2 X 660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH (EPC MAIN PLANT PACKAGE)

TECHNICAL SPECIFICATION OF OIL FILLED SERVICE TRANSFORMERS

DOC. NO. PE-TS-421-302-E001

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA - 201301

CONTENTS

TOTAL NUMBER OF SHEETS: 113

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same

2. There is no deviation with respect to specification other than those furnished in the 'schedule of deviations'

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in BOQ-Cum-Price schedule of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE

SECTION ‘I’

SPECIFIC TECHNICAL REQUIREMENTS

1.0 SCOPE OF ENQUIRY

1.1 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **OIL FILLED SERVICE TRANSFORMERS** as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation.

1.2 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respect to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation.

1.3 Standard technical requirements of the oil filled service transformers are indicated in Section-II. Project specific requirements/changes are listed in Section-I.

1.4 The requirements of Section-I shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.

2.0 BILL OF QUANTITIES:

2.1 Quantity requirements shall be as per BOQ-cum-price schedule as part of NIT.

3.0 TECHNICAL REQUIREMENTS

3.1 Specific Technical Requirement:

S.No.	***Reference Clause No. of Section- II (if any)***	***Specific Requirement/ Change***

3.2 Quality/ Inspection:

S.No.	***Reference Clause No. of Section- II (if any)***	***Specific Requirement/ Change***
1.	--	**MINIMUM QUALIFYING REQUIREMENT FOR BIDDER SHALL BE AS PER ANNEXURE-A OF SECTION-I.**

4.0 DOCUMENTATION

4.1 Documents required along with technical offer shall be as per Annexure-I.
4.2 Documents required after award of LOI shall be as per Annexure -II.

ANNEXURE – I

DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER

Signed & Stamped copy of the following to be submitted along-with technical offer:

a) The enclosed Data Sheet-B filled up completely for each rating/ type of transformers.

b) Schedule of deviations (duly filled in format-part of NIT).

c) Schedule of BOQ cum Unpriced price schedule.

d) 10% Extra oil price schedule (Unpriced).

e) Schedule of Mandatory spares (Unpriced).

f) Schedule of O & M spares (Unpriced)

g) Schedule of Type test (Unpriced).

h) Undertaking for Testing/ Quality Assurance- Annexure-III.

30. Auxiliary Oil filled Transformer:

a. Bidder / Bidder's Sub-vendor~~(s)~~ should have manufactured and supplied at least five (5) nos. (at min. two different installations) of 16 MVA, 11 kV or higher rating Oil filled Transformers which should have been in successful operation for a period of at least two (2) years prior to date of techno-commercial bid opening.

And

b. Bidder / Bidder's sub-vendor should have his own facilities for conducting all routine and type tests as per IEC 60076 (except Short Circuit Test).

And

c. 16 MVA, 11 kV Class or higher rated Oil Filled Transformer manufactured by Bidder/Bidder's sub vendor should have been successfully short circuit tested.

ANNEXURE - II

Sl No	DWG. / DOCUMENT No	DOCUMENT TITLE	SUBMISSION SCHEDULE
1	PE-V0-421-302-E041	1600 KVA SERVICE TRANSFORMER (11/0.433kV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
2	PE-V0-421-302-E042	1600 KVA SERVICE TRANSFORMER (11/0.433kV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
3	PE-V0-421-302-E043	1600 KVA SERVICE TRANSFORMER (11/0.433kV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
4	PE-V0-421-302-E044	1600KVA TRANSFORMER (11/0.433KV) FOUNDATION PLAN	Within two weeks from the date of LOI
5	PE-V0-421-302-E045	1600KVA TRANSFORMER (11/0.433KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
6	PE-V0-421-302-E046	1600KVA TRANSFORMER (11/0.433KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
7	PE-V0-421-302-E047	1600KVA TRANSFORMER (11/0.433KV) LV BUS DUCT TRUNKING DRAWING / LV CABLE BOX	Within two weeks from the date of LOI
8	PE-V0-421-302-E048	1600KVA TRANSFORMER (11/0.433KV) H.V. BUSHING	Within two weeks from the date of LOI
9	PE-V0-421-302-E049	1600KVA TRANSFORMER (11/0.433KV) L.V. BUSHING	Within two weeks from the date of LOI
10	PE-V0-421-302-E050	1600KVA TRANSFORMER (11/0.433KV) LVN BUSHING	Within two weeks from the date of LOI
11	PE-V0-421-302-E051	1600KVA TRANSFORMER (11/0.433KV) VALVE SCHEDULE PLATE	Within two weeks from the date of LOI
12	PE-V0-421-302-E052	1600KVA TRANSFORMER (11/0.433KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
13	PE-V0-421-302-E053	1600KVA TRANSFORMER (11/0.433KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
14	PE-V0-421-302-E054	1600KVA TRANSFORMER (11/0.433KV) BI- DIRECTIONAL ROLLERS	Within two weeks from the date of LOI
15	PE-V0-421-302-E055	1600KVA TRANSFORMER (11/0.433KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
16	PE-V0-421-302-E061	2000 KVA SERVICE TRANSFORMER (11/0.433KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
17	PE-V0-421-302-E062	2000 KVA SERVICE TRANSFORMER (11/0.433KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
18	PE-V0-421-302-E063	2000 KVA SERVICE TRANSFORMER (11/0.433KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
19	PE-V0-421-302-E064	2000KVA TRANSFORMER (11/0.433KV) FOUNDATION PLAN	Within two weeks from the date of LOI
20	PE-V0-421-302-E065	2000KVA TRANSFORMER (11/0.433KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
21	PE-V0-421-302-E066	2000KVA TRANSFORMER (11/0.433KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
22	PE-V0-421-302-E067	2000KVA TRANSFORMER (11/0.433KV) LV BUS DUCT TRUNKING DRAWING / LV CABLE BOX	Within two weeks from the date of LOI
23	PE-V0-421-302-E068	2000KVA TRANSFORMER (11/0.433KV) H.V. BUSHING	Within two weeks from the date of LOI
24	PE-V0-421-302-E069	2000KVA TRANSFORMER (11/0.433KV) L.V. BUSHING	Within two weeks from the date of LOI
25	PE-V0-421-302-E070	2000KVA TRANSFORMER (11/0.433KV) LVN BUSHING	Within two weeks from the date of LOI
26	PE-V0-421-302-E071	2000KVA TRANSFORMER (11/0.433KV) VALVE SCHEDULE PLATE	Within two weeks from the date of LOI
27	PE-V0-421-302-E072	2000KVA TRANSFORMER (11/0.433KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
28	PE-V0-421-302-E073	2000KVA TRANSFORMER (11/0.433KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
29	PE-V0-421-302-E074	2000KVA TRANSFORMER (11/0.433KV) BI- DIRECTIONAL ROLLERS	Within two weeks from the date of LOI
30	PE-V0-421-302-E075	2000KVA TRANSFORMER (11/0.433KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
31	PE-V0-421-302-E081	2500 KVA SERVICE TRANSFORMER (11/0.433KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI

DOC REQUIRED AFTER AWARD OF CONTRACT

32	PE-V0-421-302-E082	2500 KVA SERVICE TRANSFORMER (11/0.433KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
33	PE-V0-421-302-E083	2500 KVA SERVICE TRANSFORMER (11/0.433KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
34	PE-V0-421-302-E084	2500KVA TRANSFORMER (11/0.433KV) FOUNDATION PLAN	Within two weeks from the date of LOI
35	PE-V0-421-302-E085	2500KVA TRANSFORMER (11/0.433KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
36	PE-V0-421-302-E086	2500KVA TRANSFORMER (11/0.433KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
37	PE-V0-421-302-E087	2500KVA TRANSFORMER (11/0.433KV) LV BUS DUCT TRUNKING DRAWING / LV CABLE BOX	Within two weeks from the date of LOI
38	PE-V0-421-302-E088	2500KVA TRANSFORMER (11/0.433KV) H.V. BUSHING	Within two weeks from the date of LOI
39	PE-V0-421-302-E089	2500KVA TRANSFORMER (11/0.433KV) L.V. BUSHING	Within two weeks from the date of LOI
40	PE-V0-421-302-E090	2500KVA TRANSFORMER (11/0.433KV) LVN BUSHING	Within two weeks from the date of LOI
41	PE-V0-421-302-E091	2500KVA TRANSFORMER (11/0.433KV) VALVE SCHEDULE PLATE	Within two weeks from the date of LOI
42	PE-V0-421-302-E092	2500KVA TRANSFORMER (11/0.433KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
43	PE-V0-421-302-E093	2500KVA TRANSFORMER (11/0.433KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
44	PE-V0-421-302-E094	2500KVA TRANSFORMER (11/0.433KV) BI- DIRECTIONAL ROLLERS	Within two weeks from the date of LOI
45	PE-V0-421-302-E095	2500KVA TRANSFORMER (11/0.433KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
46	PE-V0-421-302-E802	SERVICE TRANSFORMER O & M MANUAL	Within one week after conduction of Type test
47	PE-V0-421-302-E804	SERVICE TRANSFORMER TYPE TEST PROCEDURE	Within two weeks from the date of LOI
48	PE-V0-421-302-E805	SERVICE TRANSFORMER TYPE TEST REPORTS	Within one week after conduction of Type test
49	PE-V0-421-302-E807	SERVICE TRANSFORMER O & M SPARES	Within two weeks from the date of LOI
50	PE-V0-421-302-E901	QUALITY PLAN FOR SERVICE TRANSFORMERS	Within two weeks from the date of LOI

ANNEXURE-III

During Contract Stage: The Bidder shall furnish the QAP & perform all tests in line with International Standards & Specification Requirements mentioned elsewhere in the Specification.

BIDDER'S STAMP & SIGNATURE

SECTION ‘I’

DATASHEET-A
DATASHEET-B
DATASHEET-C

DATASHEET-A FOR LT SERVICE TRANSFORMERS 11/0.433 kV

S. No.	Description	Unit	Particulars
1.0	Quantity	Nos. & kVA	16Nos.-1600 kVA 14Nos.- 2000 kVA 2Nos.- 2500 kVA
2.0	Service (Unit/Station)	--	Unit/Station
3.0	Installation	--	Out Door
4.0	Type of insulating oil	--	Mineral as per IEC 60296
5.0	No. of phase	No(s)	03
6.0	Frequency	Hz	50
7.0	Type of cooling	--	ONAN
8.0	Rated output under site conditions	kVA	As indicated
9.0	Rated Voltage		
	a) HV Winding	kV	11.0
	b) LV Winding	kV	0.415
10.0	No Load transformation ratio	--	11/0.433
11.0	Vector group	--	Dyn11
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	1600 kVA : 8% 2000 kVA : 10% 2500 kVA : 10%
13.0	Total range of tappings and tapping steps	--	$\pm$ 5% in steps of 2.5%
14.0	Type of tap changing equipment	--	Off-Circuit
15.0	Temperature rise		
	a) Top oil by thermometer	deg. C	55 above ambient of 45
	b) Winding by resistance	deg. C	60 above ambient of 45
16.0	System Highest Voltage		
	a) HV Winding	kV	12.0 kV

	b) LV Winding	kV	0.415 kV
17.0	Phase Connection		
	a) HV Winding	--	Delta
	b) LV Winding	--	Star
18.0	Insulation Levels		
A)	For winding		
1	One minute power frequency withstand voltage		
	a) HV Winding	kV	28 (11kV)
	b) LV Winding	kV	3
2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV)
	b) LV Winding	kVp	--
B)	Insulation Levels (for bushing)		
1	One minute power frequency withstand voltage		
	a) HV Winding	kV	38 (17.5 kV)
	b) LV Winding	kV	3
2	Impulse withstand voltage		
	a) HV Winding	kVp	95 (11kV)
	b) LV Winding	kVp	NA
19.0	Terminal details		
	a) HV Line	--	Cable box (XLPE cables)
	b) HV Neutral	--	N.A
	c) LV Line	--	Flange throat for TPN non-segregated Cu Bus-duct
	d) LV Neutral	--	One neutral as part of LV bus-duct throat and second neutral with copper earthing bar for system earthing brought near the base of the transformer
20.0	System Fault Level		
	a) HV Winding	kA	50 kA RMS

	b) LV Winding	kA	50 kA RMS
21.0	Method of System Earthing		
	c) HV System	--	Delta connected (11 KV system is low resistance earthed to limit earth fault current to 400A)
	d) LV System	--	Solidly grounded
	Through fault withstand time	sec	2 sec
22.0	Details of Cooling Equipment	--	Detachable tank mounted radiators
23.0	Provision/ accommodation of CTs in LV Neutral	--	2 Core PX CLASS or 5P20 CT particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
24.0	Creepage distance	mm/kV	31
25.0	Painting Details		As per Annexure-IV
a)	Interior (For M. Box)		Particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
b)	Exterior		
26.0	Cable Details		
a)	HV Side		
	Type		XLPE insulated, Un-armoured
	Voltage Grade		8.7/15 kV
	Conductor Material		Cu Conductor
	Nos. of Cores & Runs	Sq.mm	3C-120
b)	LV Side		Not Applicable
	Type		Not Applicable
	Voltage Grade		
	Conductor Material		
c)	LV Neutral		

	Type		50 X 6 MM Cu FLAT
27.0	Sea-Worthy Packing		As per Annexure-V

TRANSFORMER LOSSES

1. The No-Load and Load losses for transformers are given below:

Ratings	Maximum No-Load losses at rated frequency and 100%voltage	Maximum Load losses at normal ratio, rated current and 75 deg. C
2500 kVA	2.8kW	30.0kW
2000 kVA	2.4 kW	24.0kW
1600 kVA	2.1kW	19.0kW

2. The above indicated maximum No-Load and Load losses are inclusive of permissible tolerance as per IEC 60076. Further tolerance on maximum losses is not permissible.

3. Penalty on Auxiliary power: In case measured losses of transformers during testing exceeds the above mentioned values, BHEL may accept the transformer with penalty. The rate of penalty shall be USD 4.06 Million per MW.

