe contents	Group	Colour Name according DIN 2403	Nearest colour sample in accordance with RAL 840 HR
Water	1	Green	RAL 6018
Steam	2	Red	RAL 3000
Air	3	Grey	RAL 7001
Combustible gases	4	Yellow with auxiliary red	RAL 1021 with RAL 3000
Non-Combustible gases	5	Yellow with auxiliary black	RAL 1021 with RAL 9005
Acids	6	Orange	RAL 2003
Alkalis	7	Violet	RAL 4001
Combustible liquids	8	Brown with auxiliary red	RAL 8001 with RAL 3000
Non-Combustible liquids	9	Brown with auxiliary black	RAL 8001 with RAL 9005
Oxygen	0	Blue	RAL 5015

Table 1: Basic identification colours acc. DIN 2403

Pipes will be painted in uniform colour RAL7035 light grey. Identification colour will be applied by "colour banding".

Hot galvanized, austenitic, plastic, non-ferrous and insulated pipes: identification colour applied by colour banding;

Pipes for fire fighting:
identification colour applied by colour banding;

2.1. Pipes painted according PG-standard Ral 7035 light grey

Identification rings (adhesive foil) in the group colour shall be applied at important workpoints (e.g.: at both sides of each valve, at all junctions, wall penetrations, etc.) over a length of 150 mm. For the groups 4, 5, 8, and 9 additional colour rings are required. The distance between two identification rings should be max. 10 m inside of a building and 100 m for pipe runs.

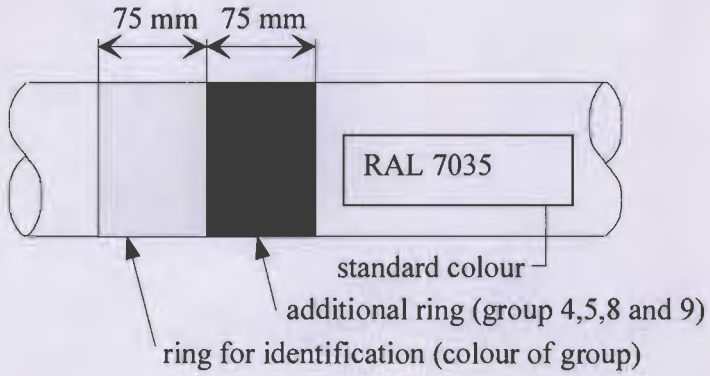


Figure 1: Application of identification rings
(e.g.: combustible gases - identification ring: yellow; additional ring: red)

2.2. Hot galvanized, austenitic, plastic, non-ferrous metals and insulated pipes

The Identifikation of galvanized, plastic, austenitic and non-ferrous metals as well as insulated pipes shall be applied with identification rings (adhesive foil) over a length of 150 mm at important workpoints (e.g.: at both sides of each valve, at all junctions, wall penetrations, and on both side of barriers etc.). For the groups 4, 5, 8 and 9 additional colour rings are required (also adhesive foil). The distance between two identification rings should be max. 10 m inside of a building and 100 m for pipe runs.

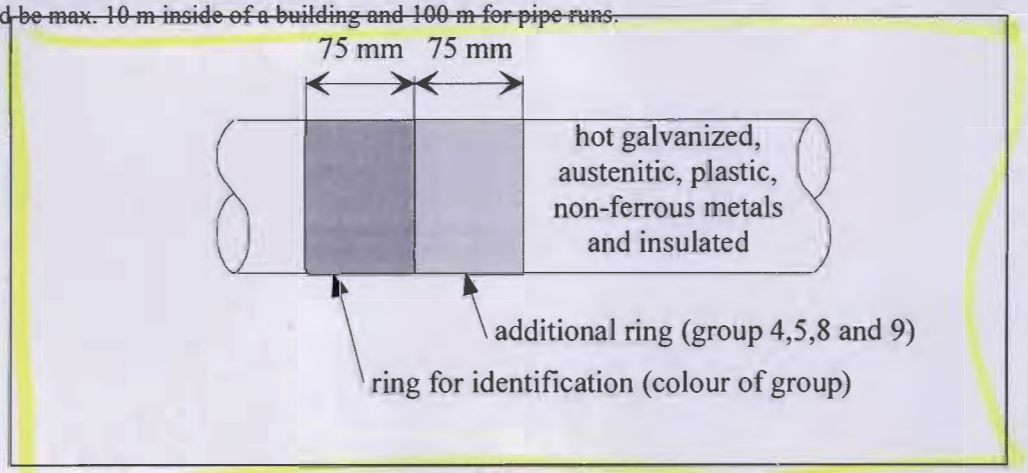


Figure 2: Application of identification rings

2.3. Pipes for Fire fighting

Galvanized pipes for fire fighting have to be marked with red tapes (RAL 3000) at important workpoints (e.g.: at both sides of each valve, at all junctions, wall penetrations, etc.). To avoid confusions with pipes for steam, an additional white tape with the letter F in the colour of the fire extinguishing agent (e.g. green for water or red for steam) is to be put up.

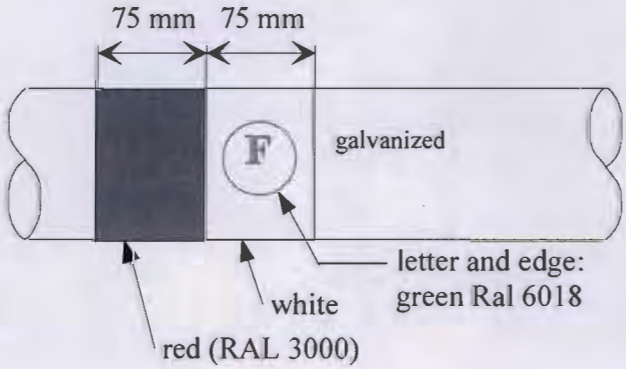


Figure 3: Application of fire fighting identification rings (using steam as fire fighting agent)

VOLUME IIB

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS

SPECIFICATION NO. PE-TS-888-100-A001

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI, INDIA

1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

2.0 SCOPE

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.

3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

4.0 Definitions

"BHEL" : Main EPC vendor

"OWNER" : Customer for a particular export project.

"VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.

"GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.

"PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .

"FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

5. General Information

The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves VENDOR of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support GOODS during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the GOODS to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the GOODS during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When VENDOR do not have packing capabilities/facilities of their own and therefore intends to sub-contract, VENDOR have to inform BHEL/Purchaser of the name and address of proposed PACKER(s) for approval.

6.0 Criteria for Selection of Packaging

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the GOODS have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If VENDOR has any doubt about the correct method of protection or packing, he should contact BHEL/Purchaser in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
-

Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

6.1 Hazardous Materials

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

6.2 Non-Hazardous GOODS

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

7. 0 Marking Instructions & Despatch details, Storage Code

7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- **"KEEP DRY"**

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.

The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.

7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour.**

X Crates or packages to be stored outdoor without covers
XX Crates or packages to be stored under tarpaulin
XXX Crates or packages to be stored in covered or enclosed premises
XXXX Crates or packages which must be stored in air-conditioned premises

8.0 GUIDELINES FOR PACKING GOODS

8.1 In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

IMPORTANT NOTE:
Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.

8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.
All pipes **2"** included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.

All SS pipes to be packed separately in crates irrespective of the pipe size.

All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

8.1.4 Structural Steel

Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

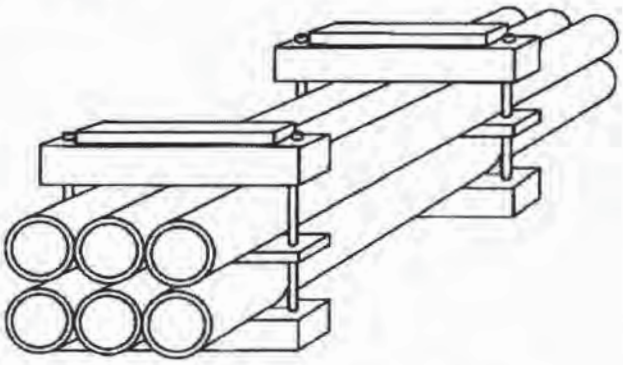
8.2 Bundling – Packing Category I

8.2.1 Type of Equipment

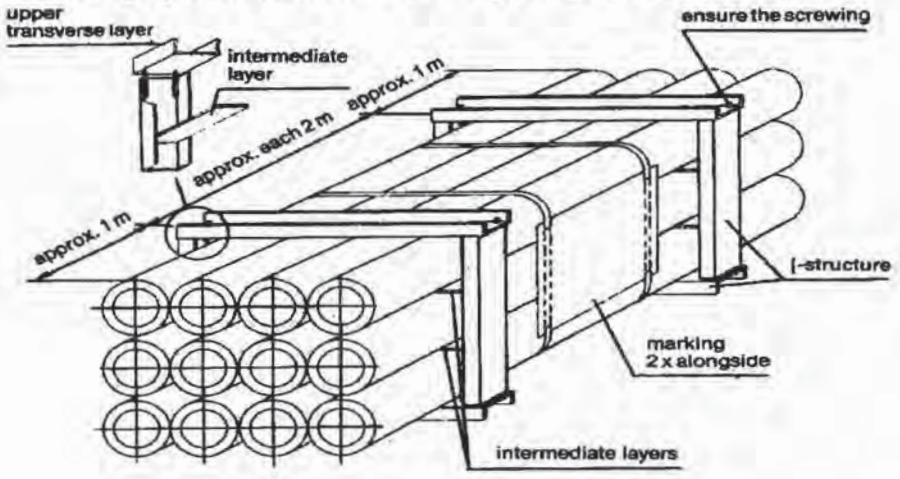
All SS pipes to be packed separately in crates irrespective of the pipe size.

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.

Packing category I



Bundling by U-shaped iron – packing category I A



8.2.2 Type of Construction

Bundling has to be effected

- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

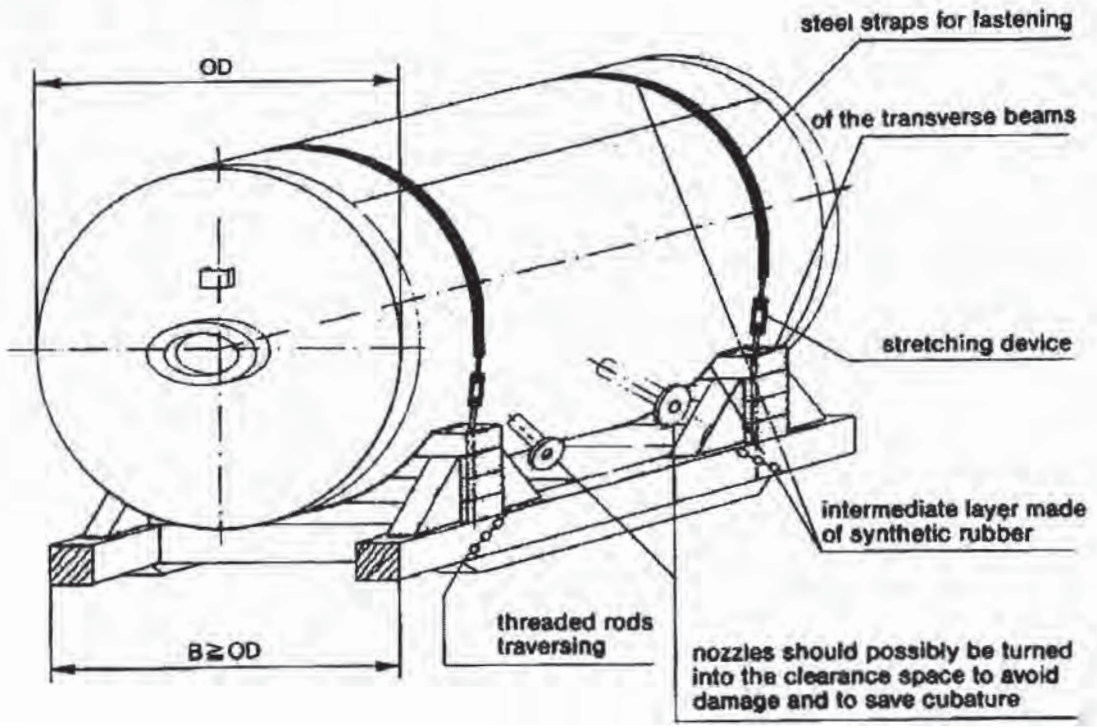
8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.

8.4.1 Packing Category III

8.4.1.1 Type of Equipment

All SS pipes to be packed separately in crates irrespective of the pipe size.

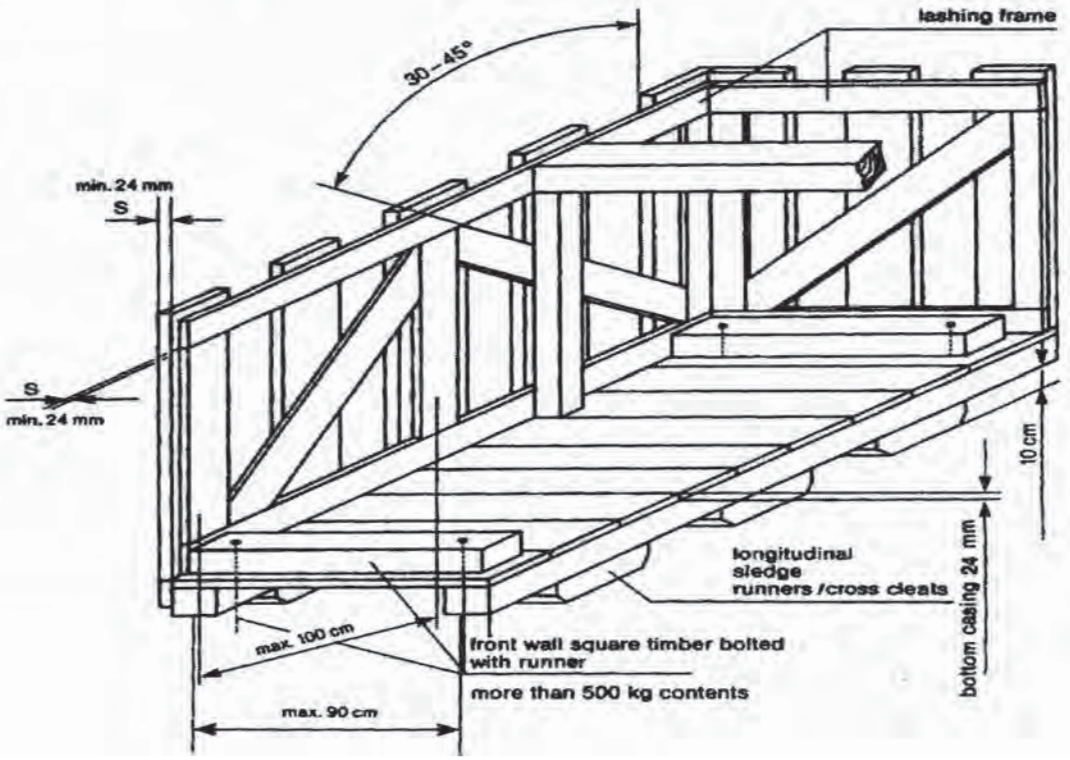
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

Packing Category III



8.4.2 Cases with Lining – Packing Category IV

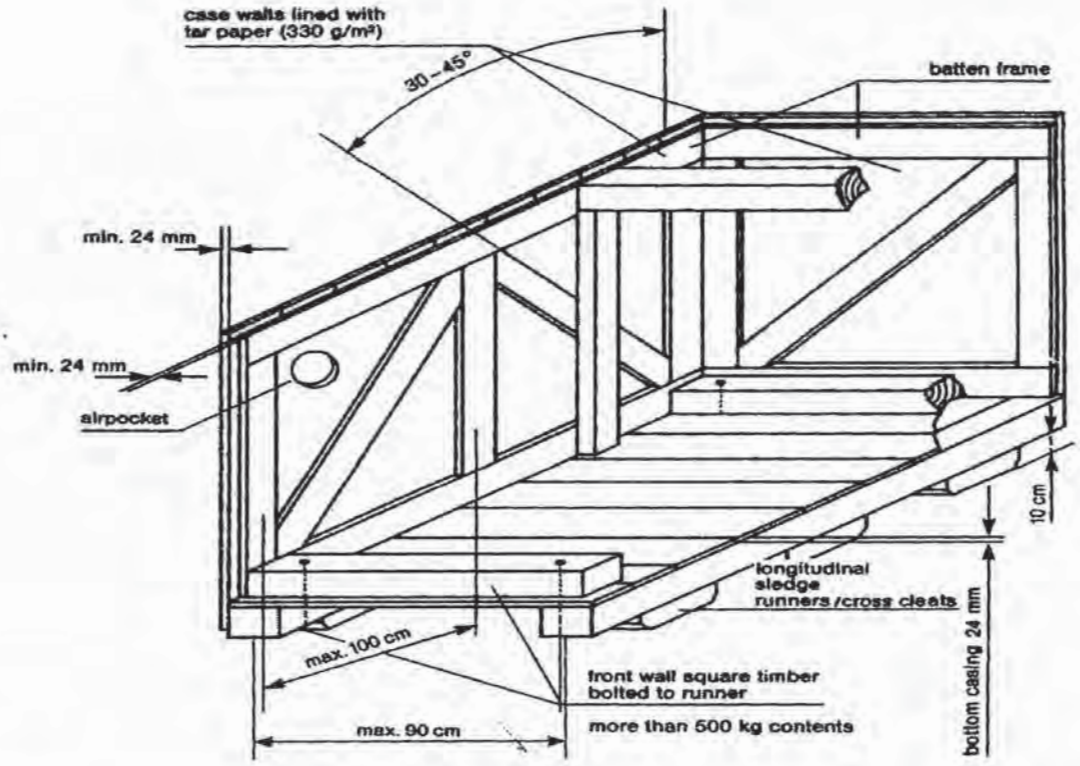
8.4.2.1 Type of Equipment

Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.

8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

Packing Category IV



8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A

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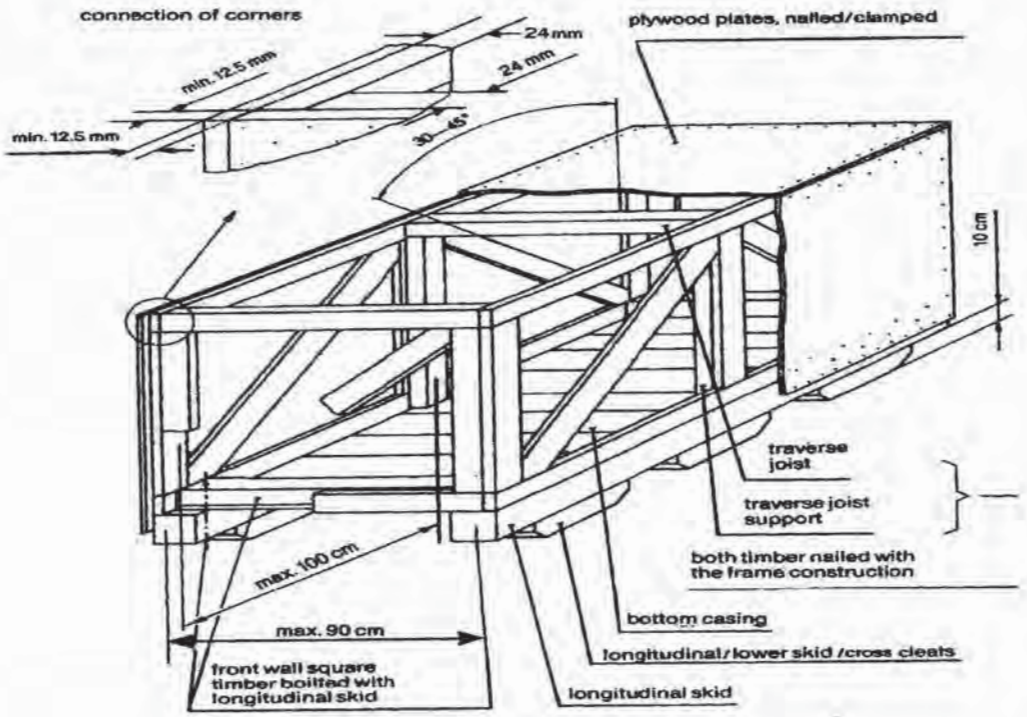


Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

8.4.4.2 Type of Construction

Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.
Additional marking:

- Case with desiccants.

8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

8.4.5.1 Type of Equipment

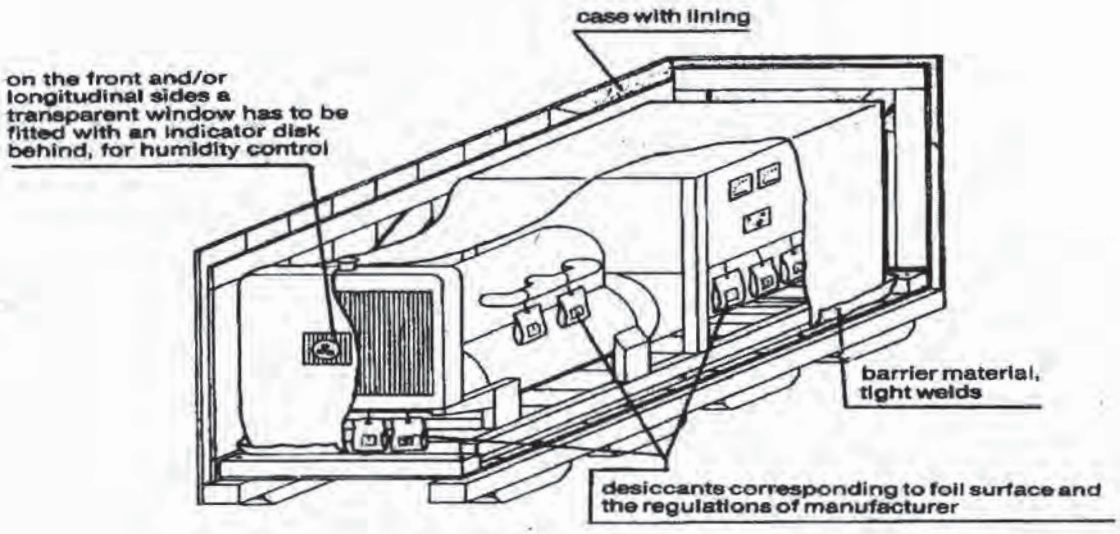
Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:
- Case with desiccants.