   The penalty shall be calculated for each transformer as given below:
   PENALTY = Penalty Rate x [measured No-Load losses - maximum No-Load losses) + (measured Load losses – maximum Load losses)]

DATA SHEET –B

TECHNICAL PARTICULARS

[***TO BE SUBMITTED ALOGWITH TECHNICAL OFFER***]

11/0.433kV

S. No	Description	1600 kVA	2000 kVA	2500 kVA
1.	Rating			
2.	No Load transformation ratio			
3.	Maximum No- load losses at rated frequency and 100% rated voltage	2.1 KW	2.4 KW	2.8 KW
4.	Maximum load losses at normal ratio, rated current and 75 deg. C	19.0 KW	24.0 KW	30.KW
5.	Overall Dimensions			
6.	Total weight			
7.	Total oil Quantity			
8.	Painting	As per Annexure-IV	As per Annexure-IV	As per Annexure-IV

DATA SHEET –C
TECHNICAL PARTICULARS

[***TO BE SUBMITTED AFTER AWARD OF CONTRACT FOR EACH RATING***]

S. No.	Description	Unit	Particulars
1.0	Name of Manufacturer	--	
2.0	Reference Standards	--	
3.0	Installation	--	
4.0	Rated No Load Voltage		
	a) HV Winding	kV	
	b) LV Winding	kV	
5.0	Type of cooling	--	
6.0	Rated kVA	--	
7.0	No. of phase	Nos.	
8.0	Rated Frequency	Hz	
9.0	Winding connections		
	a) HV Winding		
	b) LV Winding		
10.0	Vector group		
11.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	
12.0	Off-Circuit tap changer		
	a) Total range of tappings (+/-)	%	
	b) Size of tapping step	%	
	c) For HV/LV variation		
13.0	Impulse voltage withstand level		
	a) HV Winding	kVp	
	b) LV Winding	kVp	
14.0	One minute power frequency withstand voltage		
	a) HV Winding	kV	
	b) LV Winding	kV	

15.0	Maximum No load losses at rated frequency and		
	a) 100% rated voltage	kW	
	b) 110% rated voltage	kW	
16.0	Maximum Load losses at normal ratio, rated current and 75 deg. C	kW	
17.0	Tolerance on losses (+/-)		
18.0	Guaranteed maximum Temperature rise of		
	a) Top oil by thermometer above ambient of 45 deg. C	Deg. C	
	b) Winding by resistance ambient of 45 deg. C	Deg. C	
19.0	Efficiency at 75 deg. C and unity power factor for		
26.0	a) 100% full load	%	
	b) 75% full load	%	
	c) 50% full load	%	
20.0	Voltage regulation at full load at 75 deg. C		
	a) Unity power factor	%	
	b) 0.8 Power factor (Lagging)	%	
21.0	External short circuit withstand capacity & duration	MVA, sec	
22.0	Max. short time (30 sec.) rating of transformer	kVA	
23.0	Type of magnetic circuit	Core/ Shell	
24.0	Type of core joints		
25.0	Type of winding		
	a) HV Winding		
	b) LV Winding		
26.0	Type of insulation		
	a) HV Winding		
	b) LV Winding		
	c) Between core & adjacent winding		

	d) Between windings		
27.0	HV terminal arrangement		
	a) Bushing with or without CTs b) CT details (Ratio, ACC. Class, VA, Type)		
	c) Clearance between phases in air	mm	
	d) Clearances to earth in air	mm	
28.0	LV terminal arrangement		
	a) Bushing with or without CTs		
	b) CT details (Ratio, ACC. Class, VA, Type)		
	c) Clearance between phases in air	mm	
	d) Clearances to earth in air	mm	
29.0	Neutral terminal arrangement		
	a) No. of neutral terminals		
	b) Neutral CT provided or not		
	c) NCT details (Ratio, ACC. Class, VA, Type)		
30.0	HV Bushing		
	a) Rated voltage class	kV	
	b) Rated current	A	
31.0	LV Bushing		
	a) Rated voltage class	kV	
	b) Rated current	A	
32.0	LV Neutral Bushing		
	a) Rated voltage class	kV	
	b) Rated current	A	
33.0	Maximum flux density		
	a) At rated voltage	Wb/M2	
	b) At 110% rated voltage	Wb/M2	
34.0	Maximum current density for		
	a) HV Winding	Amp/mm2	
	b) LV Winding	Amp/mm2	

35.0	Magnetising current at rated voltage and frequency (% of full load current)		
36.0	Rollers		
	a) Type b) Unidirectional/ Bidirectional		
	c) Quantity		
	d) Gauges		
	e) Longitudinal	mm	
	ii) Transverse	mm	
37.0	Pressure test withstand		
	a) Tank	Kg/M2	
	b) Radiator and other fittings	Kg/M2	
38.0	Vacuum withstand		
	a) Tank	mm of Hg	
	b) Radiator and other fittings	mm of Hg	
39.0	Approximate weight of		
	a) Core	kg	
	b) Windings	kg	
	c) Tank, Fittings & Coolers etc.	kg	
40.0	Oil	kg	
	a) Total weight with oil	kg	
	b) Un-tanking weight (core & winding)	kg	
	c) Shipping weight of the heaviest package	kg	
41.0	Quantity of Insulating Oil		
	a) Oil in tank	Lts	
	b) Oil in cooling equipment	Lts	
	c) Total oil Quantity	Lts	
42.0	Dimensions		
42.1	Tank dimensions		
	a) Length	mm	

	b) Breadth	mm	
	c) Height	mm	
42.2	Shipping dimensions of the largest package		
	a) Length	mm	
	b) Breadth	mm	
	c) Height	mm	
43.0	Overall Dimensions (LxBxH)	(mmXmmXmm)	
44.0	Details of tank and other material		
	a) Thickness of tank side plate	mm	
	b) Thickness of tank bottom plate	mm	
	c) Thickness of tank cover plate	mm	
	d) Thickness of radiator sheets	mm	
	e) Minimum clearance height for lifting core and winding from tank	mm	
45.0	Positive sequence impedance at		
	Maximum voltage tap	%	
	Minimum voltage tap	%	
46.0	Zero-sequence impedance at principal tap	%	
47.0	Paint Shade		
48.0	Voltage Variation		
49.0	Noise Level		
50.0	Degree of Protection		
	Marshalling Box		
	HV Cable Box		
	LV Flange Enclosure		
51.0	Creepage Distance		
	HV Bushing	mm/kV	
	LV Bushing	mm/kV	
	Neutral Bushing	mm/kV	

52.0	Material of Winding		
	HV/LV		
53.0	Insulation level separate source power frequency voltage withstand		
	HV winding (kV RMS)		
	LV winding (kV RMS)		
	HV Bushing		
	LV Bushing		
	Neutral Winding		
54.0	Temperature Class of Insulation		
55.0	Over Excitation withstand time (sec)		
	100%		
	110%		
	125%		
	140%		
56.0	Thermal Time constant		
57.0	Magnetizing Inrush Current		
58.0	Radiator Details		
	No. of Radiators		
	No. of Flutes		
	Overall Dimensions		
	Radiator sizing calculations furnished	(YES/NO)	

ANNEXURE-IV

B0.6.4 Marking and labelling

Each crate or package is to contain a packing list in a waterproof envelope. All items of material are to be clearly marked for easy identification against the packing list.

All cases, packages, etc. are to be clearly marked on the outside to indicate the total weight, where the weight is bearing and the correct position of the slings and are to bear an identification mark relating them to the appropriate shipping documents.

All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.

B0.6.5 Corrosion protection, coating and galvanizing

This specification shall be used for the corrosion protection of steel structures, components, pipings and equipment in general which are installed in confined areas (indoors) or outdoors.

Surface preparation, as well as protective coatings and coating systems are based on this specification in order to assure that structural parts of different suppliers will get a corrosion protection of similar and high quality.

Coating material shall only be supplied by manufacturers with international experience and their products can be obtained internationally.

Regarding maintenance work (storage), application and supervision of coating work, choice of coating suppliers should be minimized. At any rate, similar parts of structures/components (such as structural steel, containers, piping, etc.) shall only be coated with products of one individual manufacturer.

The materials and equipment used, the methods of application and the quality of work shall at all times be subject to the inspection and approval of the Employer or his Representative.

To mitigate crevice corrosion, the designs and construction of structures and equipment shall ensure that no collection of water occurs in crevices which could lead to crevice corrosion.