Packing Category V/VI



8.4.6 Double Case – Packing Category VII

8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

8.4.7 Cable Drum – Packing Category VIII

8.4.7.1 Type of Equipment

All type of cables, wires, ropes, hoses.

8.4.7.2 Type of Construction

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/ protected cable ends prior to packing.

8.4.8 Hazardous Materials – Packing Category IX

8.4.8.1 Type of Equipment

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

8.4.8.2 Type of Construction

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

8.4.9 Wooden Floor as a Transport Support – Packing Category X

8.4.9.1 Type of Equipment

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

8.4.9.2 Type of Construction

- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

8.5 Air Transport Packing

8.5.1 General

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.

8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
- Wooden/cardboard packing cases.
- Plywood cases.

Are to be adapted to pallets used for air transportation.

9.0 Detailed specification for Wooden Crates/Boxes/Cases and other packing materials

9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, crakes, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

9.2 Chemical Treatment of Wood:

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

9.3.1.1 Bottom Frame

The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

9.3.1.2 **TOP FRAME**

The construction of top frame shall be as per fig-3.

9.3.1.3 **END PANELS**

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

9.3.1.4 **Sling Plate**

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

9.3.1.5 **Angle Iron Cleats**

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

9.3.1.6 **Other Requirements**

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length I.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.

- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.

- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.

- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.

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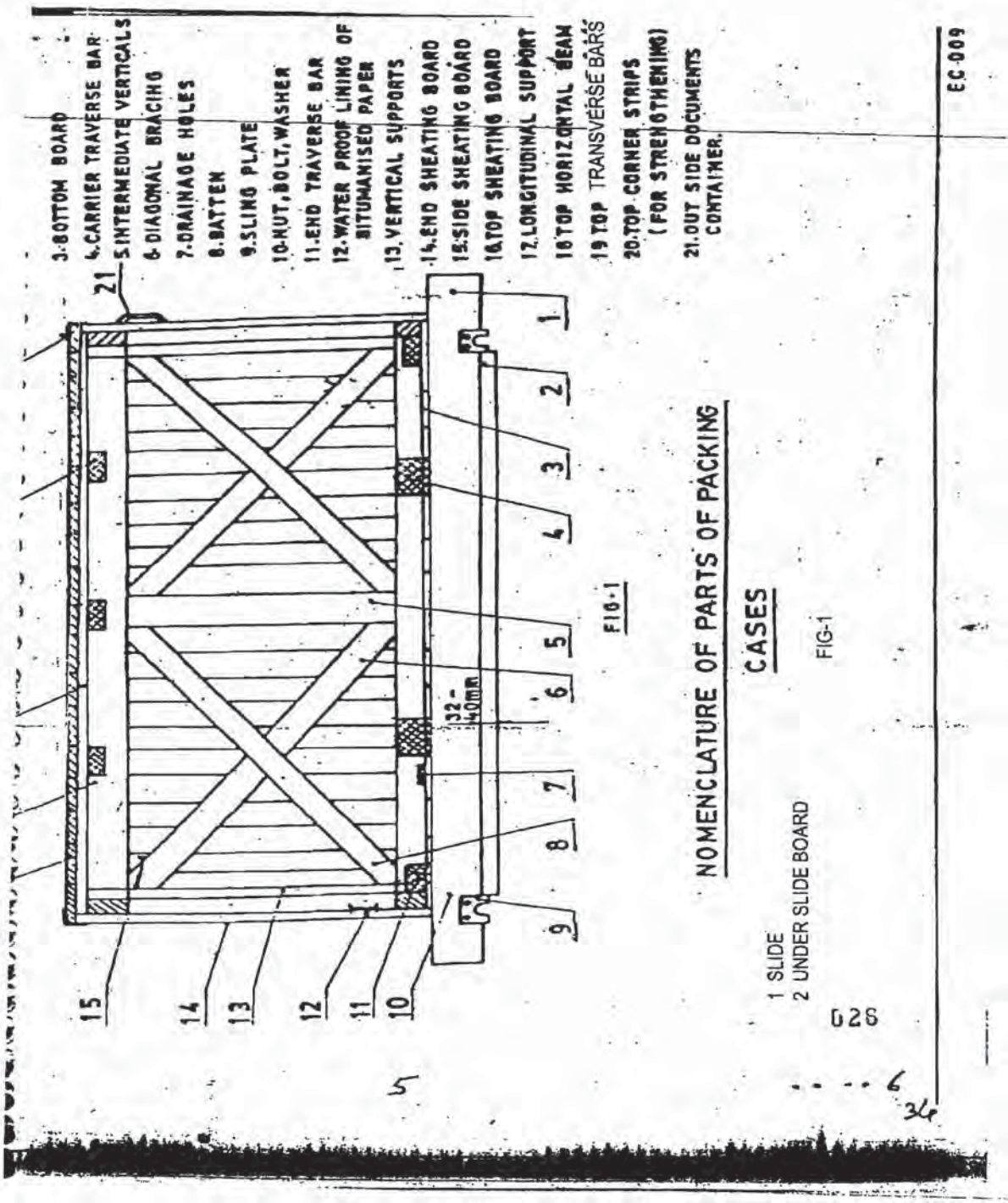

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BOTTOM FRAME ARRANGEMENTS

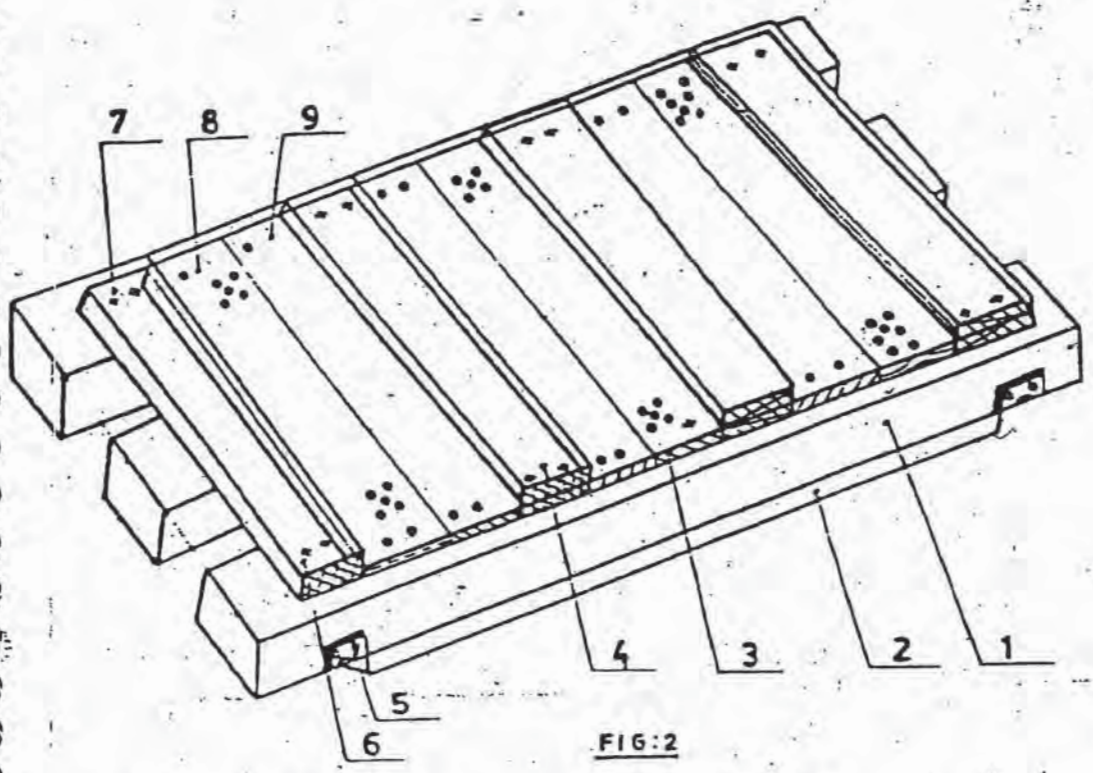

FIG:2

Nos. of slides : Minimum 2 Nos.
For length more than 1800 mm or load more than 1000kg, Nos. of slides shall be minimum 3 Nos.
For dimensions of slides, refer Table 1
Cross section of end traverse bolt; 100 X 100 mm. (minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TAVERSE BAR
5. SLING PLATE
6. END TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

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TOP FRAME ARRANGEMENT

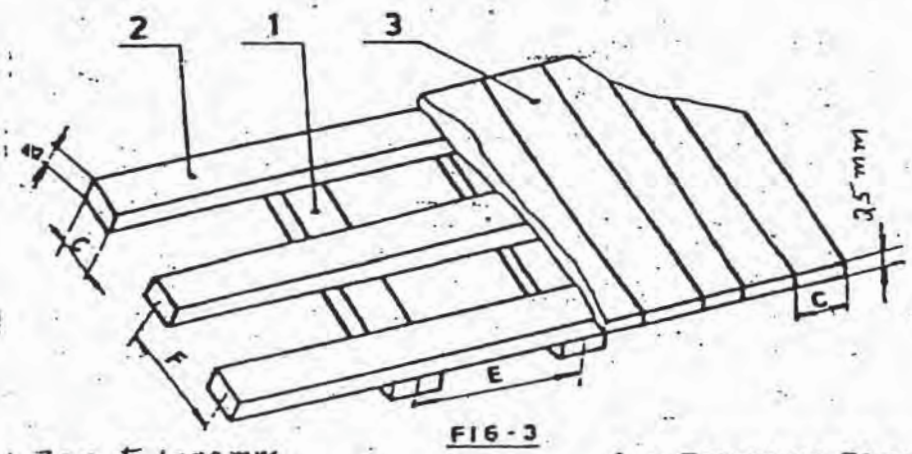
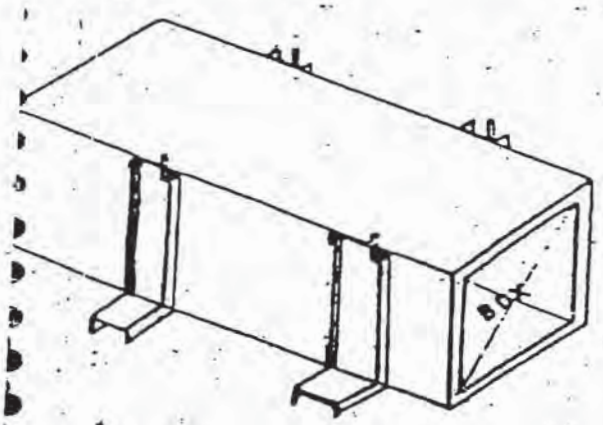


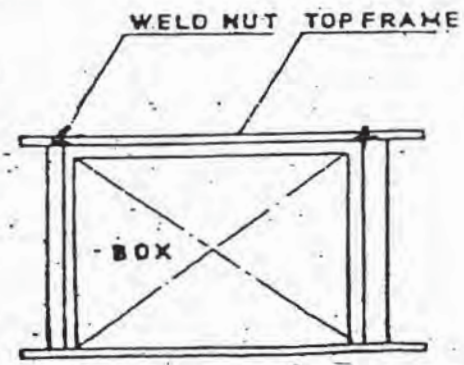
FIG-3

F : 700 t 1000 mm
E : 500 t 900 mm
: 30×100 mm.

1 – Treverse Bars
2 – Horizontal Beams
3 – Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES





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ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

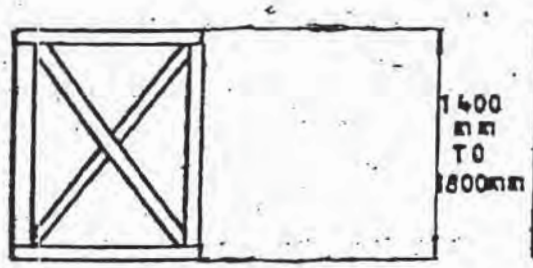


FIG: 6

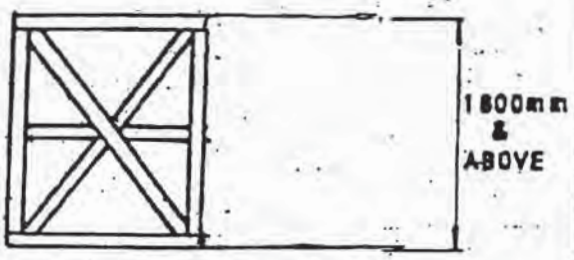


FIG: 8

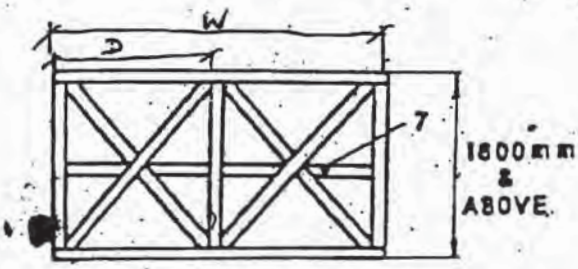


FIG: 9

7- Middle Horizontal Support

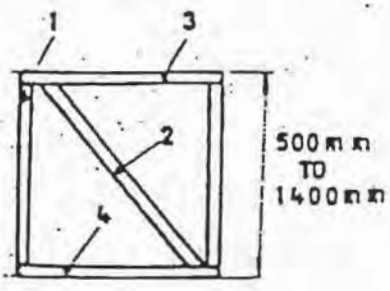


FIG: 5

1- Vertical Support

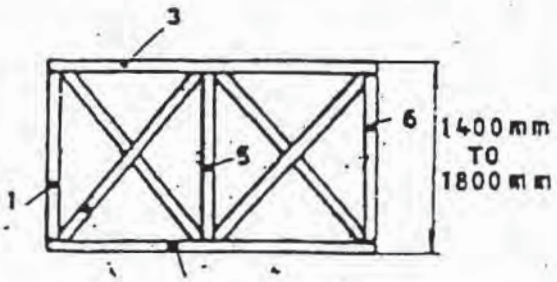
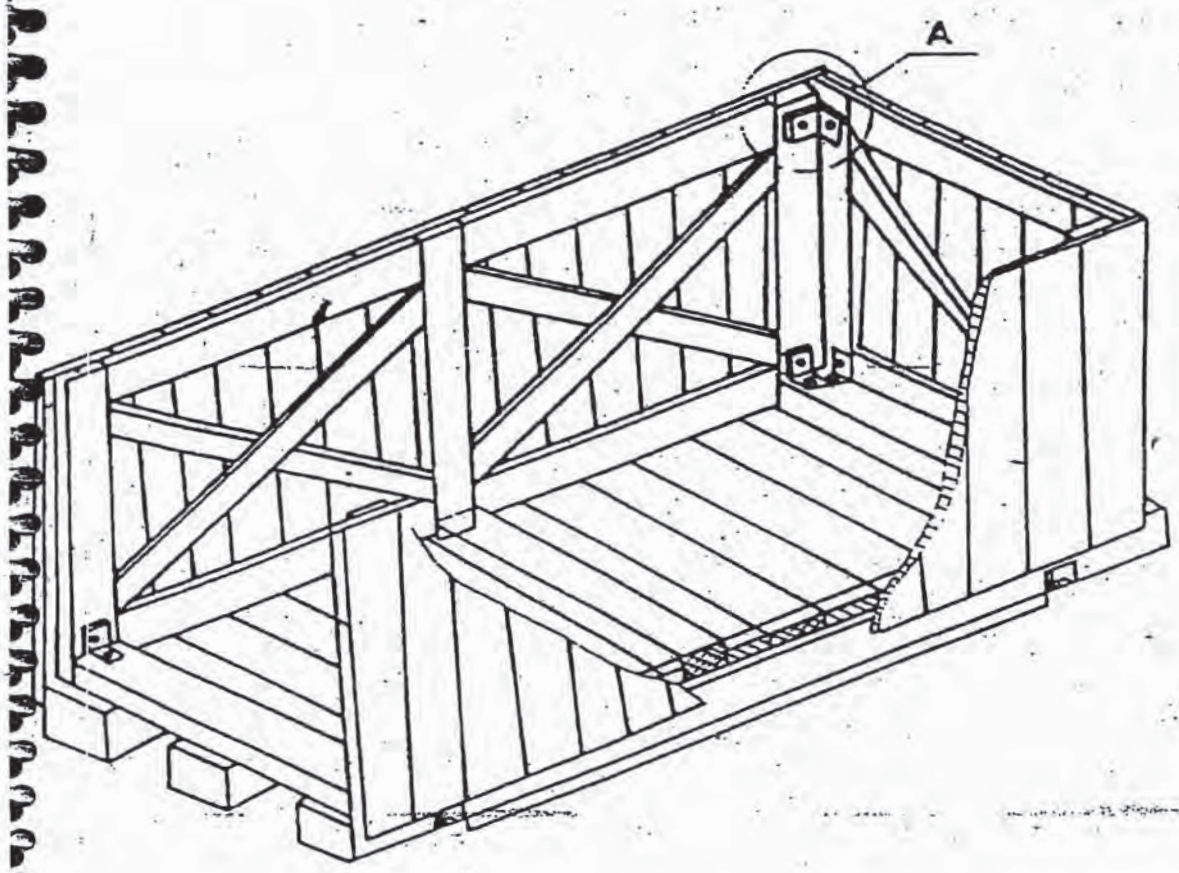


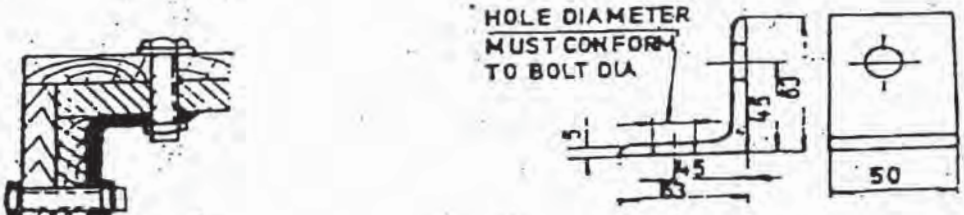
FIG: 7

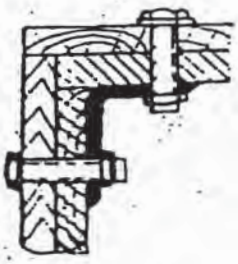
1, 5, 6 - Vertical Support

029

ARRANGEMENT OF PACKING CASE







DETAIL-A

FIG:10

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ARRANGEMENT OF SLING PLATE ON CASES

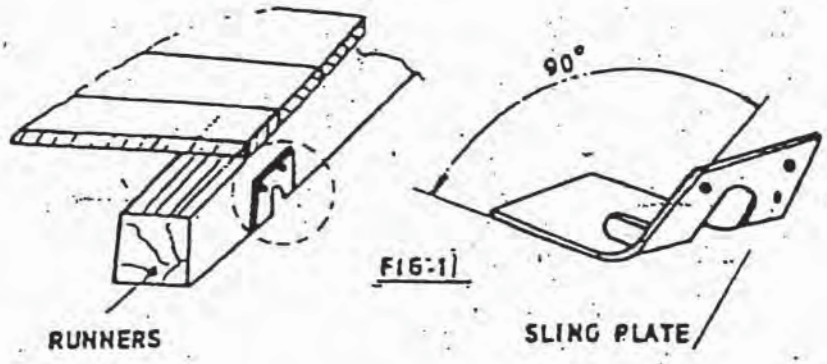

FIG:1

031

TABLE-1

LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c				b x c		
500	50 X 100	50 X 100	50 X 100	50 X 100	75 X 100	75 X 100	100 X 100
800	50 X 100	50 X 100	75 X 100	75 X 100	75 X 100	75 X 100	100 X 100
1000	75 X 100	75 X 100	75 X 100	100 X 100	100 X 100	100 X 110	100 X 150
1500	75 X 100	75 X 100	100 X 100	100 X 100	100 X 100	100 X 150	100 X 150
2000	75 X 100	100 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150
2500	75 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150	150 X 150
3000	100 X 100	100 X 150	150 X 150	150 X 150	150 X 150	150 X 150	150 X 150

Table-2

End and side panels	Width of the panel "W"	Distance between longitudinal support (Dimension "D")						
		600	800	1000	1200	1400	1600	1800
		Cross section b x c				Item 1 to 7		
Fig- 5 to Fig-9	600 to 1200	30 X 100	30 X 100	30 X 100	30 X 130	30 X 130	30 X 130	30 X 130
	1201 to 1600	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130
	1601 to 2000	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130
	2001 to 3000	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	40 X 150
	3001 to 4000	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150

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INDICATION MARKS ON CASES/BOXES/CRATES

Designation	Symbol	Explanation
Fragile, Handle with care		The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.
Use no hooks		Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.
Top		The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.
Keep away from heat (solar radiation)		Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.
Protect from heat and radioactive sources		Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.
Sling here		The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side.
Keep dry		Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.

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Center of gravity		This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.
No hand truck here		The absence of this symbol on packages amounts to permission to use a hand truck on them.
Stacking limitation		The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.
Clamp here		Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.
Temperature limitations		According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note.
Do not use forklift truck here		This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.
Electrostatic sensitive device		Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.

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Do not destroy barrier		A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants".
Tear off here		This symbol is intended only for the receiver.