It is the responsibility of the Contractor to ensure that, for all supplied equipment (including that from sub suppliers):

- The protection system is perfectly suitable for the Site conditions and for the specific purpose.
- The shop paints provide a sufficient protection during transport, storage and erection.

- The shop paints are suitable for handling and erection conditions (slinging, Site welding works etc.) and are compatible with the Site finishing coats
- All necessary precautions are taken in order to prevent damage to paints during storage, handling, welding.
- The necessary repairs are carefully executed as soon as possible.
- The colour RAL number of the finishing coat has been approved by the Employer, including identification code for piping.
- Standardised equipment will be painted according to the manufacturer's standard.
- All corrosion protection and coating on site shall be done in a workshop specifically for the purpose of the application of corrosion protection and coating.

Codes and standards
Applicable standards are:

- Product data of coating manufacturer
- DIN 2403 Indication of pipe-lines according to flowing material
- DIN 4762 Surface roughness
- ISO 8503 Surface roughness
- DIN 8201 Part 1-9 tight blasting agents
- DIN 50976 Corrosion protection, hot dip batch galvanizing of single parts, requirements and testing
- DIN 55928 Part 1-9 corrosion protection of structural steel work through protective coatings and topcoats
- ISO 8501 Preparation of steel substrates before application of paints and associated products
- ISO 12944 Paints and varnishes – corrosion protection of steel structures by protective paint systems
- RAL Colour card
- ISO 8501-1 Preparation of steel substrates before application of paints and related products
- SSPC Vol. 1 and 2 Steel structure painting council

SURFACE PREPARATION AND CLEANING OF SURFACES IN THE SHOP
Prior to blasting, areas have to be cleaned from oil, grease, paint residues, splatters, welding splashes and welding slag using a suitable aqueous degreaser, or solvent for more severe grease contamination. The cleaning should be to provide a "water break free surface".

Sharp edges have to be rounded off.

Contaminations caused by salts, acids and alkali solutions shall be eliminated by rinsing with water up to a pH value of 6-8. Soluble salt contamination is to be tested using the Weber Reilly test method (or similar approved) and pH is to be tested using universal indicator paper strips prior to continuation with the blasting.

The preparation of substrates shall be carried out on the basis of the specifications of ISO 12944 part 4 and ISO 8501. The preparation of steel before application of paint and related products shall be in line with ISO 11124 for metallic blast cleaning abrasives and ISO 11126 for non-metallic blast cleaning abrasives. No recycled blast grit may be utilised.

After blasting, an anchor profile of 25 - 50 µm shall be achieved. Blasted surfaces have to be provided with a prime coat of the approved coating system immediately within 4 hours of blasting. All blasting and priming must take place outside of the high humidity periods of the day (i.e. maximum relative humidity of 80%).

Cleaning to be performed on site
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, , unless the specific coating system allows for coating onto damp concrete, in which case only with approval from the Employer.

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

Transport and erection damages, as well as damages which result out of additional welding have to be repaired as soon as possible. The damaged areas have to be derusted with rotating or steel brushes, abrasive wheels, and abrasive blasting according to DIN ISO 8501-1.

Cleaning of prime and intermediate coats (if required)
To prevent contamination by mineral oil products, areas with prime and intermediate coat have to be treated with suitable cleaning agent. Cleaning has to be done free of residues, e.g. with alkaline detergents and thorough washing done with fresh water. Rusty spots have to be removed according to required purity. Metallic areas which are provided with temporary corrosion protection have to be cleaned. No oxidation products shall remain on the surface. Further care shall be taken that on hot components, no destructive or reaction products will be released when heating which could injure insulation.

Application procedure
When using the provided coating material, strict adherence to all application instructions given in product data of coating manufacturer is necessary. To obtain the maximum performance, technical data as well as application instructions for the individual coating material have to be strictly followed. For a multi-layer coating system each layer has to have a different colour shade in order to clearly identify number of coats applied.

The last finish coat has to be applied in the specified colour shade.

All paintings shall be performed according to ISO 12944. The durability of all paintings shall be "high" which corresponds to 15 years.

The interval between applying the different coats has to follow according to supplier's precautions. Each layer has to be cleaned and released from spray dust before the next layer will be applied. Prior to applying a further layer, the last one has to be repaired. All coatings have to be applied without retarding.

Following application procedures are allowed:

- prime coats by airless spray
  areas like disconnections, angles, corners, etc. which are difficult to be reached can be applied by brush or roller
- repair of prime coat by brush
- finish coats
  - at works by airless spray, roller or brush
  - at site by roller or brush or airless spray.

When applying coating systems by roller, rollers have to be of kind and quality which make an appropriate application possible.

Control areas in accordance with the coating supplier's instructions have to be applied. For this procedure, a schedule for control areas has to be prepared by the Contractor and coating supplier which corresponds with the requirements of the warranty agreement.

Number and performance of the control areas have to be done in accordance with ISO 12944 part 7 and have to be documented in writing.

No application shall take place either in the condition of the relative humidity not within the given limit or in case of poor weather conditions such as fog, dust, rain, snow, hail or when it can be assumed that such conditions of poor weather will arise within 2 hours after application.

Temperature of the coated parts has always to be above 5 °C and 3 K above dew point.

All specified dry film thicknesses (DFT) are minimum thicknesses.

Welding seams executed at site have to be taped with an adhesive tape of about 30-50 mm after surface preparation (blasting or manual derusting) and prior to application in the manufacturing plant and to be coated with stripping coat.

Chequered plates, nap plates, etc. have not to be covered with adhesive tape, but have to be coated with stripping coat in a dry film thickness of at least 150 µm.

Edging lines on steel structure have to be taped prior to application and after blasting in sufficient width or have to be protected with varnish before application. Thickness of prime coat may be 50 µm maximum.

During repairing works at site on shop-primed structures, it is important that different coats will have different colour shades. Numbers of layers have to be the same as the original coating system to be used.

Application of temporary primer on structures which have to be insulated has to be in accordance with a sufficient corrosion protection for the period of storage respectively erection time.

Galvanizing
Galvanizing work shall conform in all respects to ISO 1461 or equivalent 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 to suit the requirements of the process. They should be in accordance with ISO 12944.

Vent holes and drain holes shall be provided to avoid high internal pressures and air locks during immersion and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with BS 4360. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized.

The minimum coating thickness shall be as specified in Table 1 of BS 729. Structural steel items shall be first grit-blasted to BS 4232, second quality, (Sa 2 1/2) or pickled in a bath, and the minimum average coating weight on steel Sections 5 mm thick and over shall be 900 g/m^2, on steel Sections 2 - 5 mm thick 600 g/m^2.

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.

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

Small areas of the galvanized coating damaged in any way shall be restored by:

- cleaning the area of any weld slag and thorough wire brushing to give a clean surface
- The application of two coats of zinc-rich paint, or the application of a low melting point zinc alloy repair rod or powder to the damaged area, which is heated to 300 °C or the treatment with suitable cold galvanizing paint, such as ORAPI n.z.a.b 706. All zinc rich paint used for such repairs must contain a minimum of 81% by mass of zinc in the dry film.

Connections between galvanized surfaces and copper, copper alloy or aluminium surfaces shall be protected by suitable tape wrapping.

Coating Systems								
System-No.	**Surface location**	**Temp. °C**	**Surface preparation**	**Coating systems**	**No. of coats**	**Generic type**	**Dry film thickness (DFT) per coat µm**	**Total DFT µm**
1	Structural steel works, piping, vessels, tanks INDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Finish	1	Epoxy High Solid	80	80
								160
2	Structural steel works, piping, vessels, tanks OUTDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Intermediate	1 – 2	Epoxy High Solid	160	160
				Finish	1	2-Comp.Polyurethane	50	50
								290
3	Piping, tanks, etc. INDOOR and OUTDOOR, Insulated	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	Pumps, motors, other equipment OUTDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Intermediate	1	Epoxy High Solid	110	110
				Finish	1	2-Comp.Polyurethane	50	50
								240
5	Pumps, motors, other equipment INDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Finish	2	Epoxy High Solid	50	100
								180
6	Piping, reactors OUTDOOR Insulated	> 120	SA 2.5	Primer	1	Zinc Ethysilicate	75	75
7	Stacks OUTDOOR	< 120	SA 2.5	Primer	1	Zinc Ethysilicate	75	75
		< 200		Finish	2	Silicone Acrylic	50	100
								175

Coating Systems								
System-No.	**Surface location**	**Temp. °C**	**Surface preparation**	**Coating systems**	**No. of coats**	**Generic type**	**Dry film thickness (DFT) per coat µm**	**Total DFT µm**
8	Steel surfaces Uninsulated	200 - 450	SA 2.5	Primer Finish	1 2	Zinc Ethysilicate Silicone Aluminium	75 25	75 50 **125**
9	Galvanized surfaces	up to 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine sand	When Finish Coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid*	125	125
10	Steel surfaces permanently in contact with water, also river water splash zone	Medium temp. °C up to 60	SA 2.5	Prime and Finish Coat in One	1	Glassflake reinforced High Solid Epoxy	500	500
11	Plant / Cooling water pipes	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						

* Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 µm, when exposed to UV or weathering conditions and colour retention is required.

ANNEXUR-V

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

	TITLE	SPECIFICATION NO. **PE-TS-888-100-A001**
	TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	VOLUME II B
		SECTION D
		REV. NO. 0 DATE 10/08/2010
		SHEET 1 OF 52

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

8.1.3 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

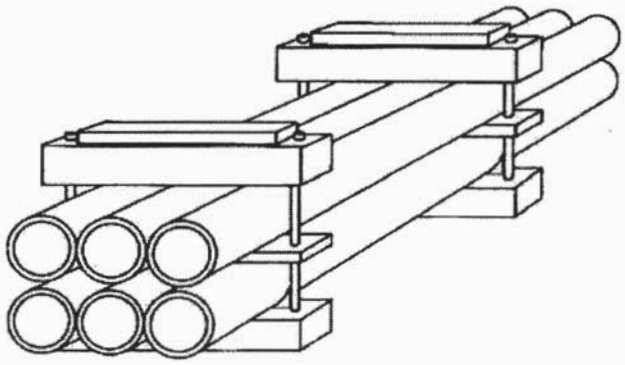
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long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

8.2 Bundling – Packing Category I

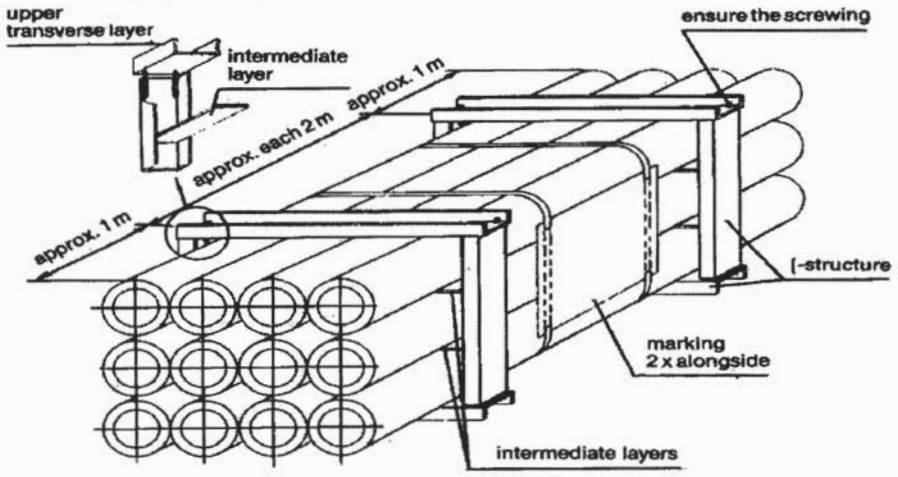
8.2.1 Type of Equipment

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)