FIG-12

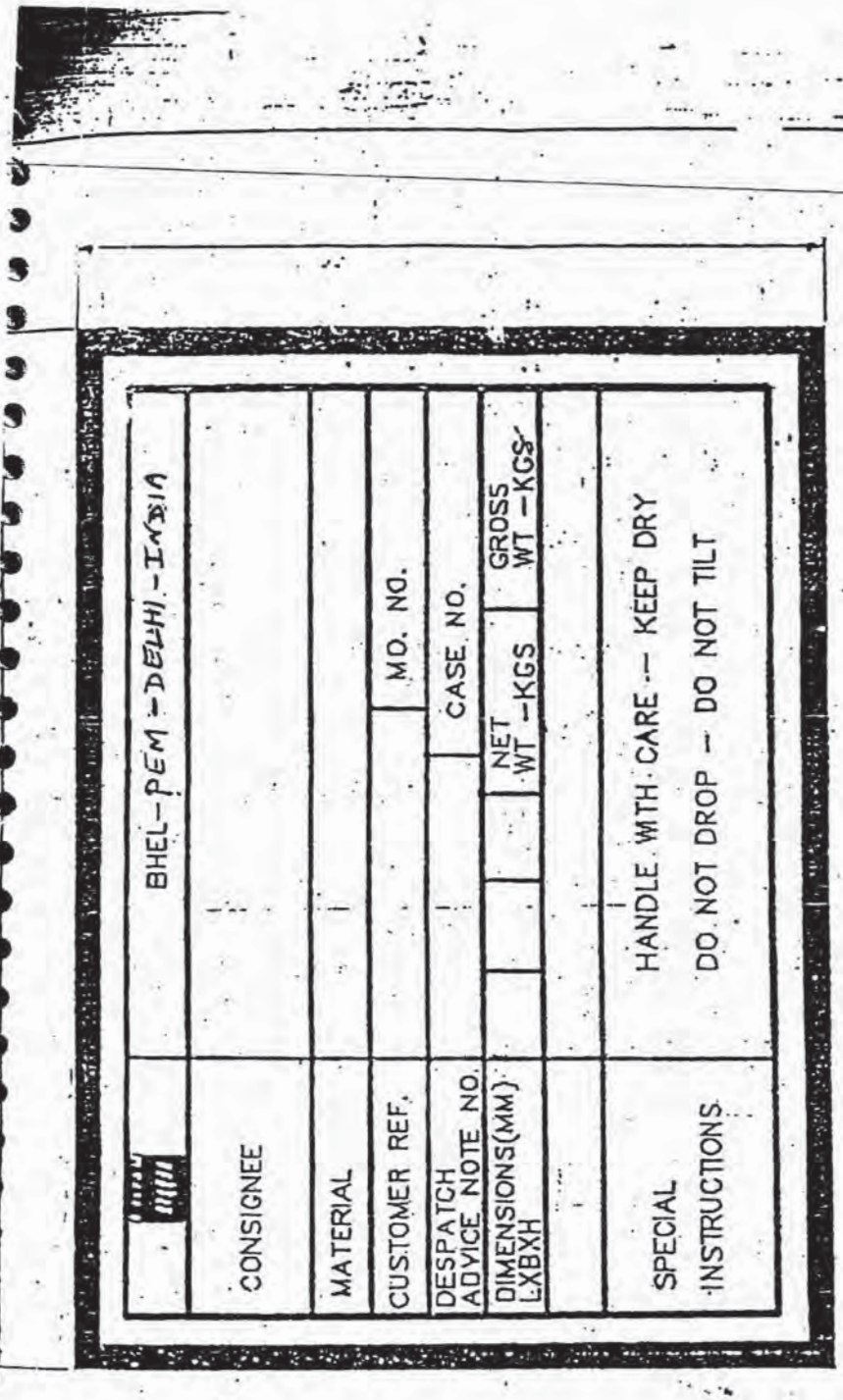
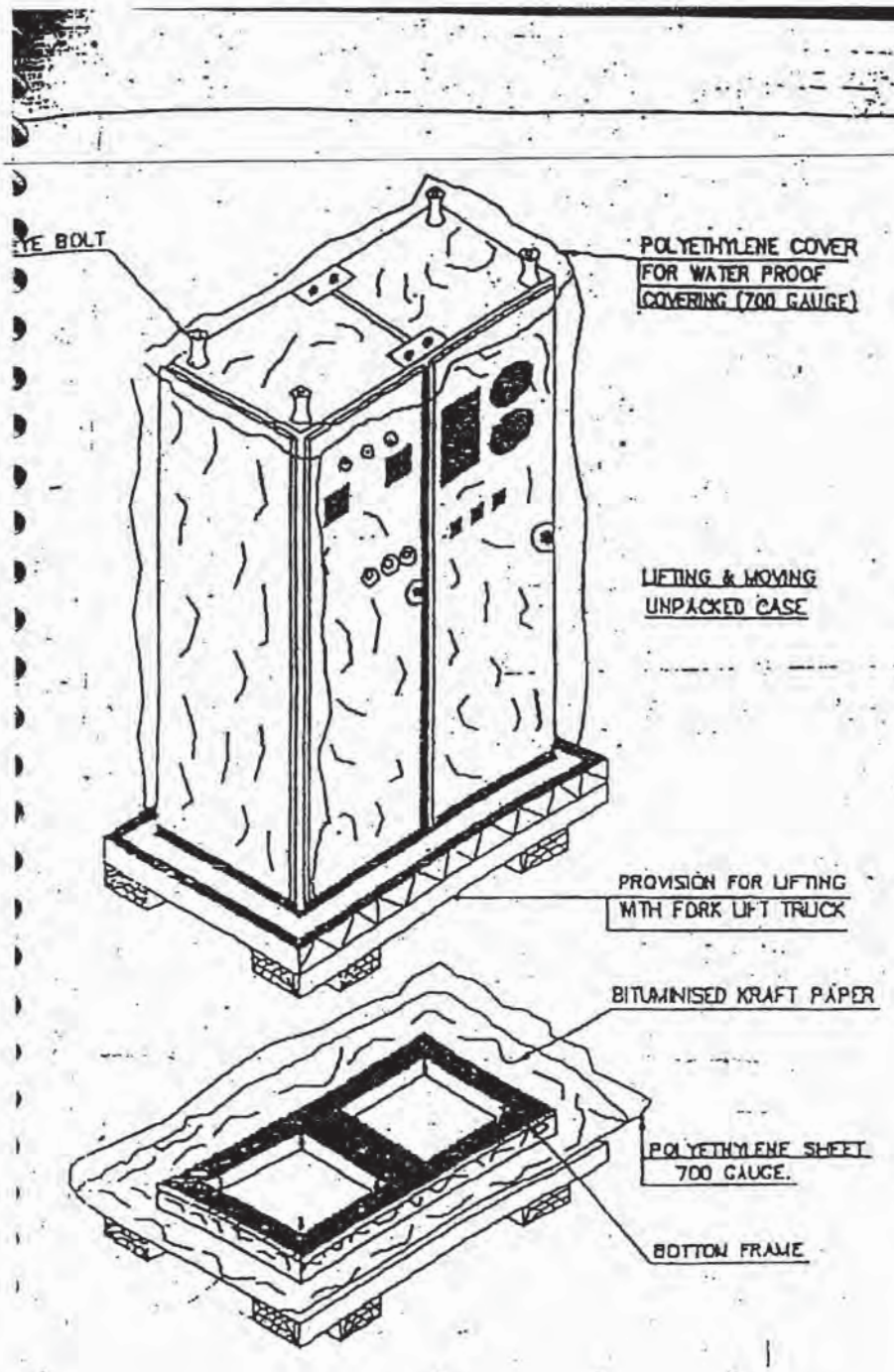


FIG-13: MARKING PLATE



FIGURE–14

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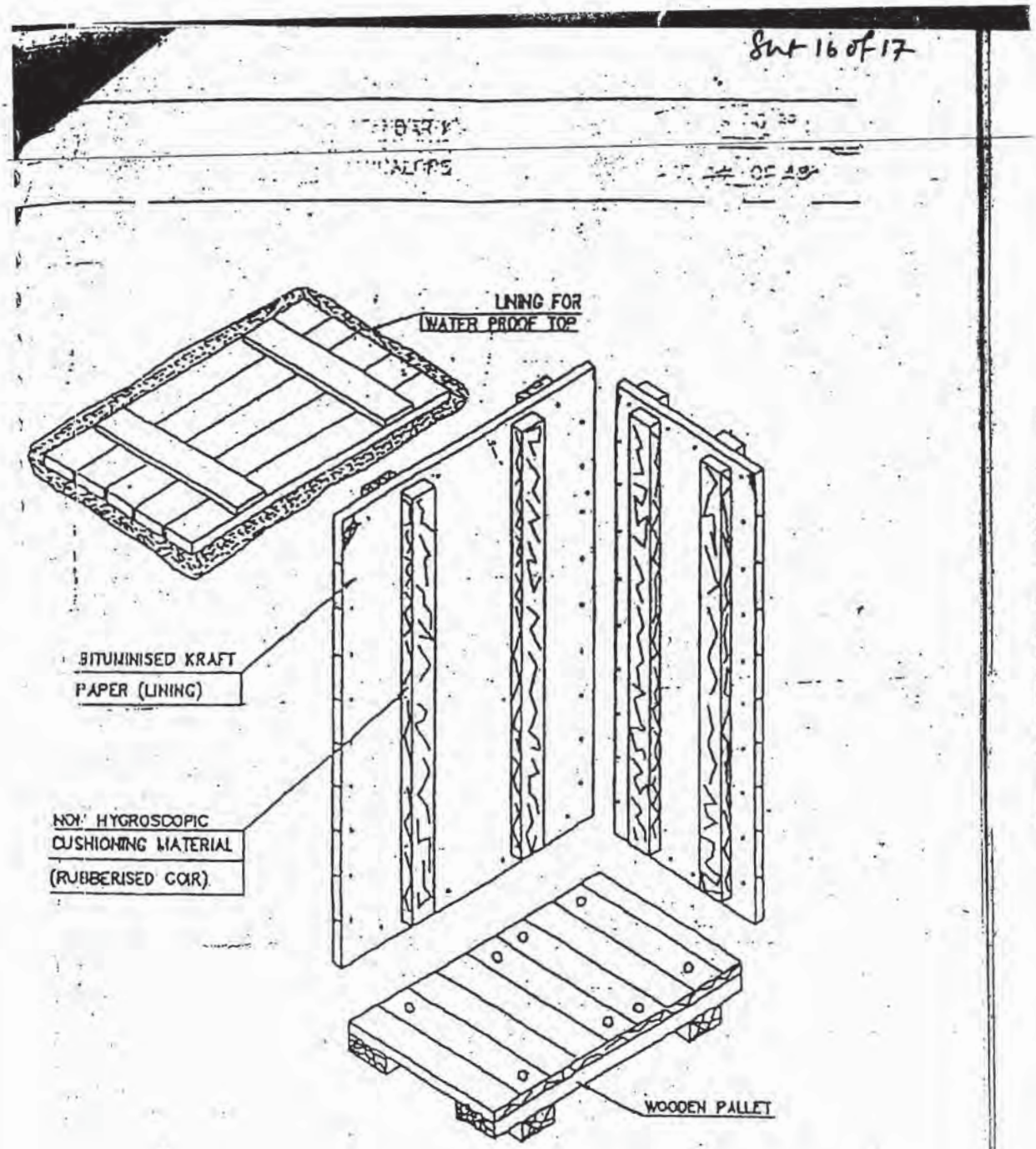