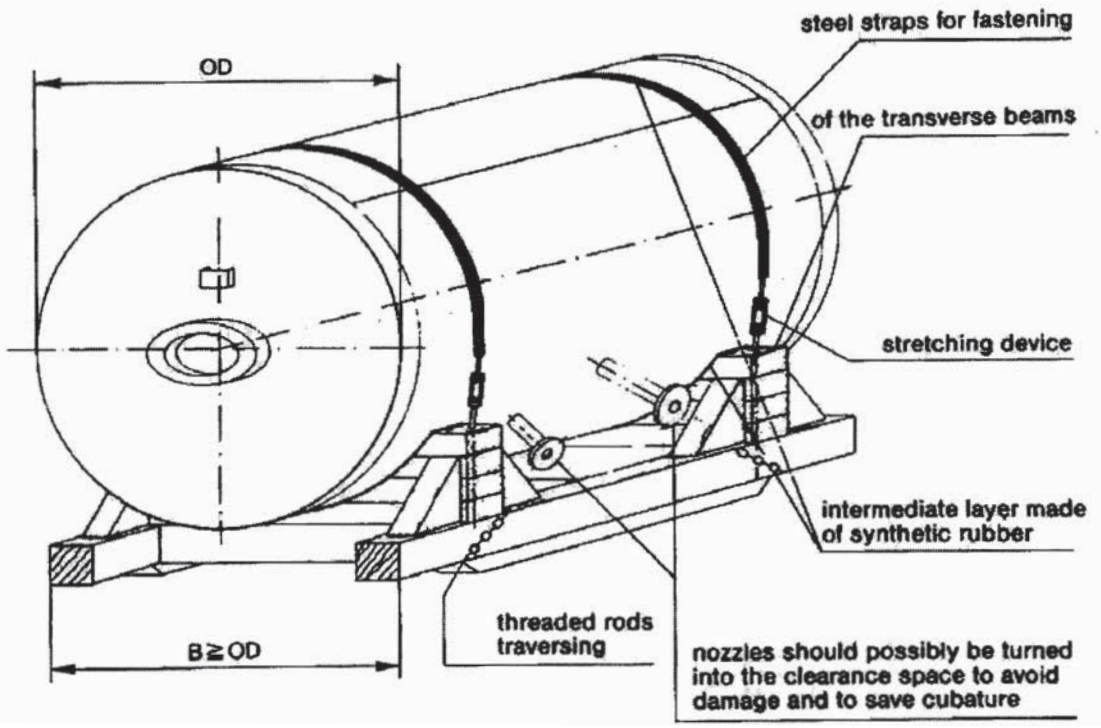
8.3.1 Type of Equipment

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

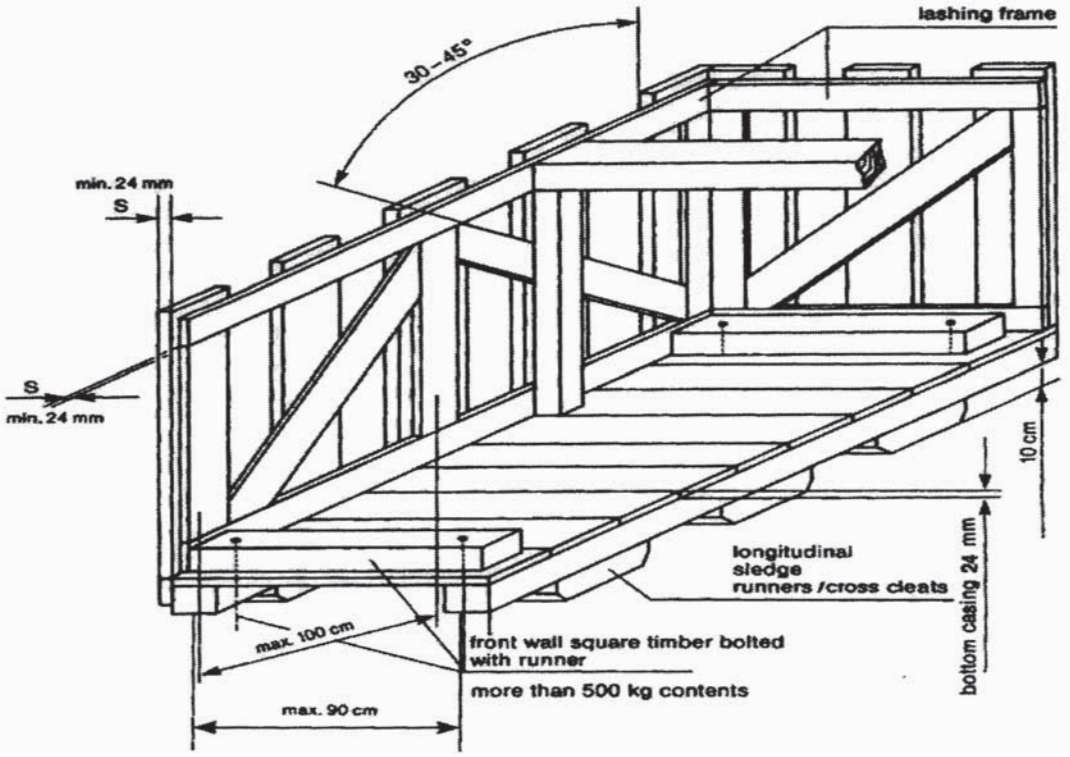
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

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

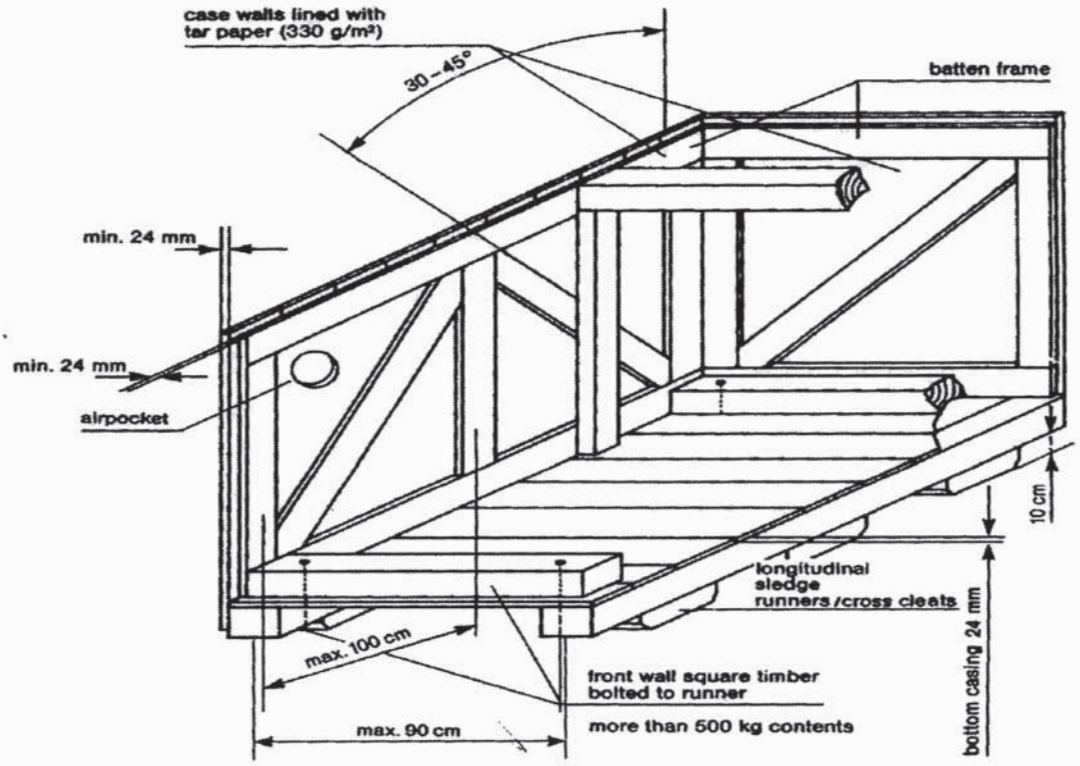
8.4.2.1 Type of Equipment

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

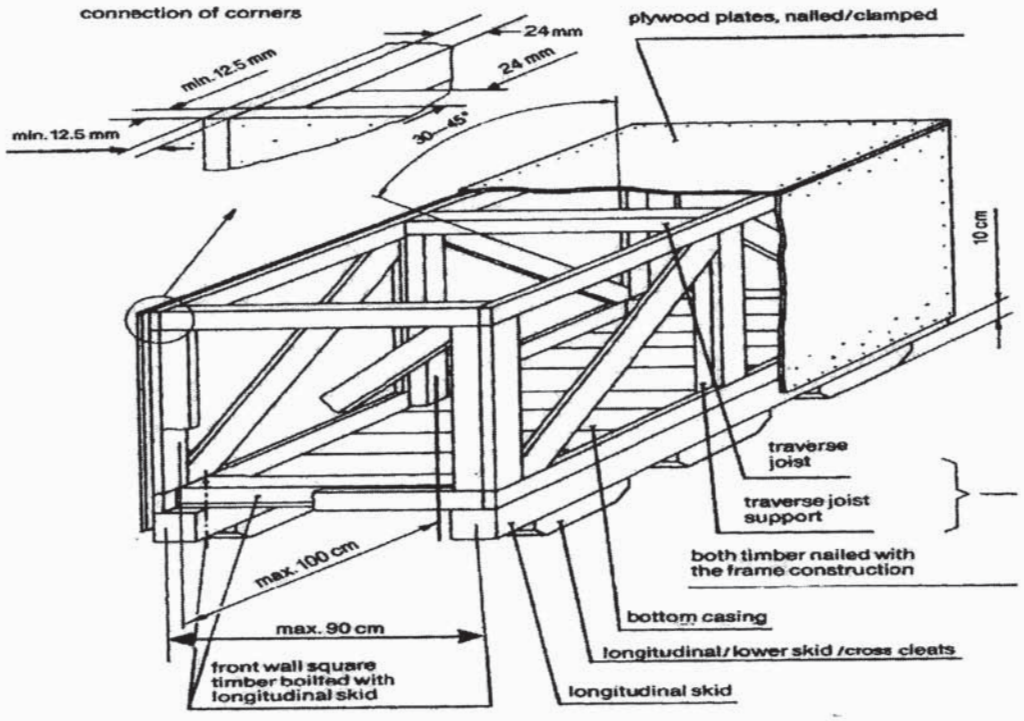
The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed 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



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.

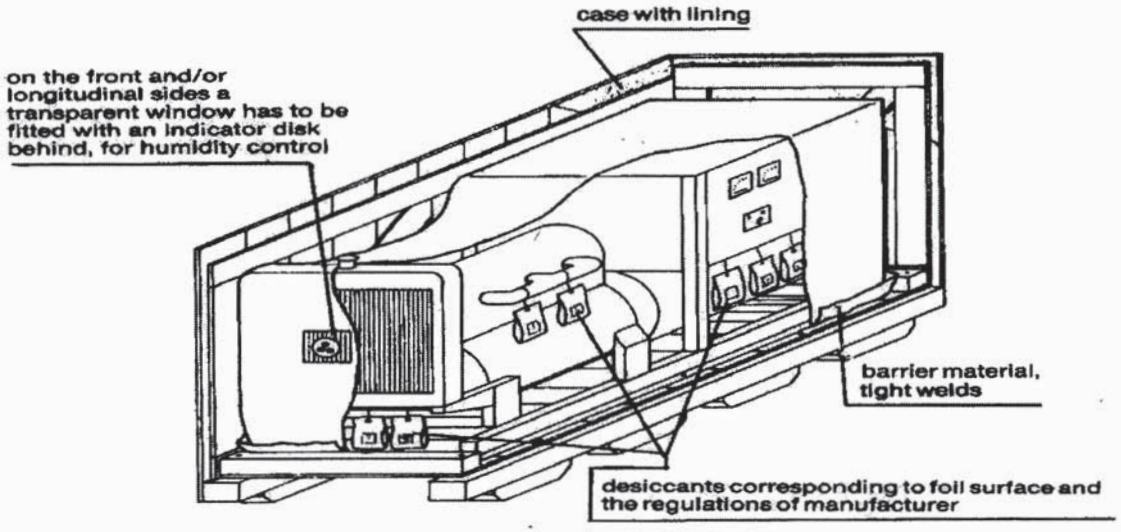
8.4.5.2 Type of Construction

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 <u>Detailed specification for Wooden Crates/Boxes/Cases and other packing materials</u>

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

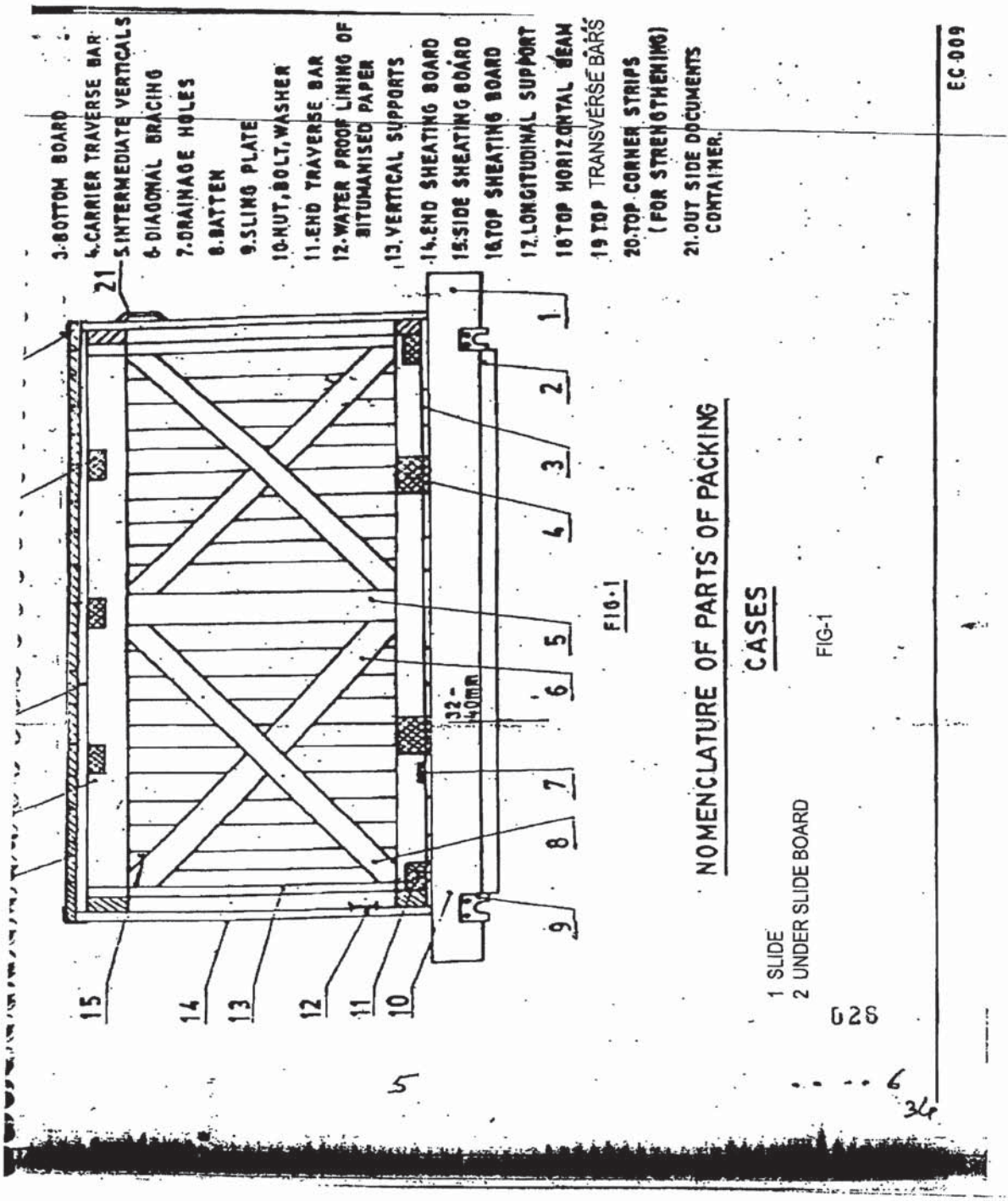
shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- 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.


3.BOTTOM BOARD
4.CARRIER TRAVERSE BAR
5.INTERMEDIATE VERTICALS
6.DIAGONAL BRACING
7.DRAINAGE HOLES
8.BATTEN
9.SLING PLATE
10.NUT,BOLT,WASHER
11.END TRAVERSE BAR
12.WATER PROOF LINING OF BITUMANISED PAPER
13.VERTICAL SUPPORTS
14.END SHEATING BOARD
15.SIDE SHEATING BOARD
16.TOP SHEATING BOARD
17.LONGITUDINAL SUPPORT
18.TOP HORIZONTAL BEAM
19.TOP TRANSVERSE BARS
20.TOP CORNER STRIPS (FOR STRENGTHENING)
21.OUT SIDE DOCUMENTS CONTAINER.
32-40mm
F10-1
NOMENCLATURE OF PARTS OF PACKING
CASES
FIG-1
1 SLIDE
2 UNDER SLIDE BOARD
EC-009