FIGURE-15

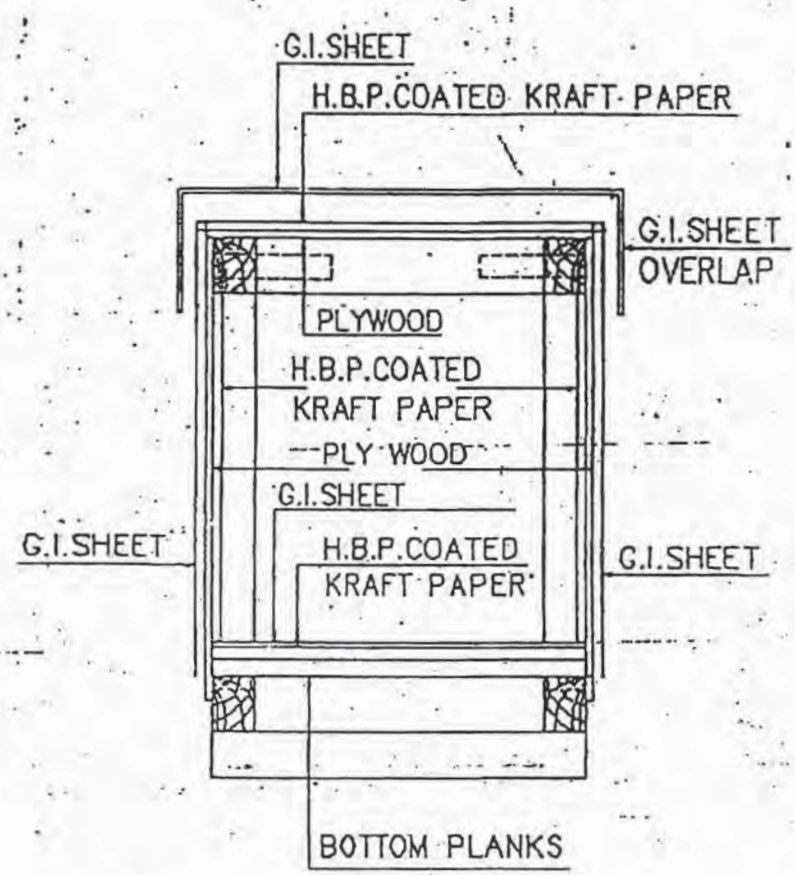

FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET SHOWING LAYERS OF PACKING MATERIALS.

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10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

a) Project Name
b) Purchase Order No.
c) Sl. No. of package
d) Size of mattress (Thickness x Length x Width)
e) Density
f) Wire netting material and size
g) Weight of the package

10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

10.2.1 Type of construction for Eye to Sky packaging

a. Strapping of coil with polyester strap around circumference at one place.

b. Putting paper I. D. Edge protector.

c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.

d. Wrapping the coil with HDPE film.

e. Covering the coil including its build up & bore with masonite / particle board.

f. Putting metallic I. D on coil.

g. Putting O.D edge protector (paper) on coil.

h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).

i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.

j. Coil is to be tilted to eye-to-sky position.

k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.

l. Fixing the coil with wooden blocks at 4 corners.

m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

10.2.2 Type of construction for Eye to Eye packaging

a. Strapping of coil with polyester strap around circumference at one place.

b. Putting paper I. D. Edge protector.

c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.

d. Wrapping the coil with HDPE film.

e. Covering the coil including its build up & bore with masonite / particle board.

f. Putting metallic I. D on coil.

g. Putting O.D edge protector (paper) on coil.

h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).

i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.

j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.

Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

10.3 Packing Procedure for Online Tube Cleaning System and accessories

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

10.3.1 Packing details:

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

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- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.

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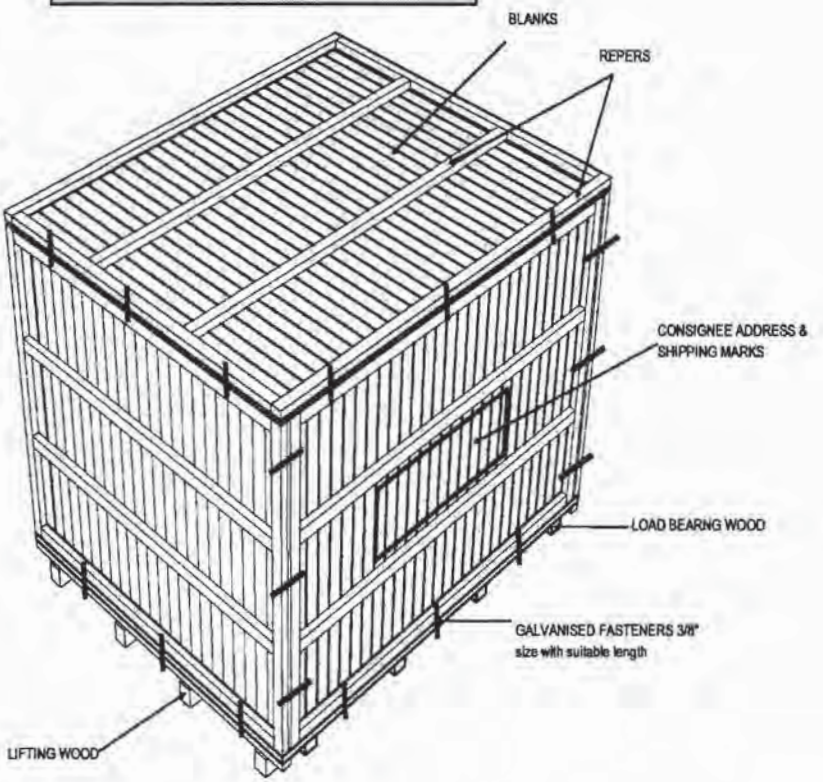
MODEL: FASTNERS TYPE (BASE, SIDE &TOP ATTACHED WITH BOLT, NUT & WASHER)

This Type of case to be used for following items:
1. BALL SEPERATOR
2. BALL COLECTOR SKID



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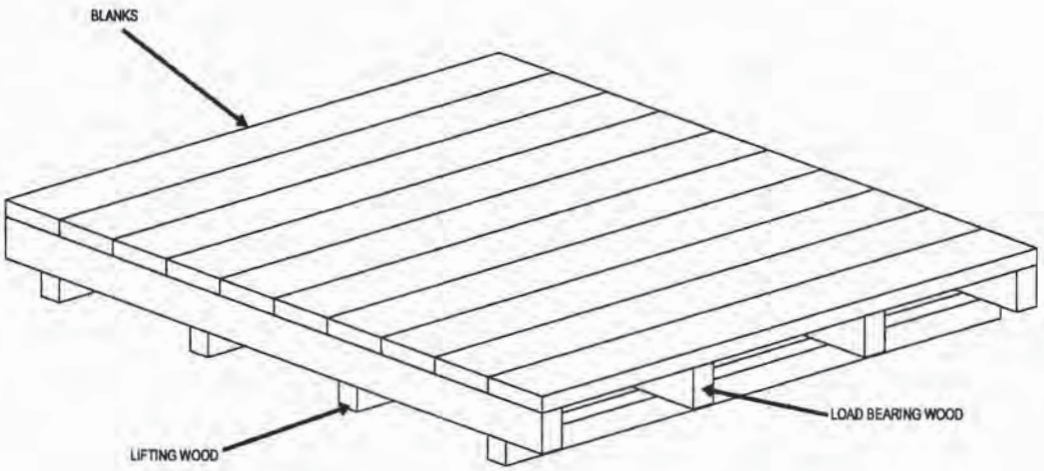
BASE FRAME



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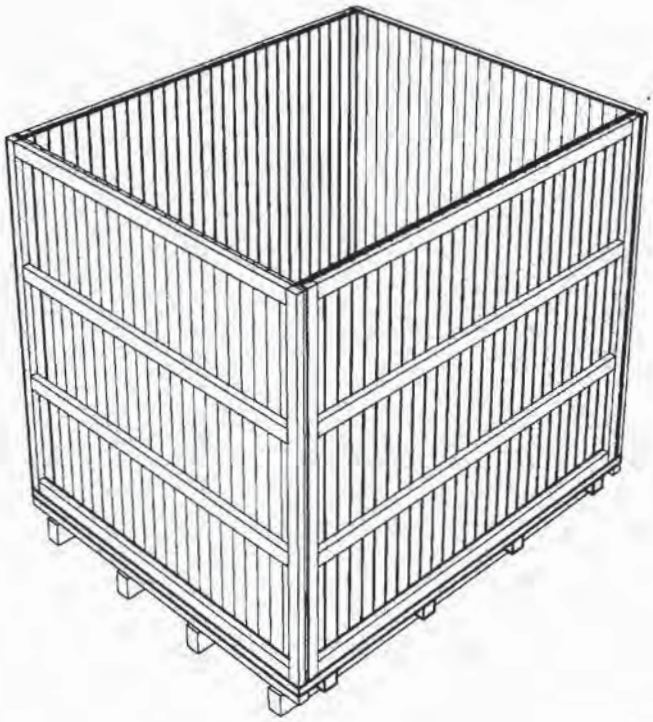
MODEL: FASTNERS TYPE - WITHOUT TOP