BOTTOM FRAME ARRANGEMENTS

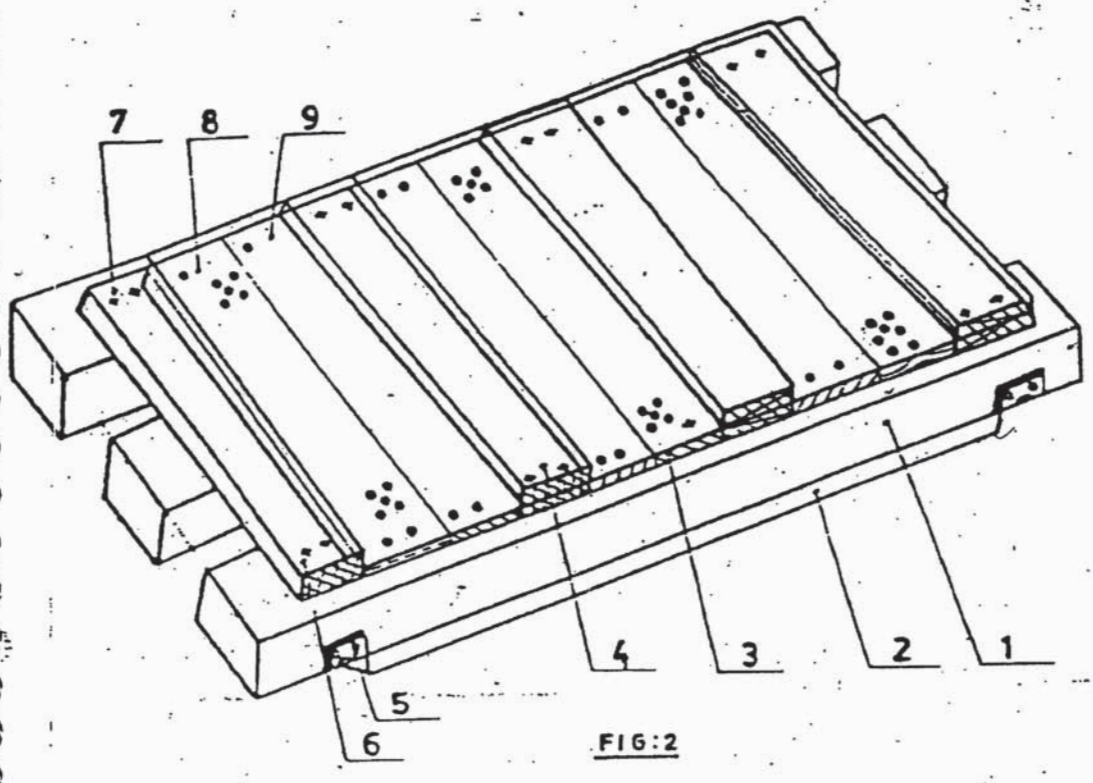


FIG:2

Nos. of slides : Minimum 2 Nos.
For length more than 1800 mm or load more than 1000 kg, 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

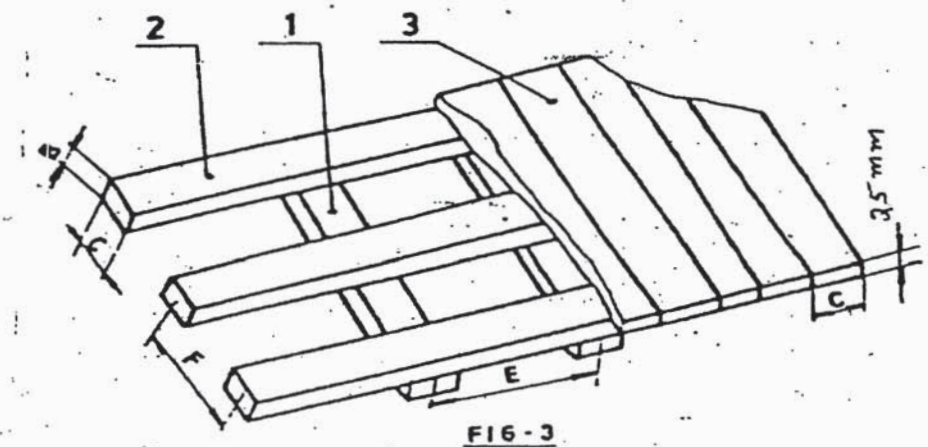
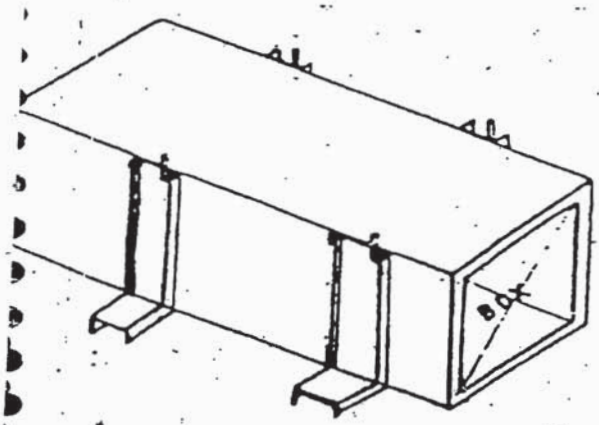


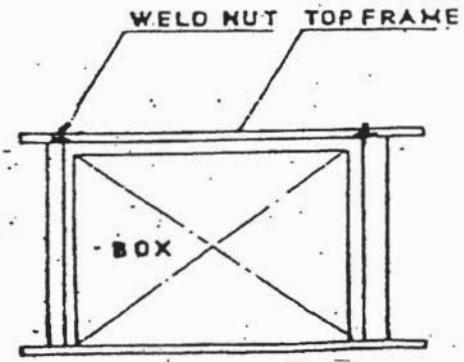
FIG-3

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





628

ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

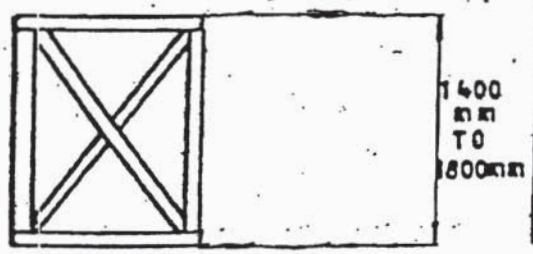


FIG:6

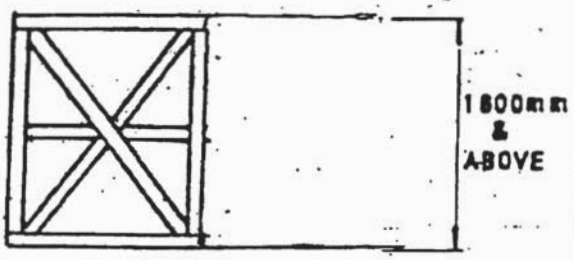


FIG:8

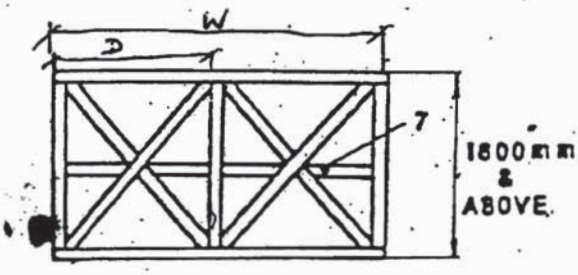


FIG:9

7- Middle Horizontal Support

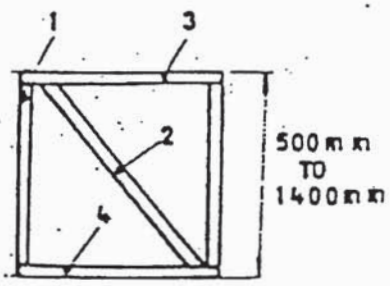


FIG:5.

1- Vertical Support

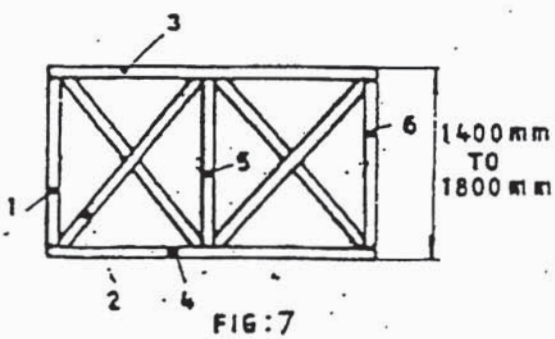


FIG:7

1, 5, 6 - Vertical Support