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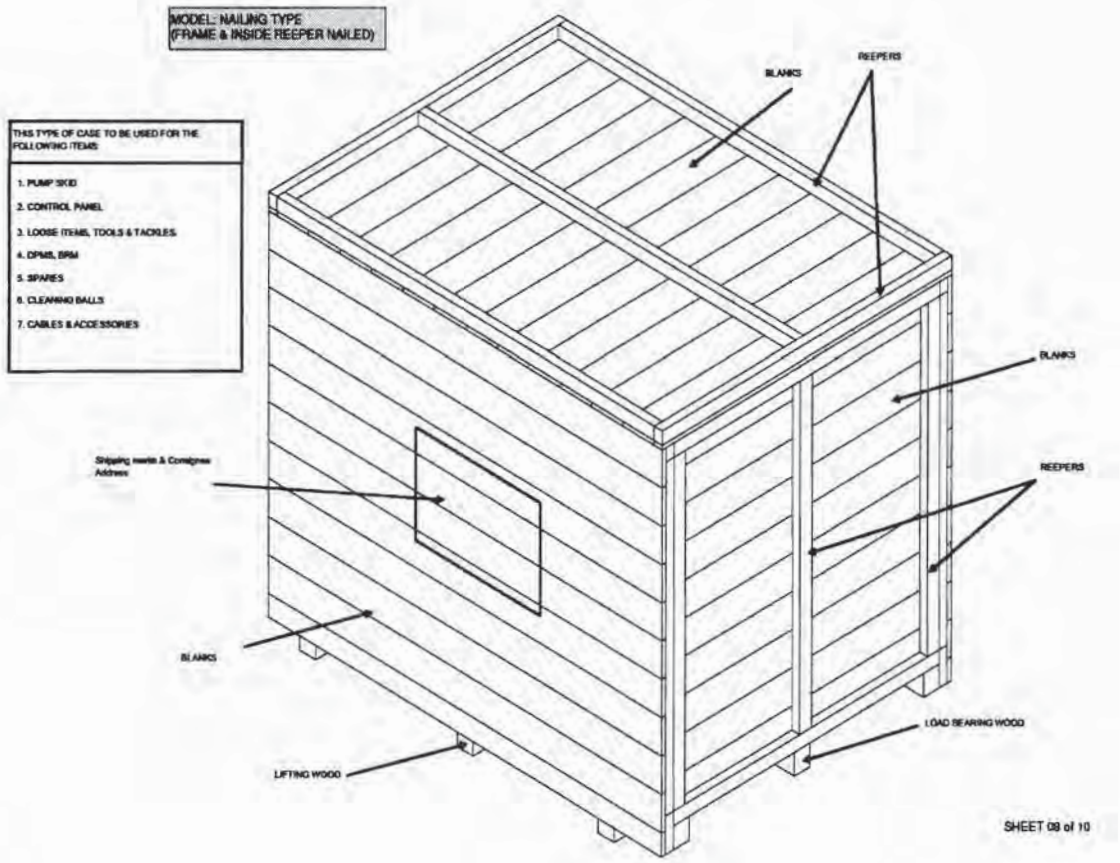

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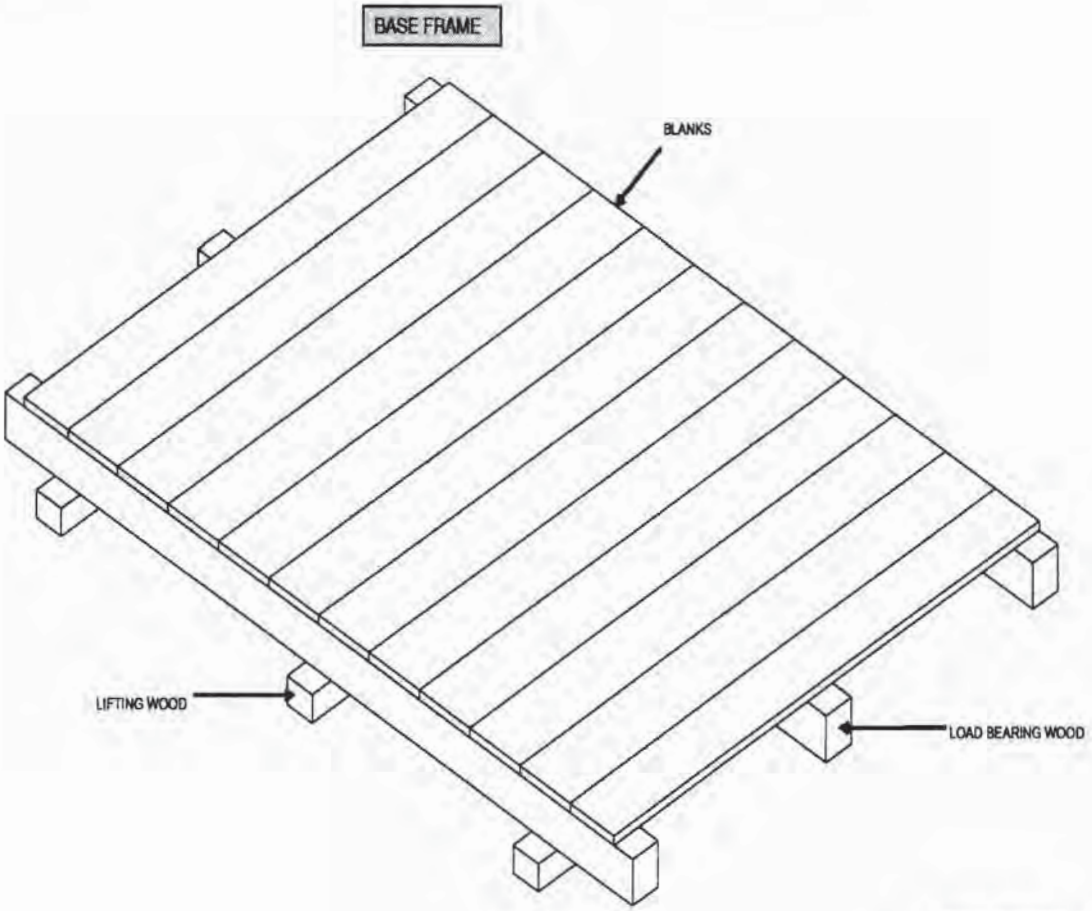

	TITLE	SPECIFICATION NO. **PE-TS-888-100-A001**
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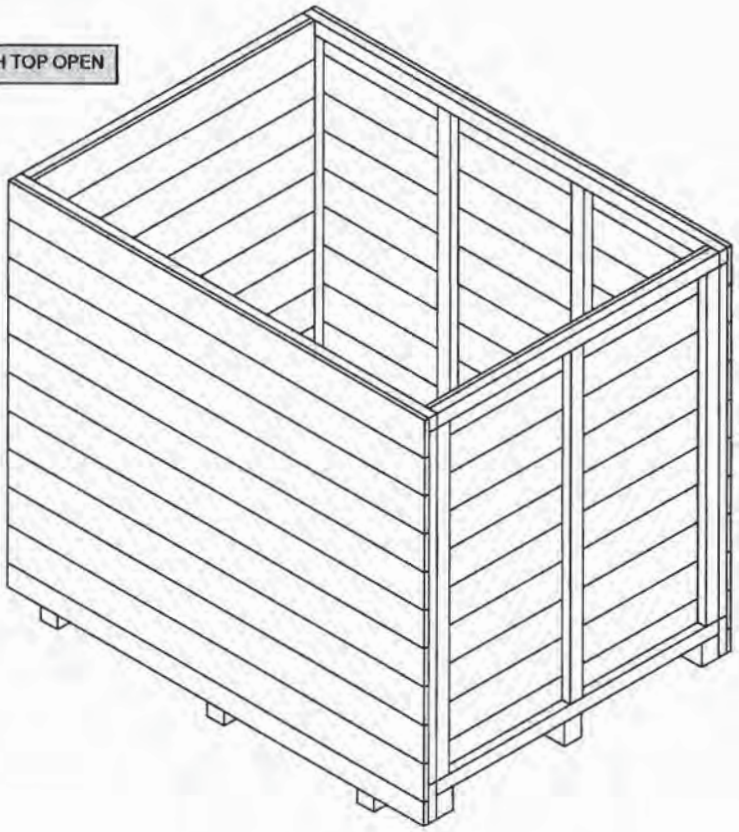
NAILING TYPE MODEL WITH TOP OPEN



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Resin, filter media and Membranes are also included in this category

10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.

11.0 PACKING OF ELECTRICAL ITEMS

11.1 CABLES

11.1.1 Type of Equipment
All type of cables..

11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).

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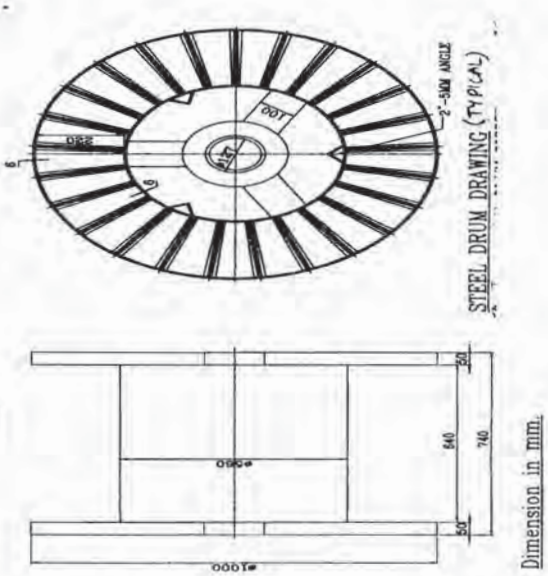

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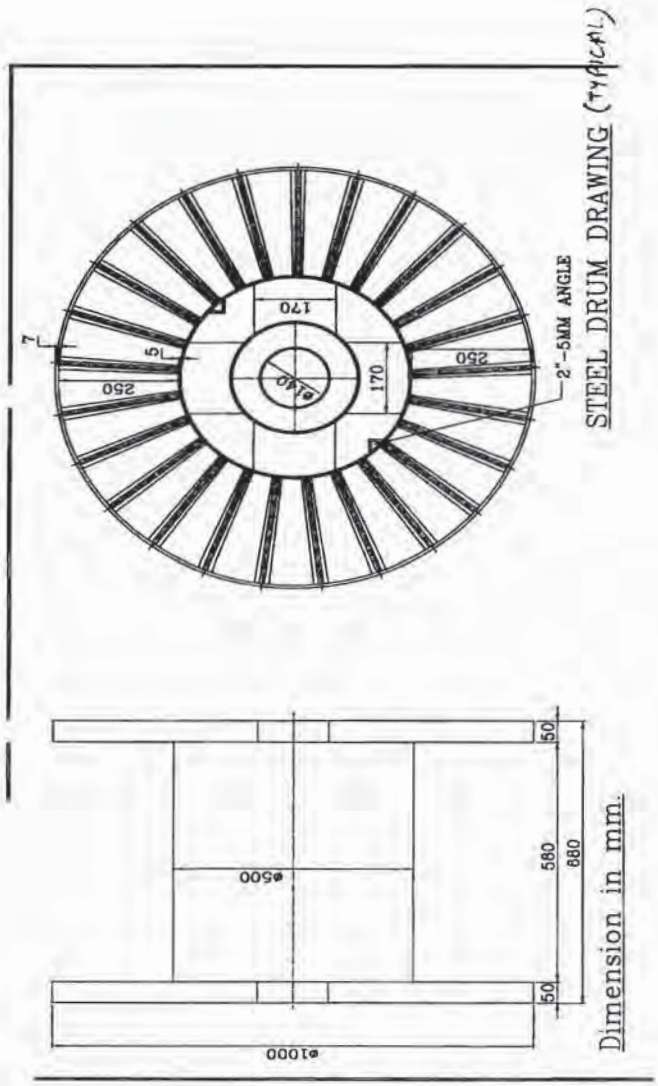

11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

1) All Dimensions are in "mm" unless otherwise stated.
2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
3) Finish of Packing Box Shall be Galvanized.
4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

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6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.

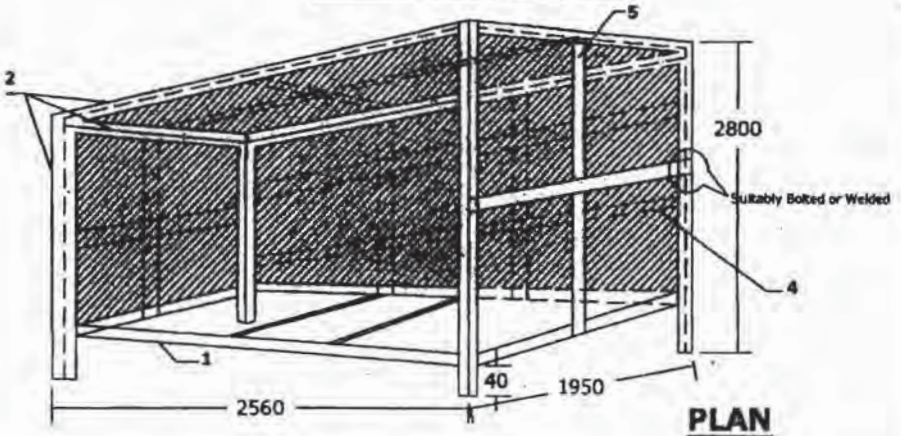
7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes

8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.

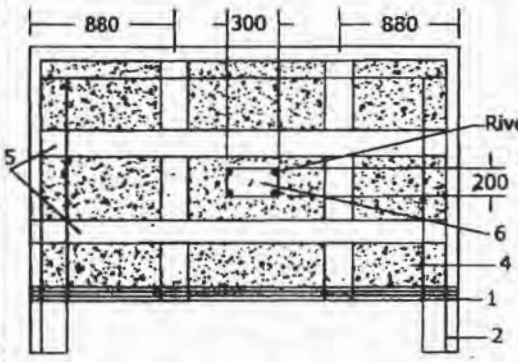
9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.

10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc

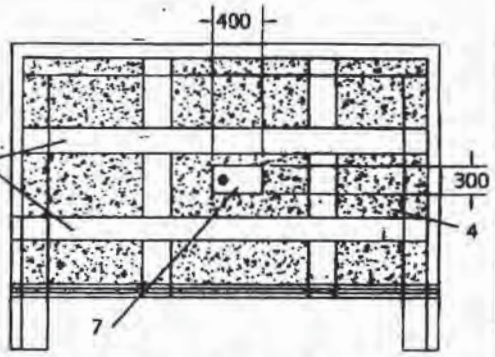
STEEL PACKING (TYPICAL DETAILS)



PLAN



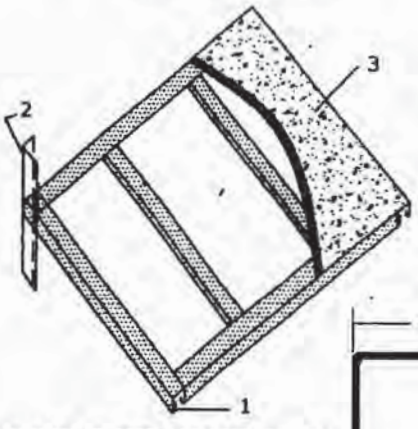
FRONT SIDE OF BOX



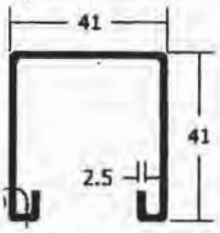
BACK SIDE OF BOX

Note:

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Alluminium Plate for Marking.
7. Hinged Inspection Window.



BOTTOM FRAME ARRANGEMENT



DETAILS OF "C" CHANNEL

11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

a) Construction of packing case for LIGHTING DIATRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.

b) Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.

c) All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

d) The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.

e) Silica get packed in cotton bags shall be placed at different positions inside the packing.

f) Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMIOSSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMBALES

a) Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.

b) Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.

c) All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.

d) Silica get packed in cotton bags shall be placed at different positions inside the packing.

11.3.3 For CONDUIT PIPE

As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.

b) Then bundle will be wrapped with bitumen coated hessian craft paper.

c) Bundle shall be strapped with steel straps.

d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

11.3.4 For POLES

Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

11.3.5 For STRUCTURAL STEEL

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Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
b) Then bundle will be wrapped with bitumen coated hessian craft paper.
c) Bundle shall be strapped with steel straps.
d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

PACKING PROCEDURE FOR CONDUIT PIPE

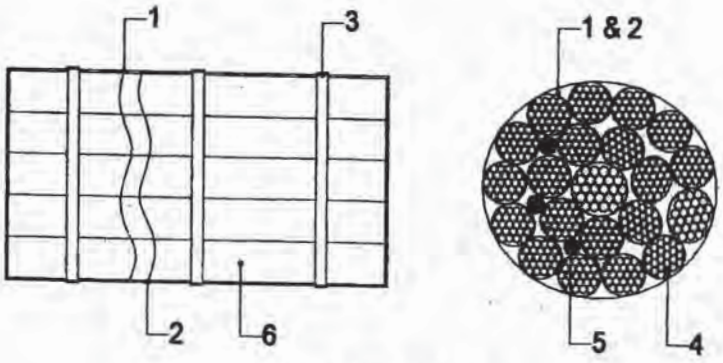

FIGURE "A"

1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
2) LAYER OF POLYTHENE SHEET.
3) METAL STRAPPING.
4) CONDUIT PIPES.
5) SILICA GEL POUCHES.
6) BUNDLES OF CONDUIT PIPES.

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PACKING PROCEDURE FOR STRUCTURAL STEEL

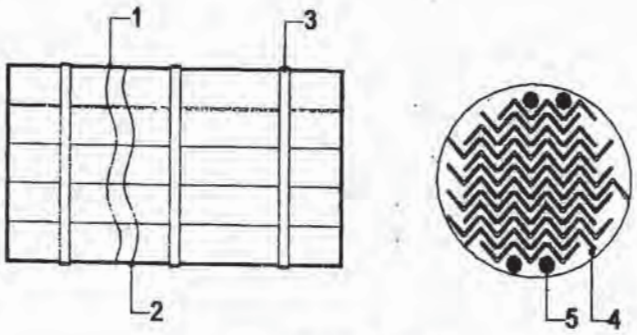

FIGURE "B"

1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
2) LAYER OF POLYTHENE SHEET.
3) METAL STRAPPING.
4) STRUCTURAL STEEL.
5) SILICA GEL POUCHES.

	TITLE	SPECIFICATION NO. PE-TS-888-100-A001
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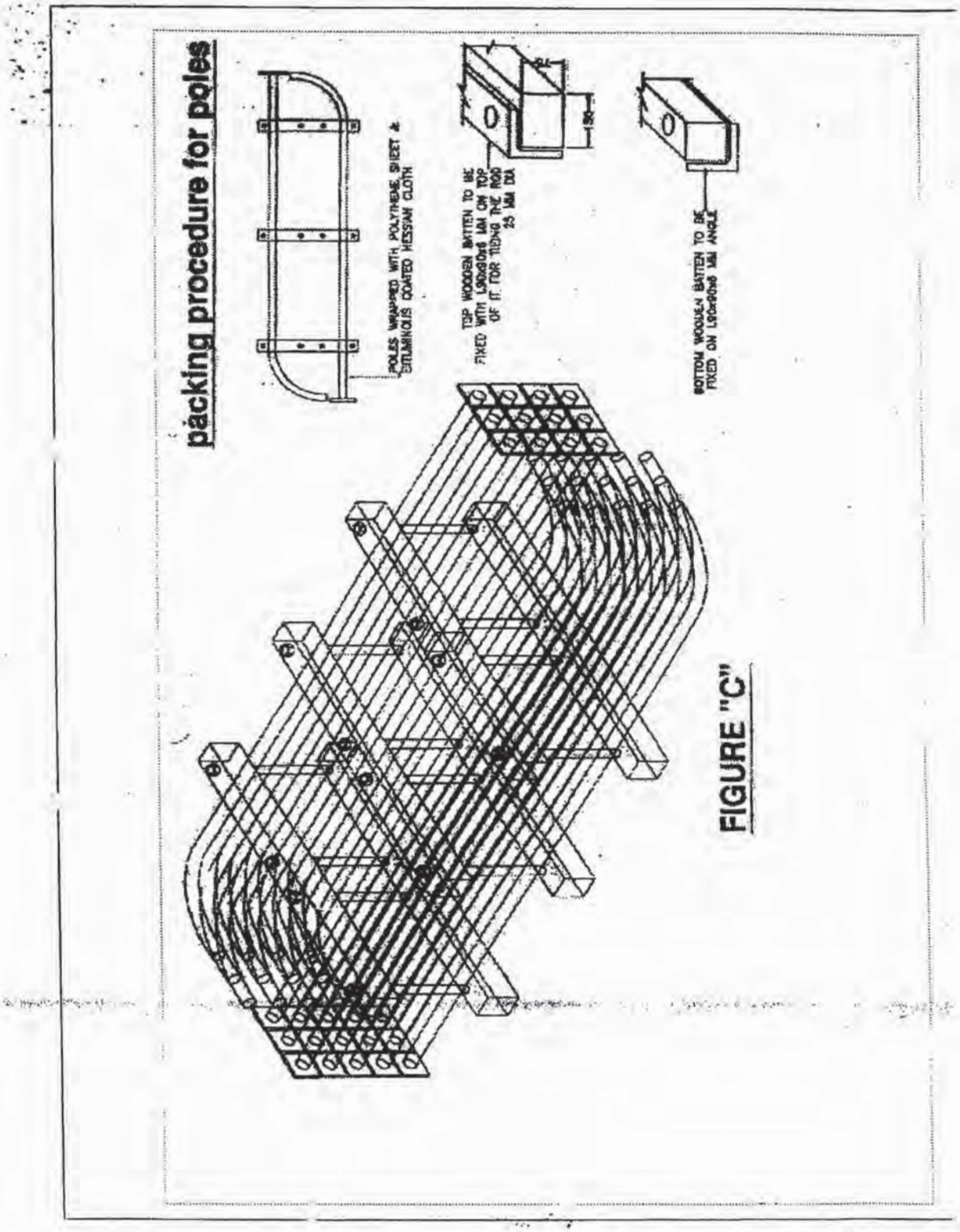

FIGURE "C"

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11.4 PACKING FOR DC BATTERY

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).

b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.

c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)

d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.

e) The battery accessories shall be packed with suitable precautions as follows:

i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.

ii) Hardware items shall be packed in polyethylene bags (Thickness ≥ 0.175mm) with item slip

iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet

iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.

f) Galvanized Steel straps are provided for binding the packing box sides.

g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.5.01 PACKING DETAILS :

a Items shall be packed in case / crates as per the shipping list.

b All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".

c Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

small / delicate items such as glass thermometer, door keys shall be packed in separate box.

d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.

e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.

f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.

g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.

h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box

i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.

j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.

k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.

l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.

m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

12.0 Containerization

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).
The maximum inside dimensions of containers are to be considered:

- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
-

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

12.2 Mechanical Constraints

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

Note:

It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.

13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS.
VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.
The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming