

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

**TECHNICAL SPECIFICATION OF HT XLPE POWER
CABLES**

DOC. NO. PE-TS-421-507-E001A



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

260234/2021/PS-PEM-EL


**TECHNICAL SPECIFICATION FOR
HT XLPE POWER CABLES**

SPECIFICATION NO. PE-TS-421-507-E001A

VOLUME II

CONTENTS SHEET

2 X 660 MW BIFPCL MAITREE STPP

REVISION 0 | DATE: 30.03.2021

SHEET 1 OF 1

CONTENTS

<u>S. NO.</u>	<u>CONTENTS</u>	<u>NO. OF SHEETS</u>
01	COMPLIANCE CERTIFICATE	01
02	SECTION - 'I' SPECIFIC TECHNICAL REQUIREMENT	03
	DATA SHEET-A	(03)
	ANNEXURE TO DATA SHEET-A	(25)
	DATA SHEET-C	(04)
	ANNEXURE-A (SEA WORTHY PACKING DETAILS)	(53)
03	SECTION - 'II' STANDARD TECHNICAL SPECIFICATION	(03)
	ANNEXURE-I (STEEL DRUM DRAWING-TYPICAL)	(01)
	ANNEXURE-II (QUALITY PLAN ALONGWITH ANNEXURE)	(11)

TOTAL NUMBER OF SHEETS: 105

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DOCUMENT TITLE

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SPECIFICATION NO. PE-TS- 421-507-E001A

VOLUME II

REVISION 00

DATE: 30.03.2021

SHEET 1 of 1

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

	TITLE : TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO.
		PE-TS-421-507-E001A
		VOLUME NO. : II
		SECTION : I
		REV NO. : 00 DATE : 30.03.2021
		SHEET : 2 of 3

1.0 SCOPE OF ENQUIRY

- 1.1 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper sea-worthy packing and delivery FOR Haldia Port of **HT XLPE POWER CABLES** as mentioned in different sections of this specification.
- 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 General technical requirements of the HT XLPE POWER CABLE are indicated in Section-II. Project specific technical/ quality 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:

<u>S.No.</u>	<u>Reference Clause No. of Section- II (if any)</u>	<u>Specific Requirement/ Change</u>
1.	3.3: ...”(except UV Radiation & Hydrolytic Stability test)”. 	THE CLAUSE SHALL BE READ AS: “Type testing requirements, routine / sample testing and special testing requirements shall be as per Annexure to QAP. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price.
2.	3.4: “The charges of UV Radiation test & Hydrolytic Stability test (if applicable) shall be reimbursed extra at actual against original money receipt of Govt. Lab. (CPRI/ ERDA etc).”	THIS CLAUSE STANDS DELETED.
3.	--	ADDITONAL REQUIREMENT:

	TITLE : TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO.
		PE-TS-421-507-E001A
		VOLUME NO. : II
		SECTION : I
		REV NO. : 00 DATE : 30.03.2021
		SHEET : 3 of 3

		“Test certificates shall be provided for each cable type proving that the insulation for the cable has successfully passed Water Tree Type Test (Accelerated) in line with specification requirement in Datasheet-A, from 31.01.2016 onwards. In case of non-availability of satisfactory test report, the test have to be conducted free of cost i.e. without any techno-commercial implication to BHEL”. Sample test report enclosed.
--	--	---

3.2 Quality/ Inspection:

<u>S.No.</u>	<i>Reference Clause No. of Section- II (if any)</i>	<i>Specific Requirement/ Change</i>
1		

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DOCUMENT TITLE

TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES

SPECIFICATION NO.

PE-TS-421-507-E001AVOLUME NO. : **II**SECTION : **I**REV NO. : **00** DATE : 30.03.2021

DATASHEET-A

1.0	Type of Cable	Flame Retardant-Low Smoke (FR-LS)
2.0	Standard applicable in general(Latest amendment to be referred if any)	IEC-60502-2, IEC-60228, ASTM:2843, ASTM:2863, IEC-60754-1, IEC:60332 (Part-1), IEC:60332-3-23, IEEE:60383
3.0	Voltage Grade	3.6/6 (7.2) kV 8.7/15 (17.5) kV
4.0	Number of cores, cross sectional area of conductors and quantities	As per BOQ-CUM-PRICE SCHEDULE
5.0	CONDUCTOR	
(a)	Material	Plain Copper
	Class	Class 2
(b)	Standard Applicable	IEC-60228
(c)	Shape	Stranded Compacted Circular & Stranded Shaped
(d)	Min. number and diameter of strands	As per Table-2 of IEC-60228
(e)	Conductor screen	
(i)	Material	Extruded Semi-conducting compound (applied on top of semiconducting tape)
(ii)	Minimum thickness	0.3 mm
6.0	INSULATION	
(a)	Material	Cross-Linked Polyethylene(XLPE), SUITABLE FOR WATER TREE TEST REQUIREMENTS as per clause no.17 below, SAMPLE REPORT AS PER ANNEXURE TO DATASHEET-A
(b)	Standard Applicable	IEC-60502-2
(c)	Continuous withstand temperature	90°C
(d)	Short-circuit withstand temperature	250°C
(e)	Nominal thickness	As per Table-6 of IEC-60502-2
7.0	INSULATION SCREEN	
(a)	Non-metallic	
(i)	Material	Cross-linked Semi-conducting compound
(ii)	Type of Semiconducting compound	Bonded
(iii)	Minimum thickness	0.3 mm
(b)	Metallic	
(i)	Material	Copper
(ii)	Type	As per Clause 10 of IEC-60502-2
(iii)	Size	Nominal thickness 0.1mm with tolerance (±) 10%
(iv)	Minimum Overlap	10%
(c)	Earth fault current withstand capacity	400A, 2 sec (For multi-core cables, screen of each core shall be rated individually for the above value).
8.0	EXTRUSION (Insulation and Screens)	
(a)	Process	Triple Extrusion



DOCUMENT TITLE

SPECIFICATION FOR HT XLPE POWER CABLES

SPECIFICATION NO.

PE-TS-421-507-E001AVOLUME NO. : **II**

SECTION : I

REV NO. : **00** DATE : 30.03.2021

		(Extruded semi-conducting compound conductor screen and insulation screen shall be applied along with XLPE insulation in a single operation by triple extrusion process).
(b)	Method of Curing	<i>Dry curing/ Gas curing/ Steam curing/ Sioplas</i>
9.0	CORE IDENTIFICATION	Colour coding as R, Y, B
10.0	INNER SHEATH	
(a)	Material	Extruded PVC Type ST-2
(b)	Standard Applicable	IEC-60502-2
(c)	Colour	<i>Black</i>
(d)	Whether FR-LSH	YES
(e)	Inner sheath applicable for single core cable	NO
(f)	Fillers	Acceptable
(g)	Material of fillers (if permitted)	Same as inner sheath (Material of filler to be compatible with that of inner sheath)
(h)	Method of application	
(1)	Multi-core cables:	
(i)	With fillers	<i>Pressure extruded/ Vacuum extruded</i>
(ii)	Without fillers	<i>Pressure extruded</i>
(2)	Single-core cables:	<i>Pressure extruded/Vacuum extruded</i>
(i)	Thickness of inner sheath	As per Table-8 of IEC-60502-2
11.0	ARMOUR	
(a)	<i>Applicable</i>	NO
(b)	Material:	--
(i)	Single core cables	--
(ii)	Multi-core cables	--
12.0	OUTERSHEATH	
(a)	Material	PVC Type ST2 as per IEC: 60502-2
(b)	Colour	<i>RED, NON FADING</i>
(c)	Whether FR-LSH	Yes
(d)	Method of application	Extruded
(e)	Thickness of outer sheath	As per Clause-14 of IEC: 60502-2
(f)	Marking	Cable size (cross section area and no. of cores) and voltage grade @ 5m (by embossing) Word "XLPE" "FR-LSH" etc, @ 5m (by embossing) Manufacturer's name and/ or trade name, and year of manufacture @ 5m (by embossing) 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing) Progressive sequential marking @ 1m (by embossing/ printing)
13.0	FR-LS CHARACTERISTICS	
(a)	Oxygen index	Min 29 (ASTMD 2863)
(b)	Temperature index	Min. 250°C(ASTMD 2863)
(c)	Acid gas generation	Max. 20% by weight (IEC-60754-1)
(d)	Smoke density rating	Max. 60% (ASTM D 2843/ IEC 61034)
14.0	TOLERANCE ON OUTER DIAMETER	(±)2 mm. over the declared value

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SPECIFICATION NO.

PE-TS-421-507-E001AVOLUME NO. : **II**

SECTION : I

REV NO. : **00** DATE : 30.03.2021

15.0	CABLE DRUMS	
(a)	Type of Drum	Steel
(b)	Standard drum length	500/600/1000 m
16.0	SEA WORTHY PACKING	YES
17.0	INSULATION SUITABLE FOR WATER TREE TEST (ACCELERATED) (Test Report for raw material to be submitted) SAMPLE REPORT AS PER ANNEXURE TO DATASHEET	• Water Tree Test of XLPE Insulation (accelerated) • Test voltage = 3 x U₀ • Test frequency = 500 Hz • Core environment = 400C water • Duration of test = 4 month • Test after 4 months: Dielectric stress withstand >14kV/mm.
18.0	ADDITIONAL REQUIREMENTS	The cables must be resistant to solar radiation, the effect of oil, seawater, bacterial action, insects and rodents.



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TKF CONNECTIVITY SOLUTIONS

Hanwha insulation for medium voltage cables

Long-term aging test 500 Hz / 3000 h

HD 620 S2: 2010 Part 10 Section J

Introduction

TKF has started a certification process with Dekra for the release of insulation material for medium voltage cables from the Hanwha brand. Alliander asked TKF to demonstrate the quality of the material by means of the long-term aging test at 500 Hz. TKF has conducted this research including a water tree analysis.

Details

Part number: 94465

Description: Sample 240 Alrm SC-XLPE-SC 6/10 (12) kV HANWHA INSULATION

Order number: 327252

Material SC : CTBA-8730BK

Material Insulation: CLNA-TR8142EC

The samples come from a ready test cable:

94467 YMeKrvslqwd 6/10 kV 3 X 240 Alrm + as70

Dimensions, breakdown voltage and field strength

There are 3 samples out of date at 500 Hz / 3000 hours.

The older samples are accelerated and photographs of all tests have been taken. Some of the photos have been added to this report. See Appendix 1 (Picking Up Photos of Images)

The result of these tests are summarized in tabular form below and the top-up forms as an attachment. See Appendix 2 (Formulating forms)

Sample #								Avg	Diam-SC1 [mm]	Diam-Iso [mm]	Ud [kV]	E Avg. [kV/mm]
Sample 1	SC1 [mm]	0.55	0.58	0.53	0.64	0.53	0.59	0.57	18.06	25.16	138	46.1
	Insulation [mm]	3.56	3.60	3.53	3.48	3.58	3.55	3.55				
	SC2 [mm]	0.77	0.77	0.79	0.74	0.84	0.71	0.77				
Sample 2	SC1 [mm]	0.54	0.56	0.53	0.64	0.50	0.59	0.56	18.04	25.30	114	37.4
	Insulation [mm]	3.65	3.66	3.56	3.59	3.65	3.66	3.63				
	SC2 [mm]	0.80	0.70	0.75	0.78	0.70	0.76	0.75				
Sample 3	SC1 [mm]	0.55	0.58	0.57	0.53	0.59	0.54	0.56	18.04	25.2	114	38.0
	Insulation [mm]	3.46	3.67	3.46	3.65	3.58	3.55	3.56				
	SC2 [mm]	0.76	0.75	0.77	0.71	0.78	0.69	0.74				

Requirement for field strength [E Avg] according to Appendix G:

100% > 14 [kV/mm]

66% > 18 [kV/mm]

33% > 22 [kV/mm]

The results completely complies with the standard.

Water tree analysis

A water tree analysis was also performed on the samples.

Here only 1 bow-tie tree is found <0.1 [mm]. See Appendix 3. (Water tree analysis)

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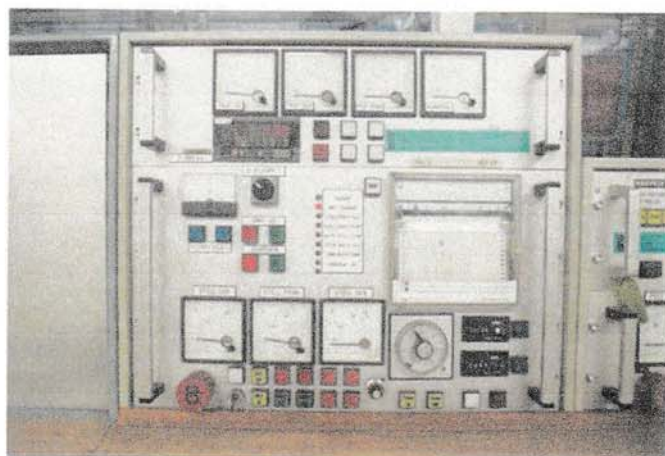


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Appendix 1 Photographing the line up



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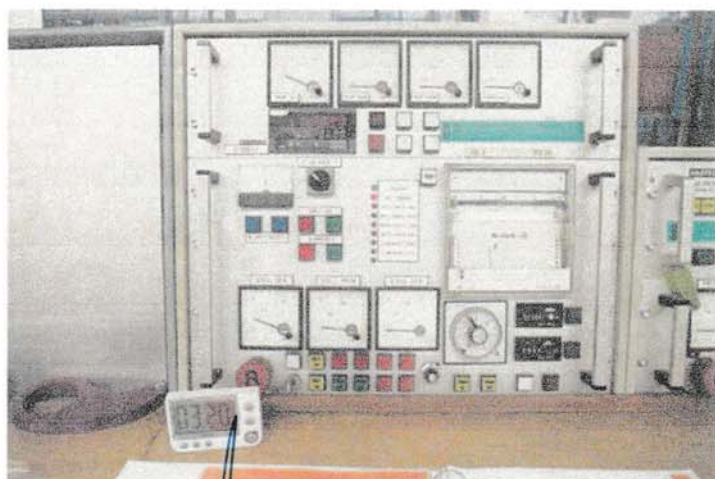
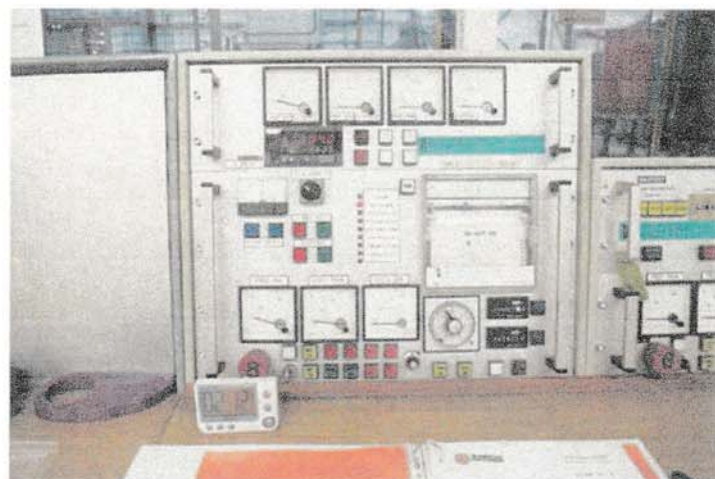
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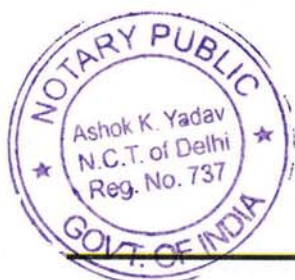
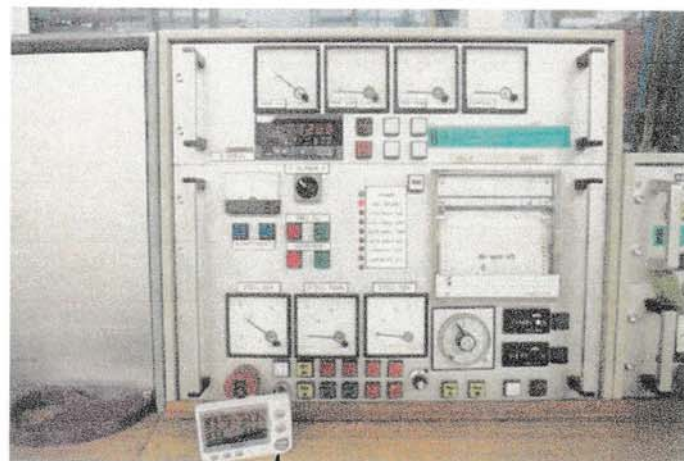
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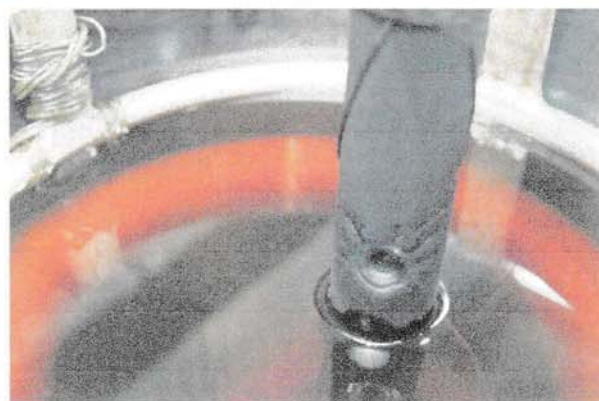
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TKF CONNECTIVITY SOLUTIONS



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ITEM NO. 1.
2.
3.

AC Step Test according to KEMA / VDE

CABLE TYPE :

1.0 m L Paks approx 40 kV 23-6-16

CABLE No. :

* not conditioned *

KK :

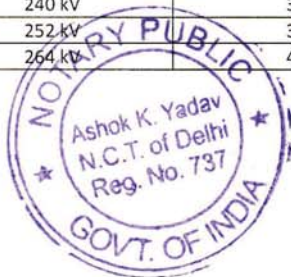
NOTE :

XL-2015-07

500Hz/3000h

DATE :	S :	FILE NO. :	MAX. SPANNING :	NOTE	SIGNATURE :
	1				
	2				
	3				
	4				

kV STAND	NR	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4
138 36 Kv	21	S			
144 48 kV	22	4 minutes			
150 60 kV	23				
156 72 kV	24				
162 84 kV	25				
168 96 kV	26				
174 108 kV	27				
180 120 kV	28				
186 132 kV	29				
192 144 kV	30				
198 156 kV	31				
204 168 kV	32				
180 kV	33				
192 kV	34				
204 kV	35				
216 kV	36				
228 kV	37				
240 kV	38				
252 kV	39				
264 kV	40				



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Appendix 2 Formulating forms



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ITEM NO. 1.
2.
3.

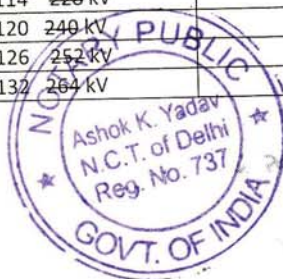
AC Step Test according to KEMA / VDE

CABLE TYPE : Low Voltage cables 4/10 kV 23.5-16
CABLE No. : * not conditioned *
KK :
NOTE : XL-2015-07 500Hz/3000h

DATE :	S :	FILE NO. :	MAX. VOLTAGE :	NOTE	SIGNATURE :
23-5-16	1		138 kV	—	(signed)
23-5-16	2		114 kV	—	(signed)
25-5-16	3		114 kV	—	(signed)
	4				

kV STAND	NR	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4
18 36 kV	1	S	S	S	
24 48 kV	2	S	S	S	
30 60 kV	3	S	S	S	
36 72 kV	4	S	S	S	
42 84 kV	5	S	S	S	
48 96 kV	6	S	S	S	
54 108 kV	7	S	S	S	
60 120 kV	8	S	S	S	
66 132 kV	9	S	S	S	
72 144 kV	10	S	S	S	
78 156 kV	11	S	S	S	
84 168 kV	12	S	S	S	
90 180 kV	13	S	S	S	
96 192 kV	14	S	S	S	
102 204 kV	15	S	S	S	
108 216 kV	16	S	S	S	
114 228 kV	17	S	S	S	
120 240 kV	18	S	2 minutes	2 minutes	
126 252 kV	19	S			
132 264 kV	20	S			

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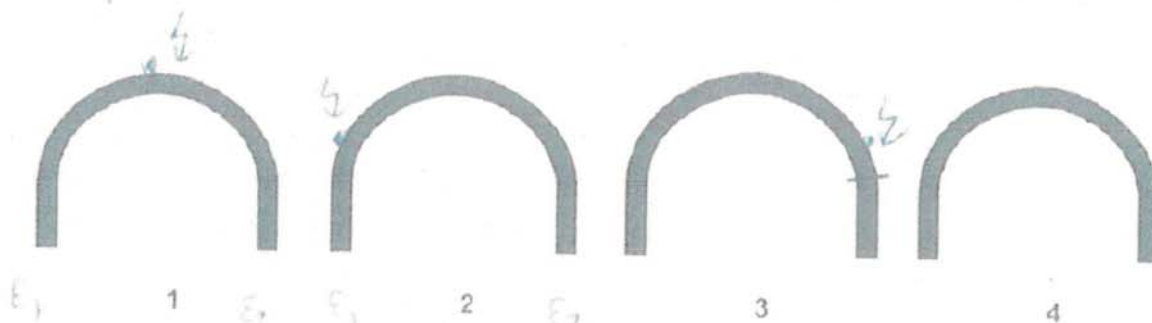
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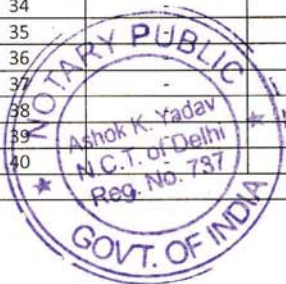
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Appendix 3 Water tree analysis

Purposeful water tree research (Client)								
Cable type : 1x150 Alrm 6/10 kVKK no. 94465								
Cable No. : : Hanwa vein No. 1 Performed by : H. vid Geest								
Number of water trees.								
Slice No.	< 0.1 mm	< 0.2mm	< 0.3 m	< 0.4 mm	< 0.5 mm	Bow-tie trees.	Vented trees.	Notes :
1	-	-	-	-	-	-	-	none
2	-	-	-	-	-	-	-	none
3	-	-	-	-	-	-	-	none
4	-	-	-	-	-	-	-	none
5	-	-	-	-	-	-	-	none
6	1x	-	-	-	-	1x	-	none
7	-	-	-	-	-	-	-	none
8	-	-	-	-	-	-	-	none
9	-	-	-	-	-	-	-	none
10	-	-	-	-	-	-	-	none
11	-	-	-	-	-	-	-	none
12	-	-	-	-	-	-	-	none
13	-	-	-	-	-	-	-	none
14	-	-	-	-	-	-	-	none
15	-	-	-	-	-	-	-	none
16	-	-	-	-	-	-	-	none
17	-	-	-	-	-	-	-	none
18	-	-	-	-	-	-	-	none
19	-	-	-	-	-	-	-	none
20	-	-	-	-	-	-	-	none

Slice from 1 to 20

Purposeful water tree research (Client)								
Cable type : 1x150 Alrm 6/10 kV								
Cable No. : : Hanwa vein No. 1								
KK no. 94465								
Performed by : H. vid Geest								
Number of water trees.								
Slice No.	< 0.1 mm	< 0.2mm	< 0.3 m	< 0.4 mm	< 0.5 mm	Bow-tie trees.	Vented trees.	Notes :
21	-	-	-	-	-	-	-	none
22	-	-	-	-	-	-	-	none
23	-	-	-	-	-	-	-	none
24	-	-	-	-	-	-	-	none
25	-	-	-	-	-	-	-	none
26	-	-	-	-	-	-	-	none
27	-	-	-	-	-	-	-	none
28	-	-	-	-	-	-	-	none
29	-	-	-	-	-	-	-	none
30	-	-	-	-	-	-	-	none
31	-	-	-	-	-	-	-	none
32	-	-	-	-	-	-	-	none
33	-	-	-	-	-	-	-	none
34	-	-	-	-	-	-	-	none
35	-	-	-	-	-	-	-	none
36	-	-	-	-	-	-	-	none
37	-	-	-	-	-	-	-	none
38	-	-	-	-	-	-	-	none
39	-	-	-	-	-	-	-	none
40	-	-	-	-	-	-	-	none



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MINISTRY OF CORPORATE AFFAIRS
Registration Number : **AAF-6592**

Purposeful water tree research (Client)								
Cable type : 1x150 Alrm 6/10 kV			KK no.		94465			
Cable No. : Hanwa vein No.2Performed by : H. vid Geest								
Number of water trees.								
Slice No.	< 0.1 mm	< 0.2mm	< 0.3 m	< 0.4 mm	< 0.5 mm	Bow-tie trees.	Vented trees.	Notes :
1	-	-	-	-	-	-	-	none
2	-	-	-	-	-	-	-	none
3	-	-	-	-	-	-	-	none
4	-	-	-	-	-	-	-	none
5	-	-	-	-	-	-	-	none
6	-	-	-	-	-	-	-	none
7	-	-	-	-	-	-	-	none
8	-	-	-	-	-	-	-	none
9	-	-	-	-	-	-	-	none
10	-	-	-	-	-	-	-	none
11	-	-	-	-	-	-	-	none
12	-	-	-	-	-	-	-	none
13	-	-	-	-	-	-	-	none
14	-	-	-	-	-	-	-	none
15	-	-	-	-	-	-	-	none
16	-	-	-	-	-	-	-	none
17	-	-	-	-	-	-	-	none
18	-	-	-	-	-	-	-	none
19	-	-	-	-	-	-	-	none
20	-	-	-	-	-	-	-	none

Slice from 1 to 20

Purposeful water tree research (Client)								
Cable type: 1x150 Alrm 6/10 kV			KK no. 94465					
Cable No. : Hanwa vein No.2			Performed by : H. vid Geest					
Number of water trees.								
Slice No.	< 0.1 mm	< 0.2mm	< 0.3 m	< 0.4 mm	< 0.5 mm	Bow-tie trees.	Vented trees.	Notes :
21	-	-	-	-	-	-	-	none
22	-	-	-	-	-	-	-	none
23	-	-	-	-	-	-	-	none
24	-	-	-	-	-	-	-	none
25	-	-	-	-	-	-	-	none
26	-	-	-	-	-	-	-	none
27	-	-	-	-	-	-	-	none
28	-	-	-	-	-	-	-	none
29	-	-	-	-	-	-	-	none
30	-	-	-	-	-	-	-	none
31	-	-	-	-	-	-	-	none
32	-	-	-	-	-	-	-	none
33	-	-	-	-	-	-	-	none
34	-	-	-	-	-	-	-	none
35	-	-	-	-	-	-	-	none
36	-	-	-	-	-	-	-	none
37	-	-	-	-	-	-	-	none
38	-	-	-	-	-	-	-	none
39	-	-	-	-	-	-	-	none
40	-	-	-	-	-	-	-	none

Slice from 21 to 40

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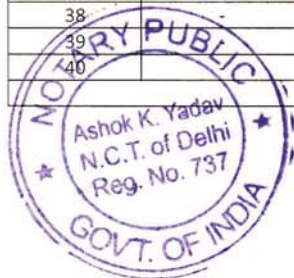
Registered In :
MINISTRY OF CORPORATE AFFAIRS
Registration Number : **AAF-6592**

Purposeful water tree research (Client)								
Cable type : 1x150 Alrm 6/10 kV			KK no. ?					
Cable No. : Hanwa vein No.3			Performed by : H. vid Geest					
Number of water trees.								
Slice No.	< 0.1 mm	< 0.2mm	< 0.3 m	< 0.4 mm	< 0.5 mm	Bow-tie trees.	Vented trees.	Notes :
1	-	-	-	-	-	-	-	none
2	-	-	-	-	-	-	-	none
3	-	-	-	-	-	-	-	none
4	-	-	-	-	-	-	-	none
5	-	-	-	-	-	-	-	none
6	-	-	-	-	-	-	-	none
7	-	-	-	-	-	-	-	none
8	-	-	-	-	-	-	-	none
9	-	-	-	-	-	-	-	none
10	-	-	-	-	-	-	-	none
11	-	-	-	-	-	-	-	none
12	-	-	-	-	-	-	-	none
13	-	-	-	-	-	-	-	none
14	-	-	-	-	-	-	-	none
15	-	-	-	-	-	-	-	none
16	-	-	-	-	-	-	-	none
17	-	-	-	-	-	-	-	none
18	-	-	-	-	-	-	-	none
19	-	-	-	-	-	-	-	none
20	-	-	-	-	-	-	-	none

Slice from 1 to 20

Purposeful water tree research (Client)								
Cable type: 1x150 Alrm 6/10 kV			KK no.		94465			
Cable No. :: Hanwa vein No.2			Performed by : H. vid Geest					
Number of water trees.								
Slice No.	< 0.1 mm	< 0.2mm	< 0.3 m	< 0.4 mm	< 0.5 mm	Bow-tie trees.	Vented trees.	Notes :
21	-	-	-	-	-	-	-	none
22	-	-	-	-	-	-	-	none
23	-	-	-	-	-	-	-	none
24	-	-	-	-	-	-	-	none
25	-	-	-	-	-	-	-	none
26	-	-	-	-	-	-	-	none
27	-	-	-	-	-	-	-	none
28	-	-	-	-	-	-	-	none
29	-	-	-	-	-	-	-	none
30	-	-	-	-	-	-	-	none
31	-	-	-	-	-	-	-	none
32	-	-	-	-	-	-	-	none
33	-	-	-	-	-	-	-	none
34	-	-	-	-	-	-	-	none
35	-	-	-	-	-	-	-	none
36	-	-	-	-	-	-	-	none
37	-	-	-	-	-	-	-	none
38	-	-	-	-	-	-	-	none
39	-	-	-	-	-	-	-	none
40	-	-	-	-	-	-	-	none

Slice from 21 to 40



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Registered In :
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Registration Number : **AAF-6592**

Date : 20.12.18

Sub : Translation Certificate

To Whomsoever it may concern

This is to certify that 3ADE Translation Services LLP has translated the **Water Tree Test Reports for Hanwha Insulation for medium voltage cables** from **Dutch** to **English** by a Native professional translator.

We confirm hereby that the translated **English** version is in line with original **Dutch** version of the document.

Thanking you

Yours Truly



For 3ADE Translation Services LLP



Hanwha isolatie voor middenspanningskabels

Lange duur verouderingsproef 500 Hz / 3000 h

HD 620 S2:2010 Part 10 Section J

Inleiding

TKF is een certificeringstraject gestart met Dekra voor de vrijgave van isolatiemateriaal voor middenspanningskabels van het merk Hanwha.

Alliander heeft aan TKF de vraag gesteld om aan de kwaliteit van het materiaal aan te tonen door middel van de lange duur verouderingsproef bij 500 Hz. TKF heeft dit onderzoek uitgevoerd inclusief een waterboomanalyse.

Gegevens

Artikelnummer: 94465

Omschrijving: Ader 240 Alrm SC-XLPE-SC 6/10 (12)kV HANWHA ISOLATIE

Ordernummer: 327252

Materiaal SC: CTBA-8730BK

Materiaal Iso: CLNA-TR8142EC

De aders zijn afkomstig uit een gereede proefkabel:

94467 YMeKrvaslqwd 6/10 kV 3 X 240 Alrm + as70

Afmetingen, doorslagspanning en veldsterkte

Er zijn 3 aders verouderd op 500 Hz / 3000 uur.

De verouderde aders zijn opgeregeld en van alle proeven zijn foto's gemaakt. Een gedeelte van de foto's is toegevoegd aan dit rapport. Zie Bijlage 1 (Foto's opregel proeven)

De resultaten van deze proeven zijn hieronder in tabelvorm samengevat weergegeven en de opregel formulieren als bijlage. Zie bijlage 2 (Opregel formulieren)

Sample #								Gem	Diam-SC1 [mm]	Diam-Iso [mm]	Ud [kV]	Egem. [kV/mm]
Ader 1	SC1 [mm]	0,55	0,58	0,53	0,64	0,53	0,59	0,57	18,06	25,16	138	46,1
	Isolatie [mm]	3,56	3,60	3,53	3,48	3,58	3,55	3,55				
	SC2 [mm]	0,77	0,77	0,79	0,74	0,84	0,71	0,77				
Ader 2	SC1 [mm]	0,54	0,56	0,53	0,64	0,50	0,59	0,56	18,04	25,30	114	37,4
	Isolatie [mm]	3,65	3,66	3,56	3,59	3,65	3,66	3,63				
	SC2 [mm]	0,80	0,70	0,75	0,78	0,70	0,76	0,75				
Ader 3	SC1 [mm]	0,55	0,58	0,57	0,53	0,59	0,54	0,56	18,04	25,2	114	38,0
	Isolatie [mm]	3,46	3,67	3,46	3,65	3,58	3,55	3,56				
	SC2 [mm]	0,76	0,75	0,77	0,71	0,78	0,69	0,74				

Eis op veldsterkte [Egem] volgens Appendix G:

100% > 14 [kV/mm]

66% > 18 [kV/mm]

33% > 22 [kV/mm]

De resultaten voldoen ruim aan de norm.

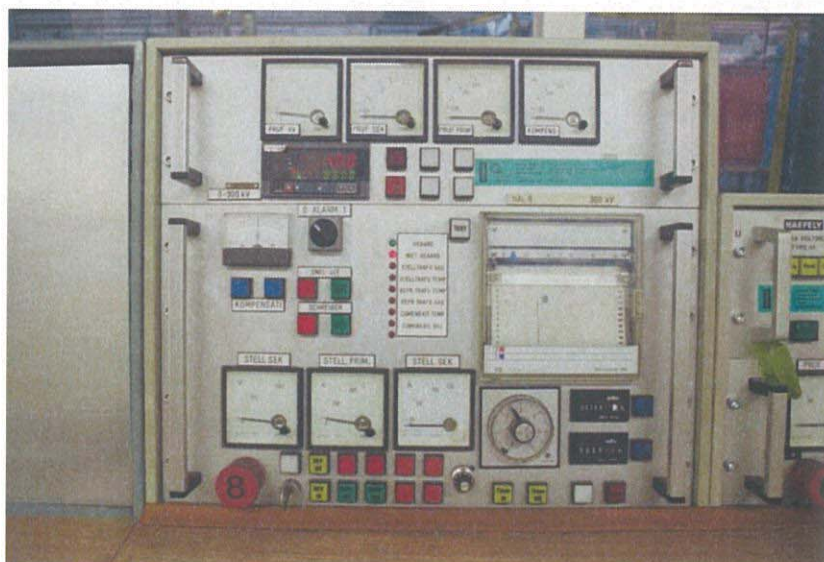
Waterboomanalyse

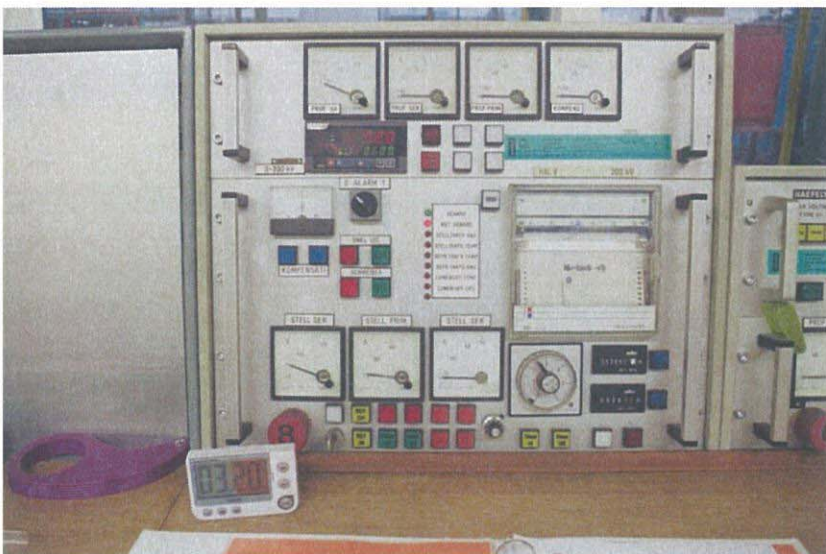
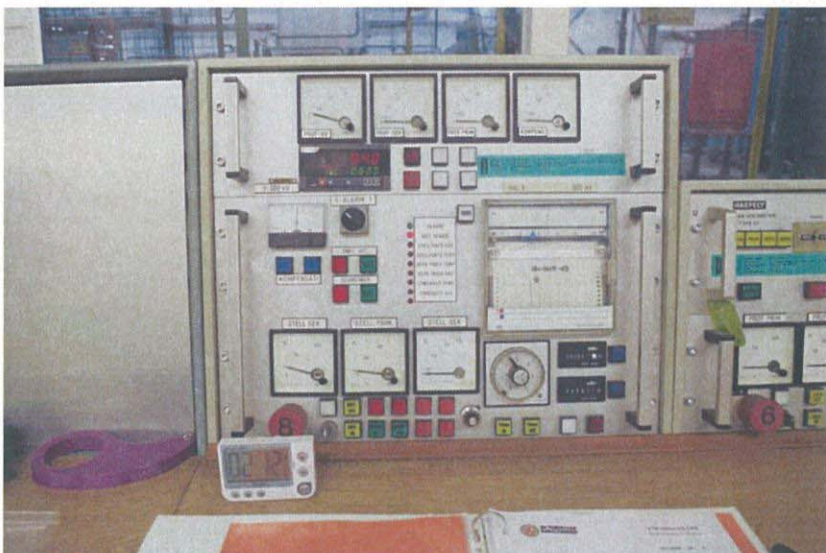
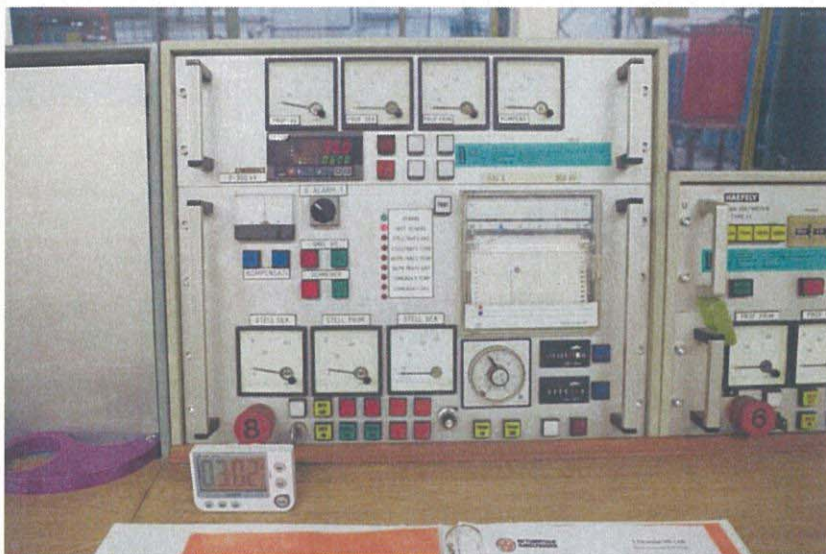
Er is ook een waterboomanalyse uitgevoerd aan de adersamples.

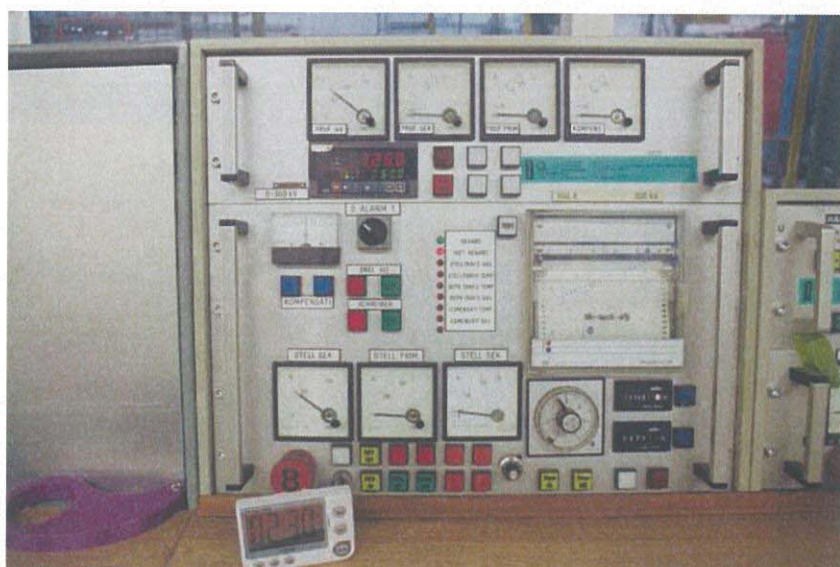
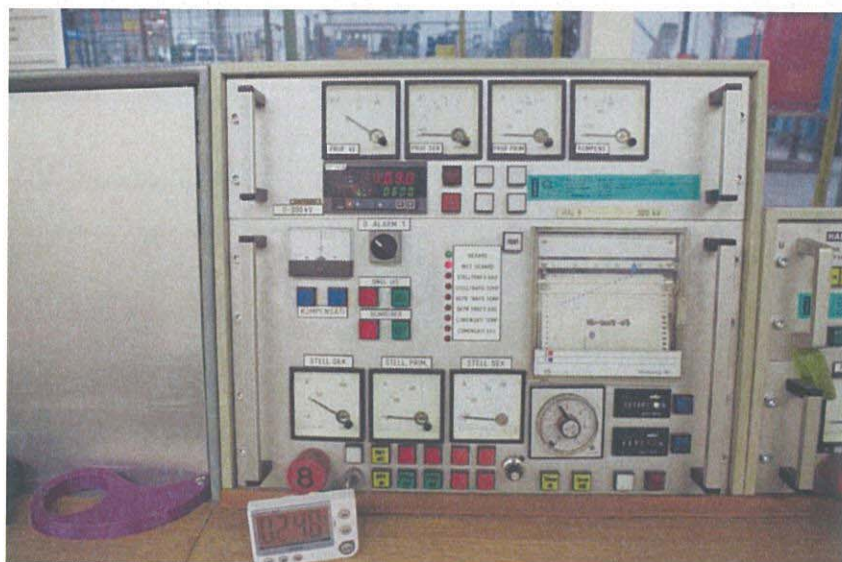
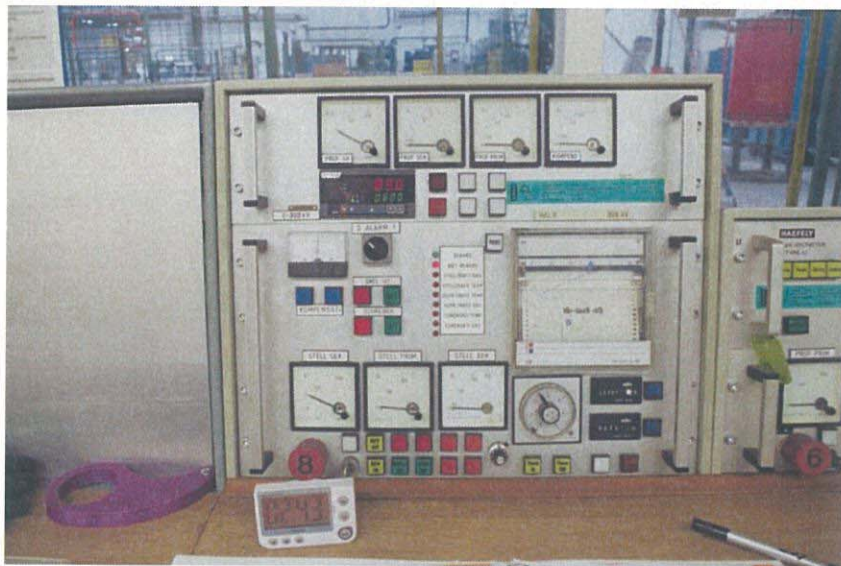
Hierin is slechts 1 bow-tie tree geconstateerd < 0,1 [mm]. Zie bijlage 3. (Waterboomanalyse)



Bijlage 1 Foto's opregel proeven











Bijlage 2 Opregel formulieren

BV TWENTSCHE
KABELFABRIEK

v Deventer HS-LAB

Senior Technicus G. Roolvink

VOLG NR ...204-0...

1.
2.
3.

AC Steptest volgens KEMA / VDE

KABELTYPE: : i.o.w. L. Pots opgegeven als 6/10 kV 23-5-16

KABELNR : * niet geconditioneerd *

KK :

OPMERKING : X - 2015 - 07 500 Hz / 3000 h

DATUM:	S:	FILENR:	MAX. SPANNING:	OPMERKING	PARAAF:
23-5-16	1		130 kV	-	GR
23-5-16	2		114 kV	-	GR
23-5-16	3		114 kV	-	GR
	4				

	kV STAND	NR	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4
foto	18 36 kV	1	8	8	8	
	24 48 kV	2	8	8	8	
	30 60 kV	3	8	8	8	
foto	36 72 kV	4	8	8	8	
	42 84 kV	5	8	8	8	
	48 96 kV	6	8	8	8	
foto	54 108 kV	7	8	8	8	
	60 120 kV	8	8	8	8	
	66 132 kV	9	8	8	8	
foto	72 144 kV	10	8	8	8	
	78 156 kV	11	8	8	8	
	84 168 kV	12	8	8	8	
foto	90 180 kV	13	8	8	8	
	96 192 kV	14	8	8	8	
	102 204 kV	15	8	8	8	
foto	108 216 kV	16	8	8	8	
	114 228 kV	17	8	8	8	
	120 240 kV	18	8	2 minute	2 minute	
foto	126 252 kV	19	8			
	132 264 kV *	20	8			

* pot meter schuiven naar 70

OPREGELFORM 02.doc

BV TWENTSCHE
KABELFABRIEK

v Deventer HS-LAB

Senior Technicus G. Roolvink

VOLG NR ...201 - 0...

1.
2.
3.

AC Steptest volgens KEMA / VDE

KABELTYPE:

: i.o.m. l. Pats opgegeven als 410kV

KABELNR

: * niet geconditioneerd *

KK

:

OPMERKING

: XL - 2015-02 500 Hz / 3000 h

DATUM:	S:	FILENR:	MAX. SPANNING:	OPMERKING	PARAAF:
	1				
	2				
	3				
	4				

kV STAND	NR	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4
130 36 kV	2 1	8			
144 48 kV	2 2	4 minuten			
150 60 kV	2 3				
156 72 kV	2 4				
162 84 kV	2 5				
168 96 kV	2 6				
174 108 kV	2 7				
180 120 kV	2 8				
186 132 kV	2 9				
192 144 kV	3 0				
198 156 kV	3 1				
204 168 kV	3 2				
180 kV	3 3				
192 kV	3 4				
204 kV	3 5				
216 kV	3 6				
228 kV	3 7				
240 kV	3 8				
252 kV	3 9				
264 kV	20				

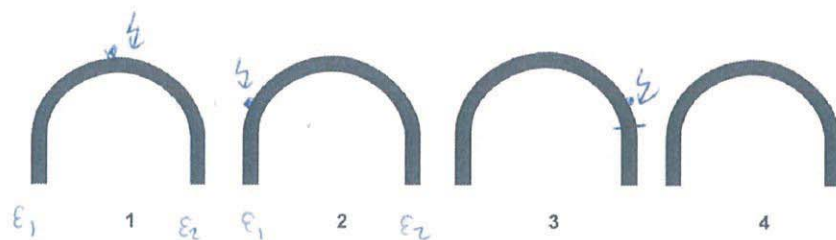


TKF CONNECTIVITY SOLUTIONS

BV TWENTSCHE
KABELFABRIEK

v Deventer HS-LAB

Senior Technicus G. Roolvink





Bijlage 3 Waterboomanalyse

Waterboom onderzoek t.b.v. (Klant).								
Kabeltype: 1x150 Alrm 6/10 kV.			KK nr. 94465					
Kabelnr: Hanwa ader nr. 1			Uitgevoerd door: H. vld Geest.					
Aantal waterbomen.								
Schijfje nr.	< 0,1 mm	< 0,2 mm	< 0,3 mm	< 0,4 mm	< 0,5 mm	Bow-tie trees.	Vented trees.	Opmerkingen:
1	-	-	-	-	-	-	-	geen
2	-	-	-	-	-	-	-	geen
3	-	-	-	-	-	-	-	geen
4	-	-	-	-	-	-	-	geen
5	-	-	-	-	-	-	-	geen
6	1x	-	-	-	-	1x	-	geen
7	-	-	-	-	-	-	-	geen
8	-	-	-	-	-	-	-	geen
9	-	-	-	-	-	-	-	geen
10	-	-	-	-	-	-	-	geen
11	-	-	-	-	-	-	-	geen
12	-	-	-	-	-	-	-	geen
13	-	-	-	-	-	-	-	geen
14	-	-	-	-	-	-	-	geen
15	-	-	-	-	-	-	-	geen
16	-	-	-	-	-	-	-	geen
17	-	-	-	-	-	-	-	geen
18	-	-	-	-	-	-	-	geen
19	-	-	-	-	-	-	-	geen
20	-	-	-	-	-	-	-	geen

Schijfje 1 tot 20

Waterboom onderzoek t.b.v. (Klant).								
Kabeltype: 1x150 Alrm 6/10 kV.			KK nr. 94465					
Kabelnr: Hanwa ader nr. 1			Uitgevoerd door: H. v/d Geest.					
	Aantal waterbomen.							
Schijfje nr.	< 0,1 mm	< 0,2 mm	< 0,3 mm	< 0,4 mm	< 0,5 mm	Bow-tie trees.	Vented trees.	Opmerkingen:
21	-	-	-	-	-	-	-	geen
22	-	-	-	-	-	-	-	geen
23	-	-	-	-	-	-	-	geen
24	-	-	-	-	-	-	-	geen
25	-	-	-	-	-	-	-	geen
26	-	-	-	-	-	-	-	geen
27	-	-	-	-	-	-	-	geen
28	-	-	-	-	-	-	-	geen
29	-	-	-	-	-	-	-	geen
30	-	-	-	-	-	-	-	geen
31	-	-	-	-	-	-	-	geen
32	-	-	-	-	-	-	-	geen
33	-	-	-	-	-	-	-	geen
34	-	-	-	-	-	-	-	geen
35	-	-	-	-	-	-	-	geen
36	-	-	-	-	-	-	-	geen
37	-	-	-	-	-	-	-	geen
38	-	-	-	-	-	-	-	geen
39	-	-	-	-	-	-	-	geen
40	-	-	-	-	-	-	-	geen

Schijfje 21 tot 40



Waterboom onderzoek t.b.v. (Klant).								
Kabeltype: 1x150 Alrm 6/10 kV.			KK nr. 94465					
Kabelnr: Hanwa ader nr. 2			Uitgevoerd door: H. v/d Geest.					
Aantal waterbomen.								
Schijfje nr.	< 0,1 mm	< 0,2 mm	< 0,3 mm	< 0,4 mm	< 0,5 mm	Bow-tie trees.	Vented trees.	Opmerkingen:
1	-	-	-	-	-	-	-	geen
2	-	-	-	-	-	-	-	geen
3	-	-	-	-	-	-	-	geen
4	-	-	-	-	-	-	-	geen
5	-	-	-	-	-	-	-	geen
6	-	-	-	-	-	-	-	geen
7	-	-	-	-	-	-	-	geen
8	-	-	-	-	-	-	-	geen
9	-	-	-	-	-	-	-	geen
10	-	-	-	-	-	-	-	geen
11	-	-	-	-	-	-	-	geen
12	-	-	-	-	-	-	-	geen
13	-	-	-	-	-	-	-	geen
14	-	-	-	-	-	-	-	geen
15	-	-	-	-	-	-	-	geen
16	-	-	-	-	-	-	-	geen
17	-	-	-	-	-	-	-	geen
18	-	-	-	-	-	-	-	geen
19	-	-	-	-	-	-	-	geen
20	-	-	-	-	-	-	-	geen

Schijfje 1 tot 20

Waterboom onderzoek t.b.v. (Klant).								
Kabeltype: 1x150 Alrm 6/10 kV.			KK nr. 94465					
Kabelnr: Hanwa ader nr. 2			Uitgevoerd door: H. v/d Geest.					
Aantal waterbomen.								
Schijfje nr.	< 0,1 mm	< 0,2 mm	< 0,3 mm	< 0,4 mm	< 0,5 mm	Bow-tie trees.	Vented trees.	Opmerkingen:
21	-	-	-	-	-	-	-	geen
22	-	-	-	-	-	-	-	geen
23	-	-	-	-	-	-	-	geen
24	-	-	-	-	-	-	-	geen
25	-	-	-	-	-	-	-	geen
26	-	-	-	-	-	-	-	geen
27	-	-	-	-	-	-	-	geen
28	-	-	-	-	-	-	-	geen
29	-	-	-	-	-	-	-	geen
30	-	-	-	-	-	-	-	geen
31	-	-	-	-	-	-	-	geen
32	-	-	-	-	-	-	-	geen
33	-	-	-	-	-	-	-	geen
34	-	-	-	-	-	-	-	geen
35	-	-	-	-	-	-	-	geen
36	-	-	-	-	-	-	-	geen
37	-	-	-	-	-	-	-	geen
38	-	-	-	-	-	-	-	geen
39	-	-	-	-	-	-	-	geen
40	-	-	-	-	-	-	-	geen

Schijfje 21 tot 40



Waterboom onderzoek t.b.v. (Klant).								
Kabeltype: 1x150 Alrm 6/10 kV.			KK nr. ?					
KabeInr: Hanwa ader nr. 3			Uitgevoerd door: H. v/d Geest.					
Aantal waterbomen.								
Schijfje nr.	< 0,1 mm	< 0,2 mm	< 0,3 mm	< 0,4 mm	< 0,5 mm	Bow-tie trees.	Vented trees.	Opmerkingen:
1	-	-	-	-	-	-	-	geen
2	-	-	-	-	-	-	-	geen
3	-	-	-	-	-	-	-	geen
4	-	-	-	-	-	-	-	geen
5	-	-	-	-	-	-	-	geen
6	-	-	-	-	-	-	-	geen
7	-	-	-	-	-	-	-	geen
8	-	-	-	-	-	-	-	geen
9	-	-	-	-	-	-	-	geen
10	-	-	-	-	-	-	-	geen
11	-	-	-	-	-	-	-	geen
12	-	-	-	-	-	-	-	geen
13	-	-	-	-	-	-	-	geen
14	-	-	-	-	-	-	-	geen
15	-	-	-	-	-	-	-	geen
16	-	-	-	-	-	-	-	geen
17	-	-	-	-	-	-	-	geen
18	-	-	-	-	-	-	-	geen
19	-	-	-	-	-	-	-	geen
20	-	-	-	-	-	-	-	geen

Schijfje 1 tot 20

Waterboom onderzoek t.b.v. (klant).								
Kabeltype: 1x150 Alrm 6/10 kV.			KK nr. 94465					
Kabelnr: Hanwa ader nr. 3			Uitgevoerd door: H. v/d Geest.					
Aantal waterbomen.								
Schijfje nr.	< 0,1 mm	< 0,2 mm	< 0,3 mm	< 0,4 mm	< 0,5 mm	Bow-tie trees.	Vented trees.	Opmerkingen:
21	-	-	-	-	-	-	-	geen
22	-	-	-	-	-	-	-	geen
23	-	-	-	-	-	-	-	geen
24	-	-	-	-	-	-	-	geen
25	-	-	-	-	-	-	-	geen
26	-	-	-	-	-	-	-	geen
27	-	-	-	-	-	-	-	geen
28	-	-	-	-	-	-	-	geen
29	-	-	-	-	-	-	-	geen
30	-	-	-	-	-	-	-	geen
31	-	-	-	-	-	-	-	geen
32	-	-	-	-	-	-	-	geen
33	-	-	-	-	-	-	-	geen
34	-	-	-	-	-	-	-	geen
35	-	-	-	-	-	-	-	geen
36	-	-	-	-	-	-	-	geen
37	-	-	-	-	-	-	-	geen
38	-	-	-	-	-	-	-	geen
39	-	-	-	-	-	-	-	geen
40	-	-	-	-	-	-	-	geen

Schijfje 21 tot 40

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS- 421-507-E001A	
		VOLUME II	
		SECTION I	
		REVISION 00	DATE: 30.03.2021
		SHEET 1 OF 4	

DATASHEET C

**GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)**

S.No.	Particulars	Unit	Description
1.0	GENERAL		
1.1	Name of Manufacturer	-	
1.2	Place of Manufacture	-	
2.0	STANDARDS APPLICABLE		
2.1	IEC-60502-2 For general specification of XLPE Cables	YES	
2.2	IEC-60228 For conductor material	YES	
2.3	IEC-60502-2 For material of innersheath & outersheath	YES	
2.4	IEC-60502-2/IEC-60228 For armour of 3 core/ single core cables	YES	
2.5	IEC-60811 For method of tests	YES	
2.6	ASTMD-2863 For oxygen index test & Temperature index test	YES	
2.7	SS:424-14-75 & IEC-60332-1 & IEEE: 60383 For flammability test	YES	
2.8	IEC-60754-1 For acid gas generation test	YES	
2.9	ASTMD-2843, IEC 61034 For smoke generation test	YES	
2.10	Current rating of cables conforms to	-	
2.11	Short circuit rating conforms to	-	
2.12	Formula for calculating short circuit current for different durations	-	
3.0	INSTALLATION CONDITIONS AT SITE		
3.1	Ambient air temperature	deg. C	
3.2	Ground temperature	deg. C	
3.3	Depth of laying of cables buried in ground	cm	
3.4	Thermal resistivity of soil	deg. C cm/W	
4.0	INSTALLATION CONDITIONS FOR CURRENT RATING		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS- 421-507-E001A	
		VOLUME II	
		SECTION I	
		REVISION 00	DATE: 30.03.2021
		SHEET 2 OF 4	

	SPECIFIED AT CLAUSE 7.3		
5.0	CHARACTERISTICS OF FR-LSH SHEATH		
5.1	Oxygen index	-	
5.2	Temperature index	-	
5.3	Acid gas generation	-	
5.4	Smoke density rating	-	
6.0	CABLE DRUMS		
6.1	Type & construction	-	
6.2	Standard drum length	-	
6.3	Tolerance on drum length	-	
7.0	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE		
7.1	No. of cores x size	-	
7.2	Voltage grade (Uo/U)	kV	
7.3	Base current ratings (*) based on Clause No. 3.0		
a)	In air	Amp	
b)	In ground	Amp	
c)	ducts	Amp	
7.4	Short circuit rating	kA, sec	
7.5	Properties		
a)	D.C. resistance of conductor at 20 deg. C	ohm/km	
b)	A.C. resistance of conductor at 90 deg. C	ohm/km	
c)	Reactance of cable at normal frequency	ohm/km	
d)	Electrostatic capacitance of cable at normal frequency	mF/km	
7.6	CONDUCTOR		
a)	Material type & grade	-	
b)	No & dia of wires in each core before stranding	no x mm	
c)	Shape	-	
7.7	CONDUCTOR SCREEN		
a)	Material	-	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS- 421-507-E001A	
		VOLUME II	
		SECTION I	
		REVISION 00	DATE: 30.03.2021
		SHEET 3 OF 4	

b)	Minimum thickness	mm	
7.8	XLPE INSULATION		
a)	Nominal thickness of insulation	mm	
b)	Method of curing	-	
c)	Whether suitable for Water Tree Test (accelerated) - Water Tree Test of XLPE Insulation (accelerated) - Test voltage = 3 x U₀ - Test frequency = 500 Hz - Core environment = 400C water - Duration of test = 4 month - Test after 4 months: Dielectric stress withstand >14kV/mm.	YES	
7.9	INSULATION SCREEN		
a)	Type of screen	-	
b)	Material and thickness (minimum and nominal)	mm	
i)	Metallic	-	
	No. of tapes and Minimum overlapping	-	
ii)	Non-metallic	-	
iii)	Earth fault current withstand capacity (calculation to be furnished)	kA, sec.	
7.10	PVC ST2 FR-LSH INNERSHEATH		
a)	Material	-	
b)	Thickness (min.)	mm.	
c)	Method of application	-	
1)	Multi-core cables		
i)	With fillers	-	
ii)	With out fillers	Pressure Extruded	
2)	Single core cables		
d)	Type & Shape of fillers (if used)	-	
e)	Colour	-	
7.11	ARMOUR	NOT APPLICABLE	
a)	Material	-	
b)	Size/ dimensions	-	
c)	Minimum no. of wires/ formed wires	-	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS- 421-507-E001A	
		VOLUME II	
		SECTION I	
		REVISION 00	DATE: 30.03.2021
		SHEET 4 OF 4	

d)	Tolerance on formed wire dimension	-	
e)	Maximum resistivity of GS formed wire	-	
f)	Maximum resistivity of Al round wire	-	
7.12	PVC ST2 FR-LSH OUTERSHEATH		
a)	Nominal thickness of outer sheath	mm.	
7.13	DIAMETERS		
a)	Diameter of insulated conductor	mm.	
b)	Cable diameter under armour	mm.	
c)	Cable diameter over armour	mm.	
d)	Overall diameter of cable	mm.	
7.14	Tolerance on overall diameter	(±) mm	
7.15	Minimum bending radius	x O.D.	
7.16	Safe pulling force	kg.	
7.17	Weight of cable	kg./km	
a)	Weight of conductor	MT./km	
b)	Weight of XLPE insulation	MT./km	
c)	Weight of PVC (Inner Sheath & Fillers)	kg./km	
d)	Maximum resistivity of GS formed wire	kg./km	
e)	Weight of PVC (Outer Sheath & Fillers)	kg./km	
7.18	Dimension of drum	mm.	
7.19	Shipping weight	kg	
7.20	Cable marking on outer sheath	-	

(*) For single core cables, the continuous current rating shall be furnished separately for armour earthed at one end and at both ends.

:

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

ANNEXUR-A

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 TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 2	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 3	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 4	OF 52

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 5	OF 52

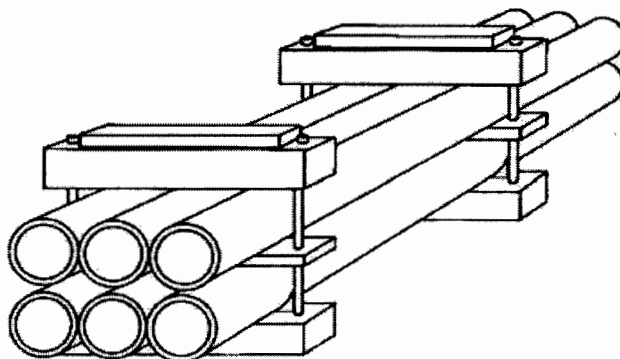
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long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

8.2 Bundling – Packing Category I

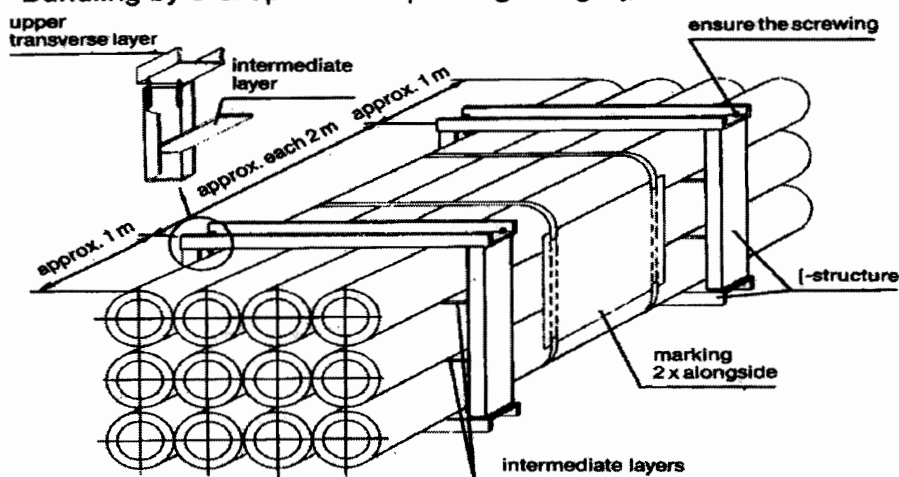
8.2.1 Type of Equipment

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 6	OF 52

- 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)

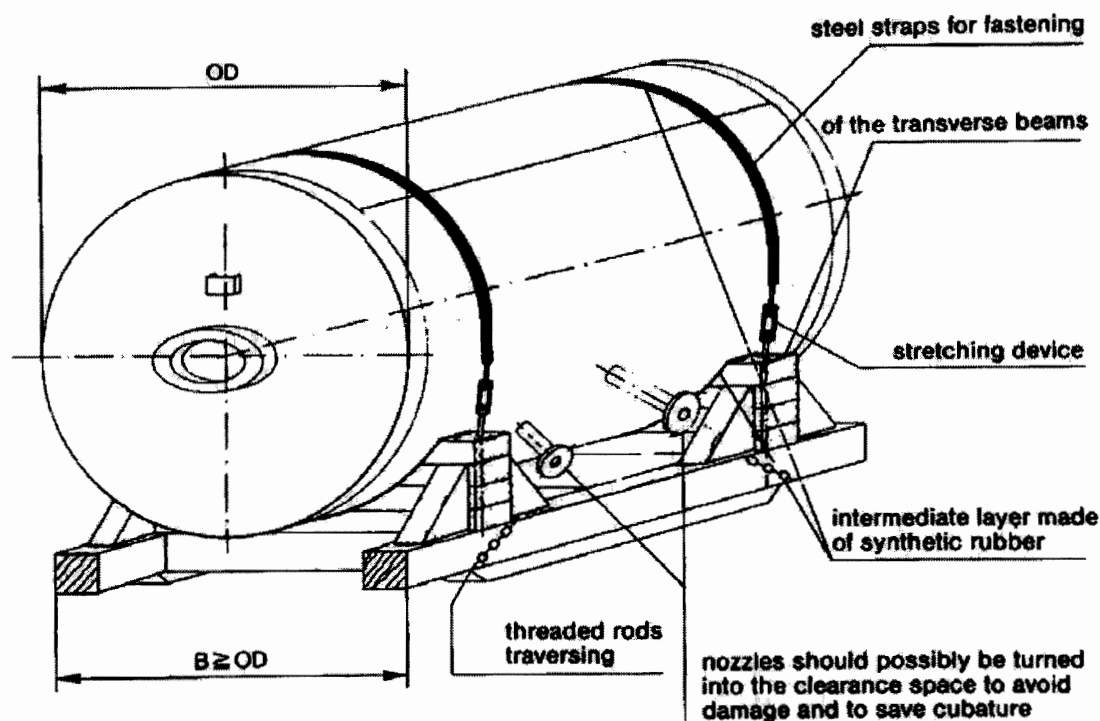
8.3.1 Type of Equipment

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



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 7	OF 52

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

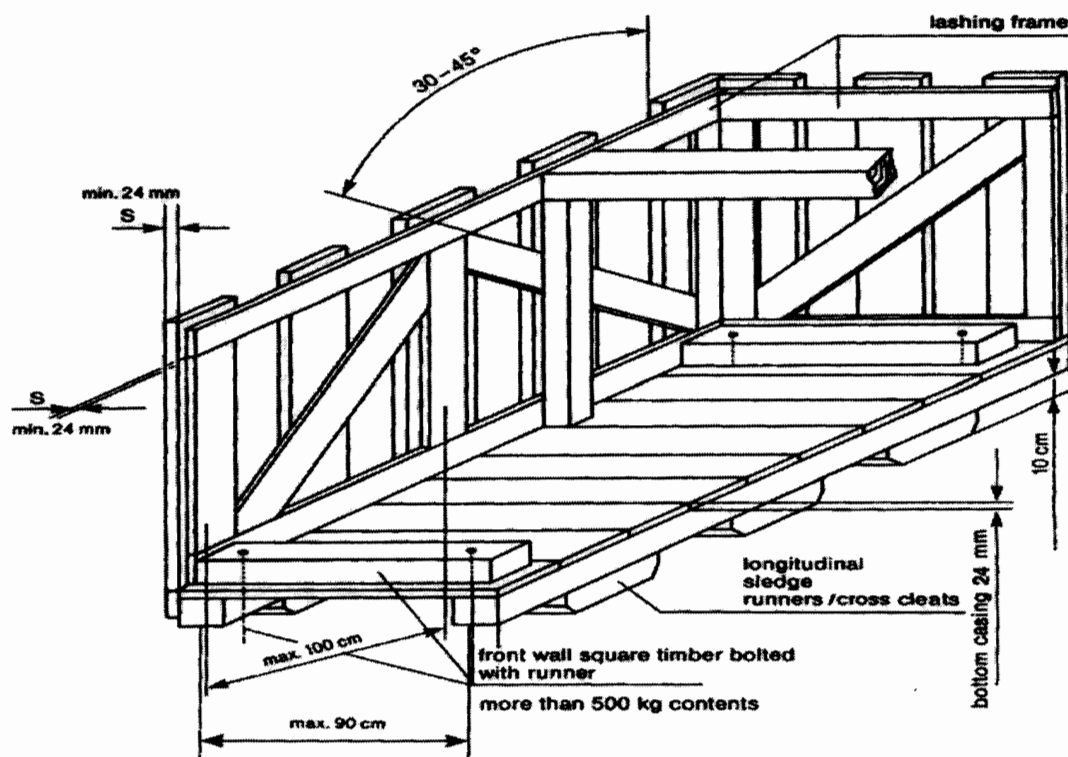
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

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



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 8	OF 52

8.4.2 Cases with Lining – Packing Category IV

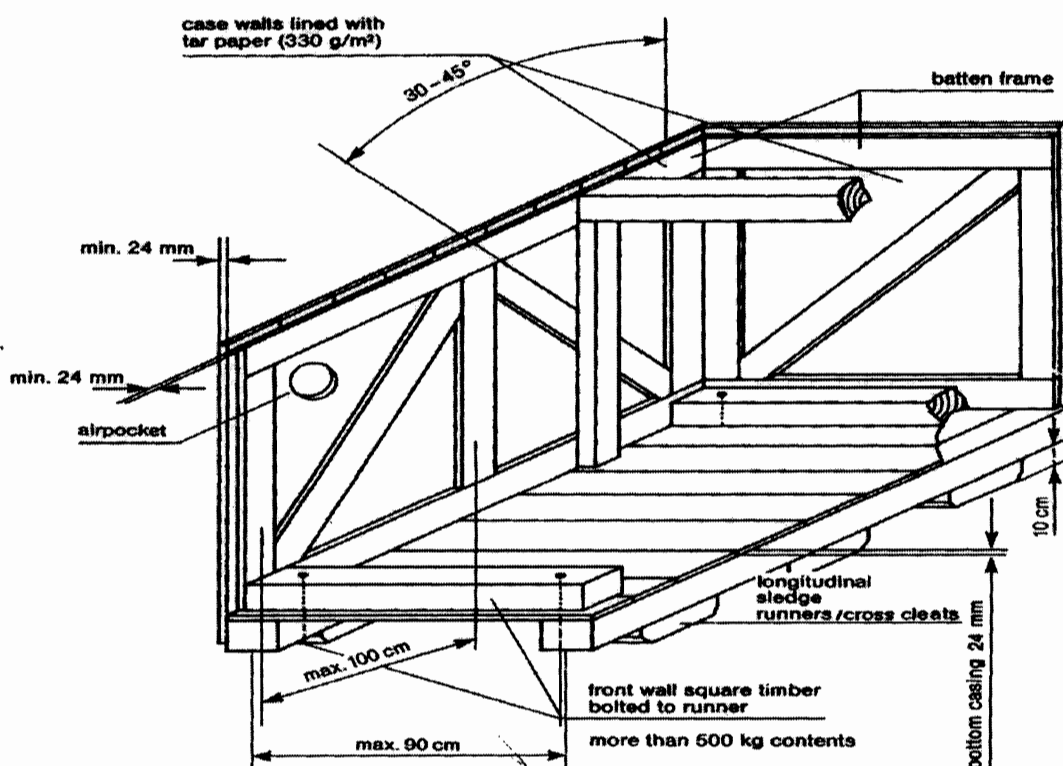
8.4.2.1 Type of Equipment

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.

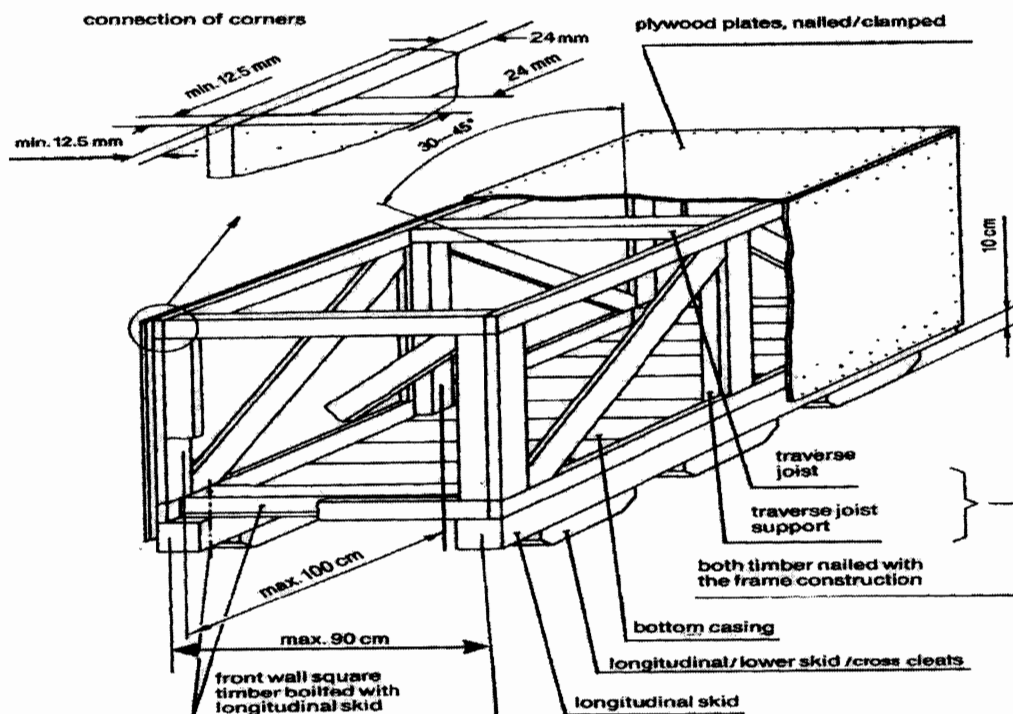
Packing Category IV



8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 9	OF 52



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

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

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

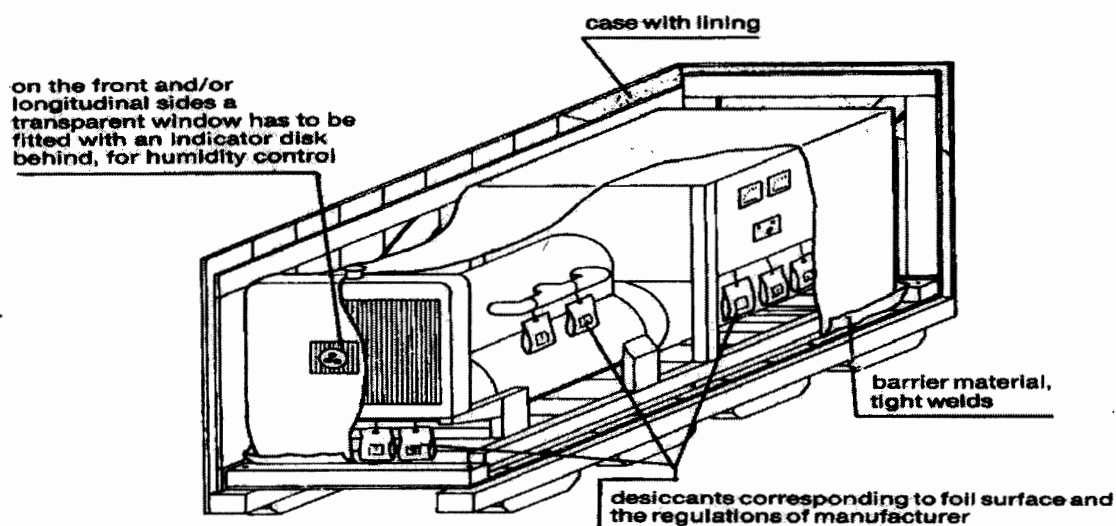
8.4.5.2 Type of Construction

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).

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 11	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001		
		VOLUME II B		
		SECTION D		
		REV. NO. 0	DATE 10/08/2010	
		SHEET 12	OF	52

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, cracks, 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 13	OF 52

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

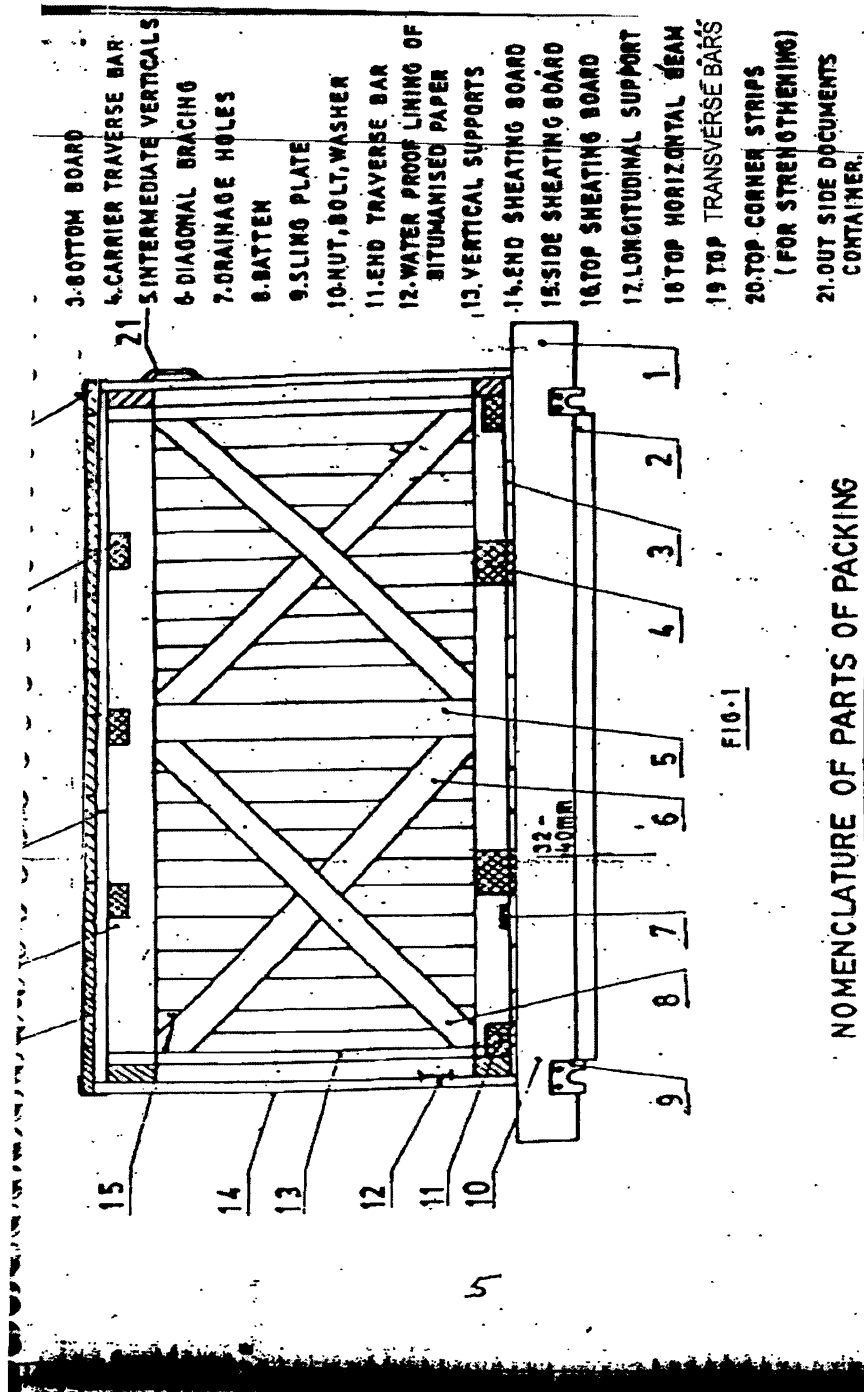
- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 14	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 15	OF 52



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 16	OF 52

BOTTOM FRAME ARRANGEMENTS

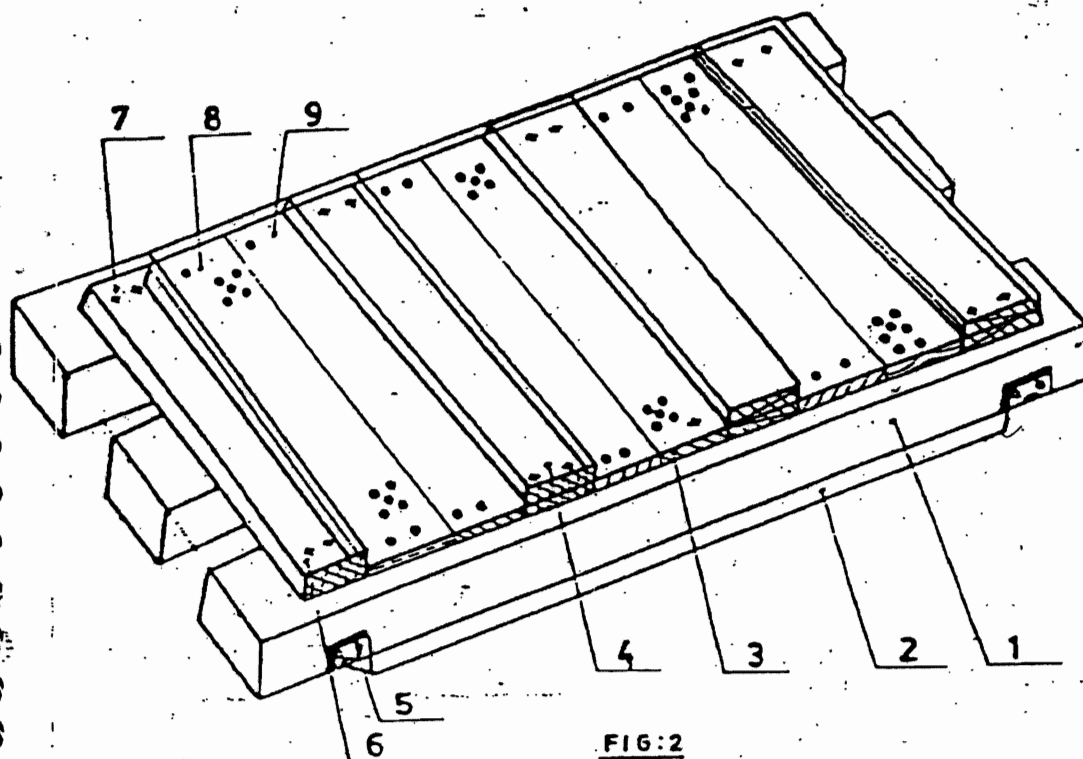


FIG:2

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 bar; 100 x 100 mm.
(minimum)

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

027

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 17	OF 52

TOP FRAME ARRANGEMENT

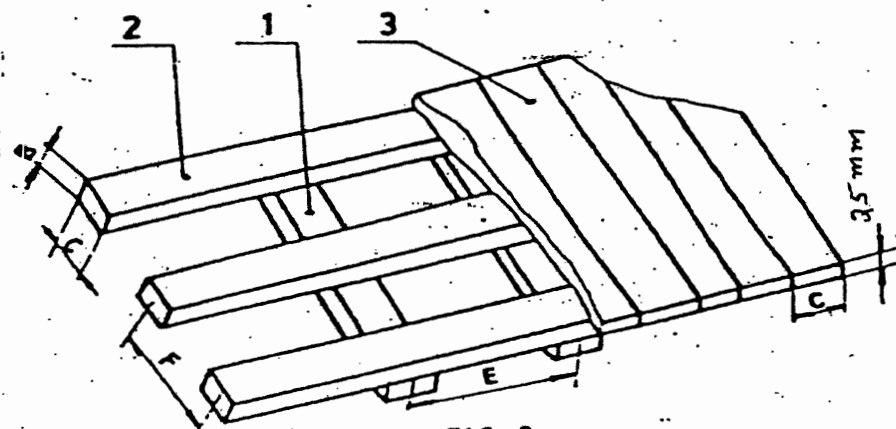
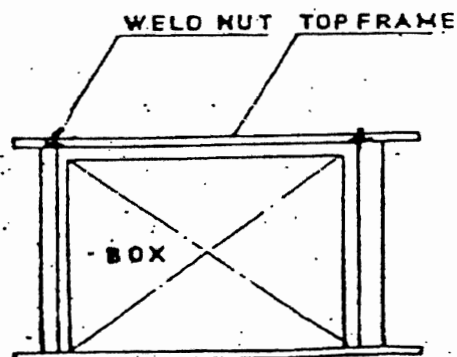
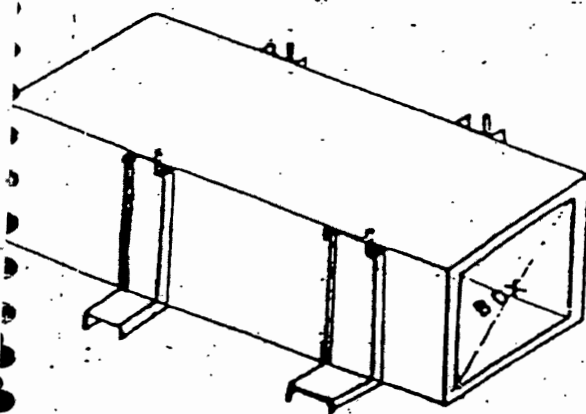


FIG-3

F : 700 to 1000 mm
 E : 500 to 900 mm
 30x100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Soans
- 3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 18	OF 52

ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

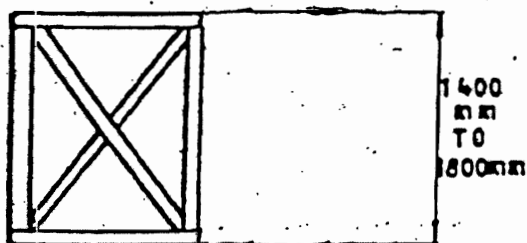


FIG: 6

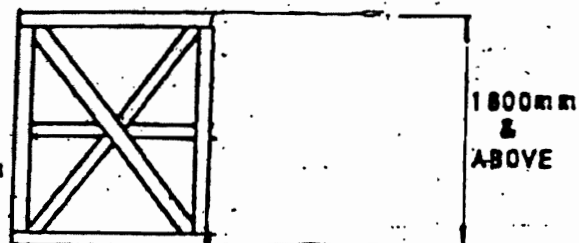


FIG: 8

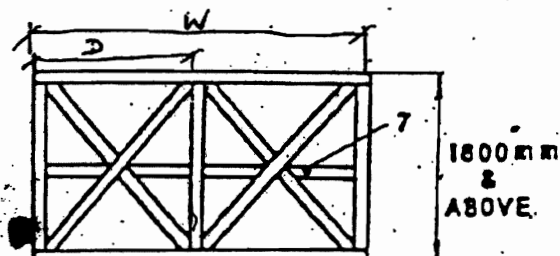


FIG: 7

7- Middle Horizontal Support

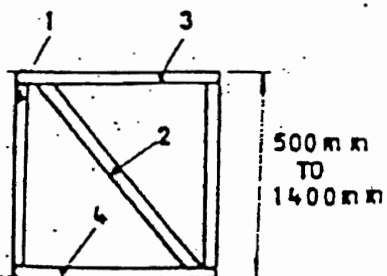


FIG: 5

1- Vertical Support

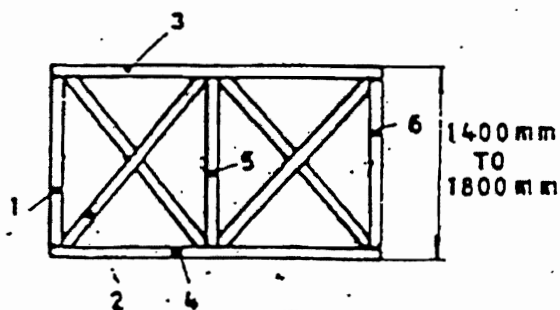
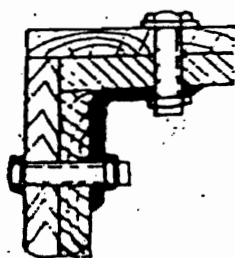
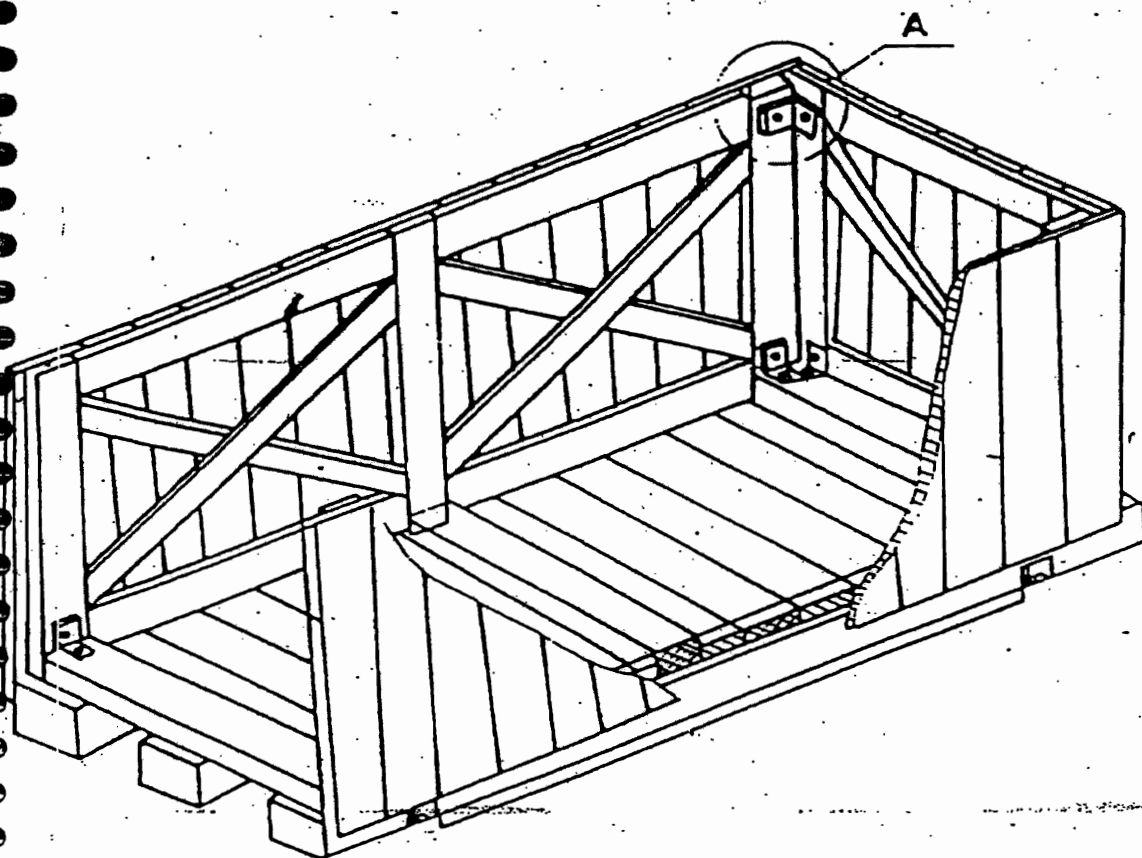


FIG: 7

1, 5, 6 - Vertical Support

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 19	OF 52

ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

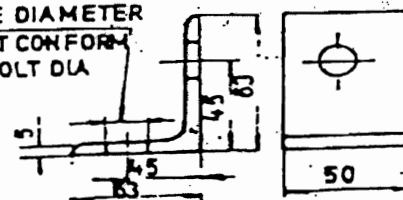
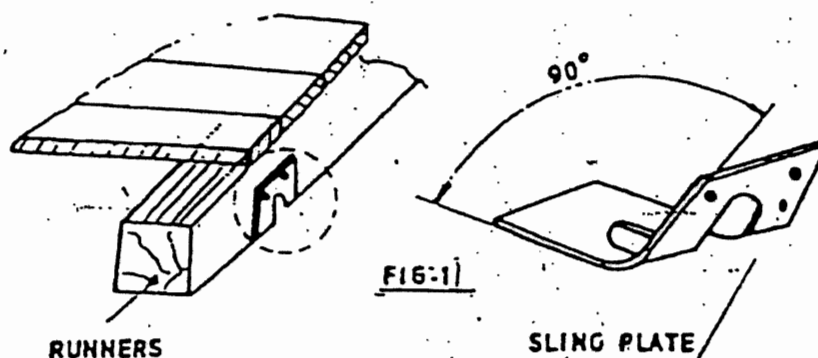


FIG:10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 20	OF 52

ARRANGEMENT OF SLING & PLATE ON CASES



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 21	OF 52

TABLE-1

LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c				c b		
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

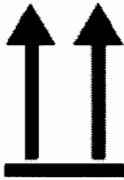
	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 22	OF 52

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	30	30	30	30	30	30
		X	X	X	X	X	X	X
	1201 to 1600	100	100	100	130	130	130	130
		30	30	30	30	30	30	30
	1601 to 2000	X	X	X	X	X	X	X
		130	130	130	130	130	130	130
	2001 to 3000	30	30	30	30	30	30	40
		X	X	X	X	X	X	X
	3001 to 4000	130	130	130	130	130	130	150
		40	40	40	40	40	40	40
		X	X	X	X	X	X	X
		150	150	150	150	150	150	150

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 23	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 24	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 25	OF 52

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS		SPECIFICATION NO. PE-TS-888-100-A001	
			VOLUME II B	
			SECTION D	
			REV. NO. 0	DATE 10/08/2010
			SHEET 26	OF 52

BHEL-PEM-DELHI-INDIA	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	MO. NO.
DESPATCH ADVICE NOTE NO.	CASE NO.
DIMENSIONS(MM) LXBXH	NET WT -KGS
	GROSS WT -KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE -- KEEP DRY DO NOT DROP -- DO NOT TILT

FIG-13: MARKING PLATE

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 27	OF 52

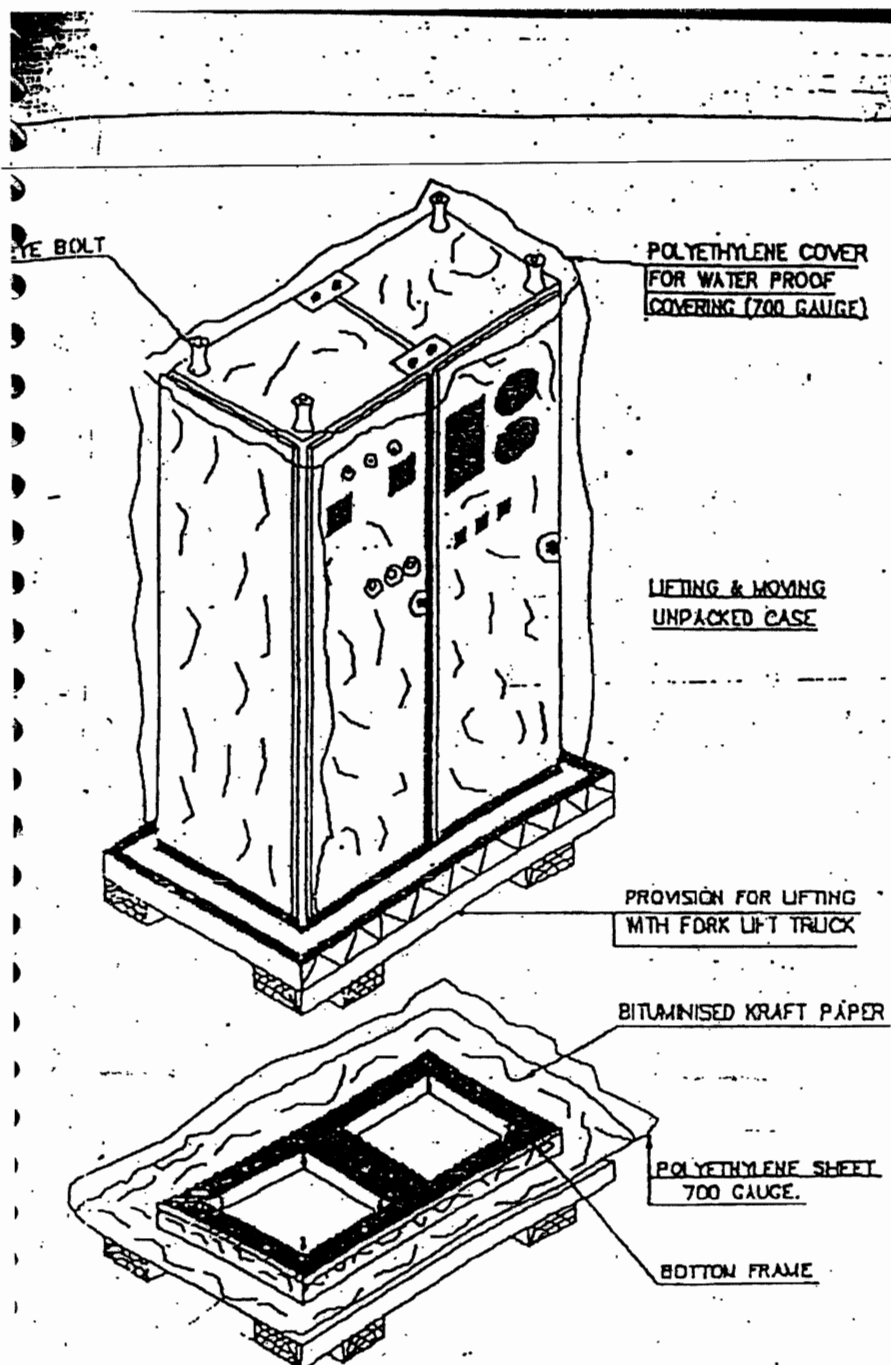


FIGURE-14

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 28	OF 52

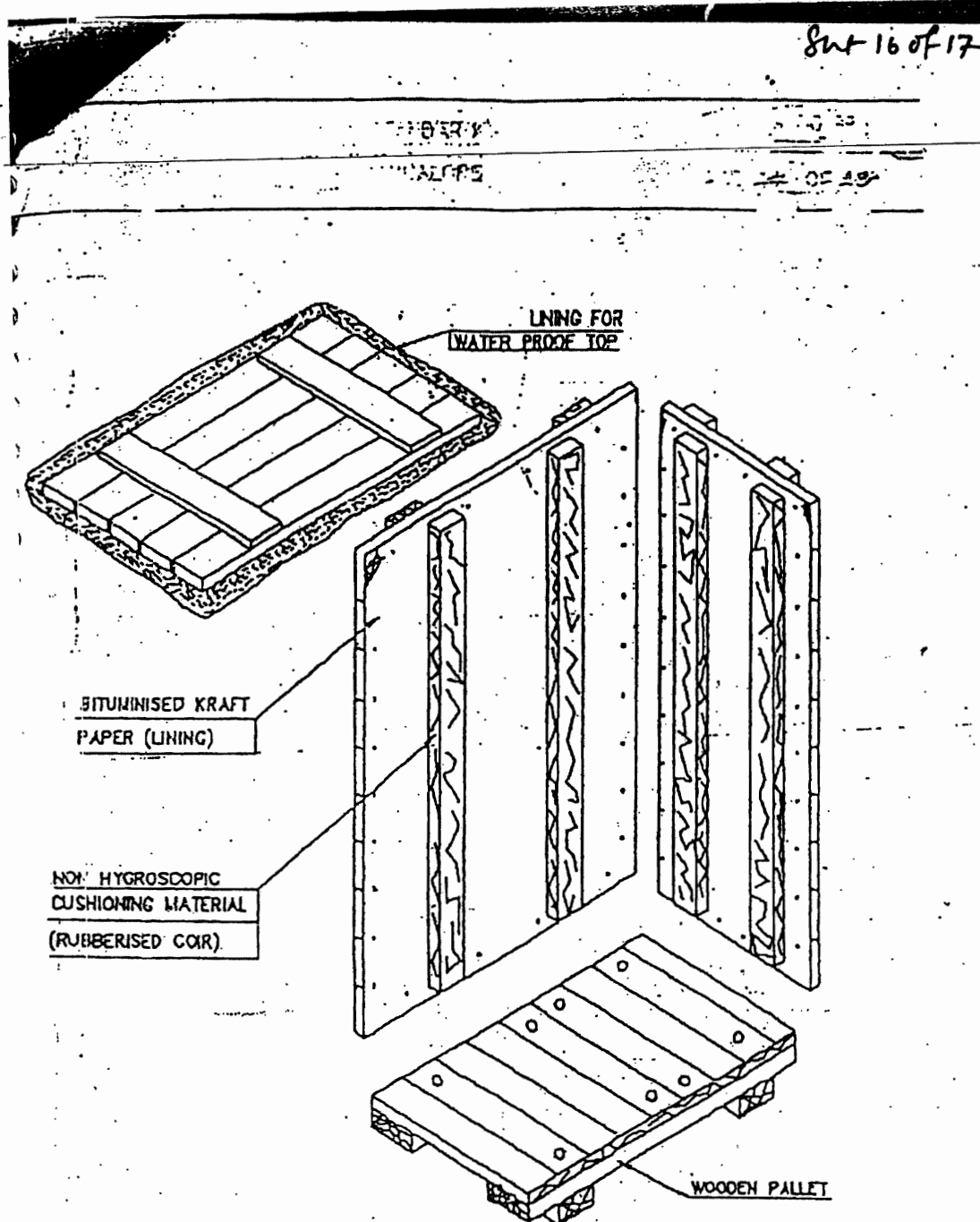
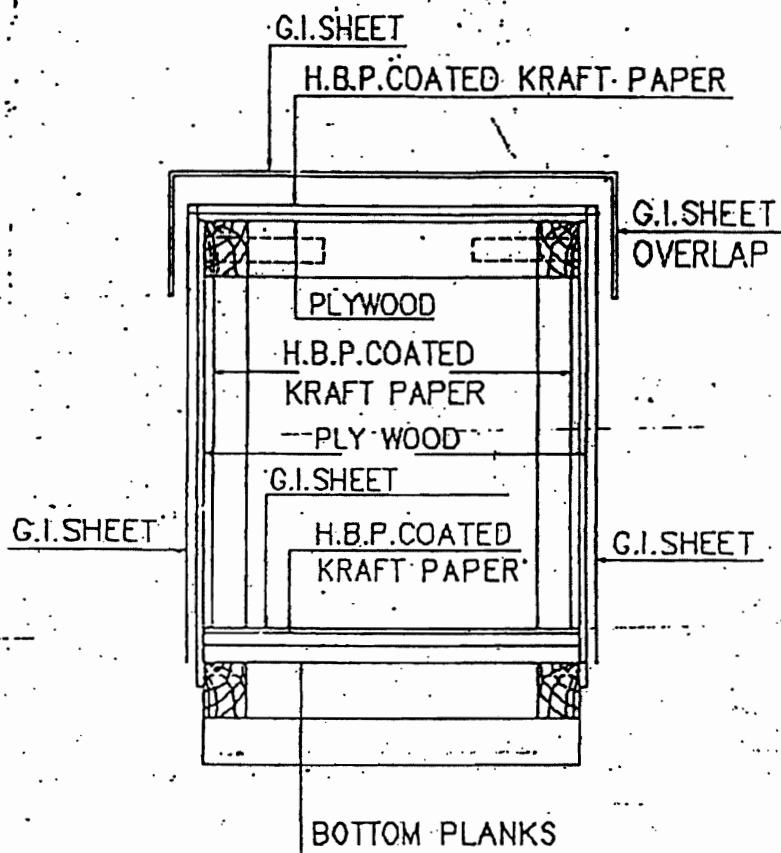


FIGURE-15

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 29	OF 52



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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 30	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 31	OF 52

- 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.

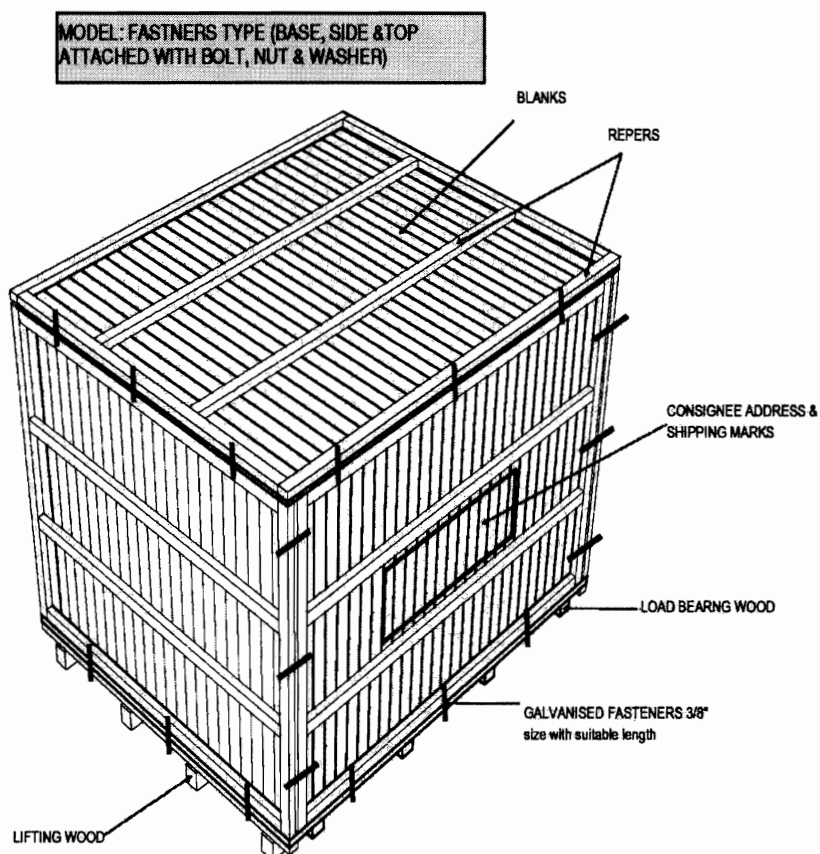
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		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 32	OF 52

- 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.

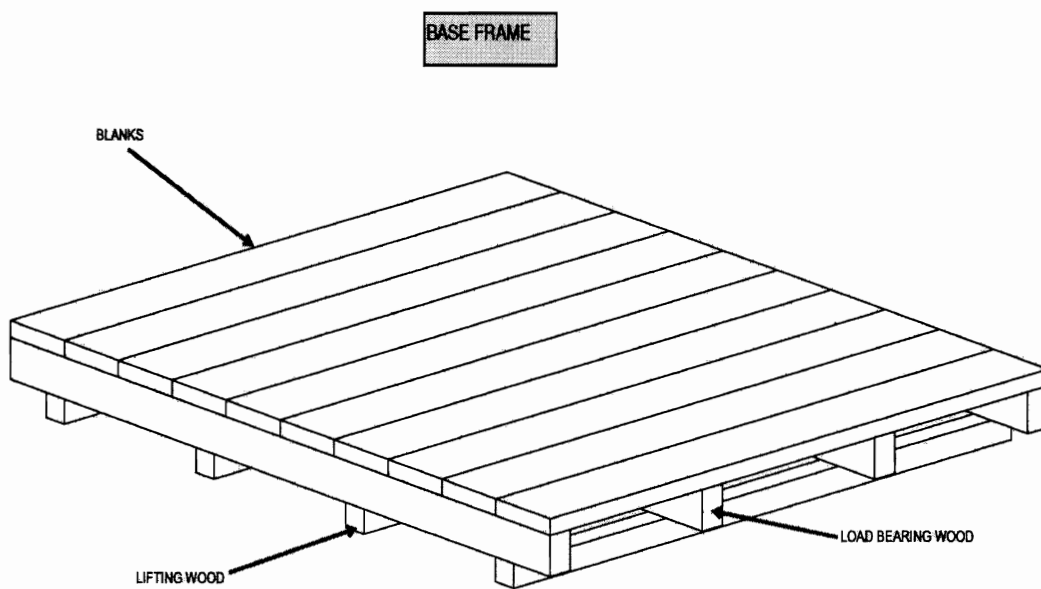
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		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 33	OF 52

This Type of case to be used for following items:

1. BALL SEPERATOR
2. BALL COLECTOR SKID

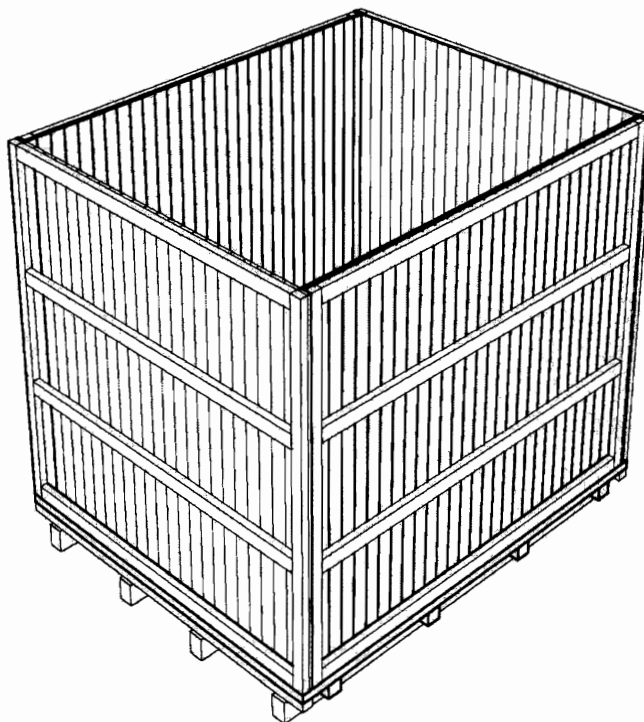


	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 34	OF 52

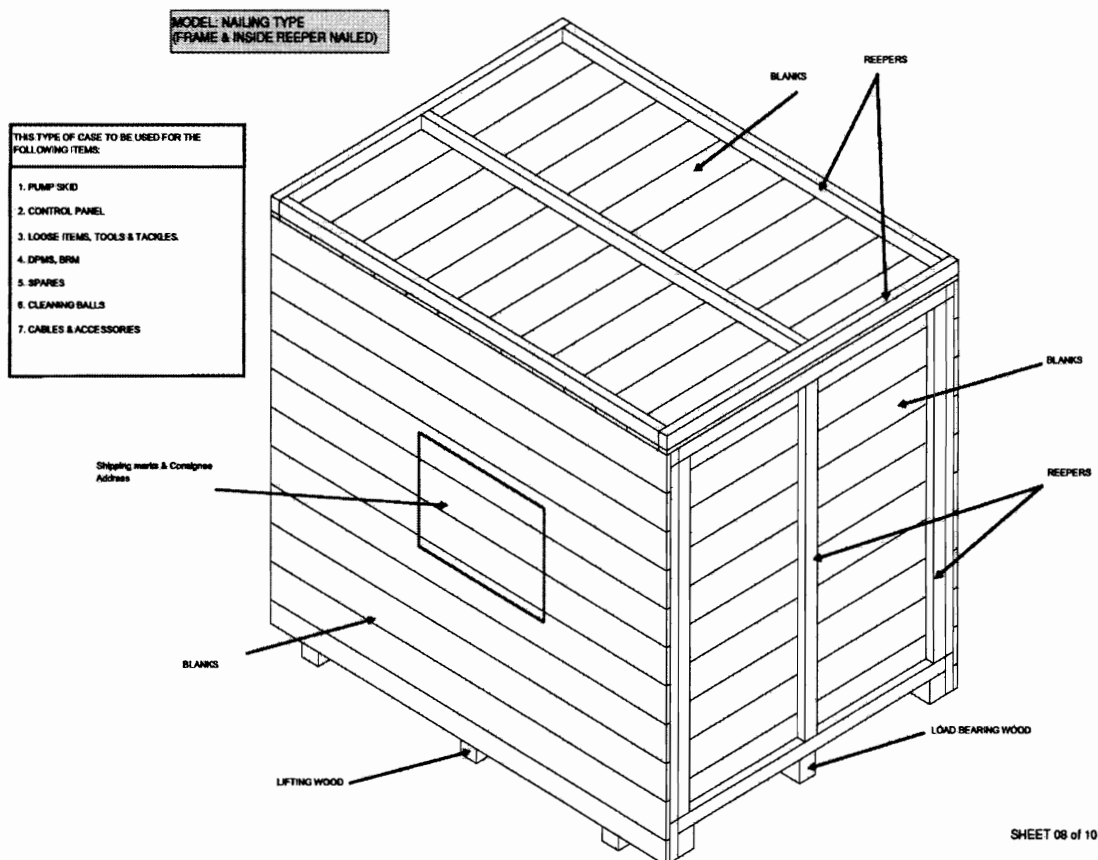


	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 35	OF 52

MODEL: FASTNERS TYPE - WITHOUT TOP

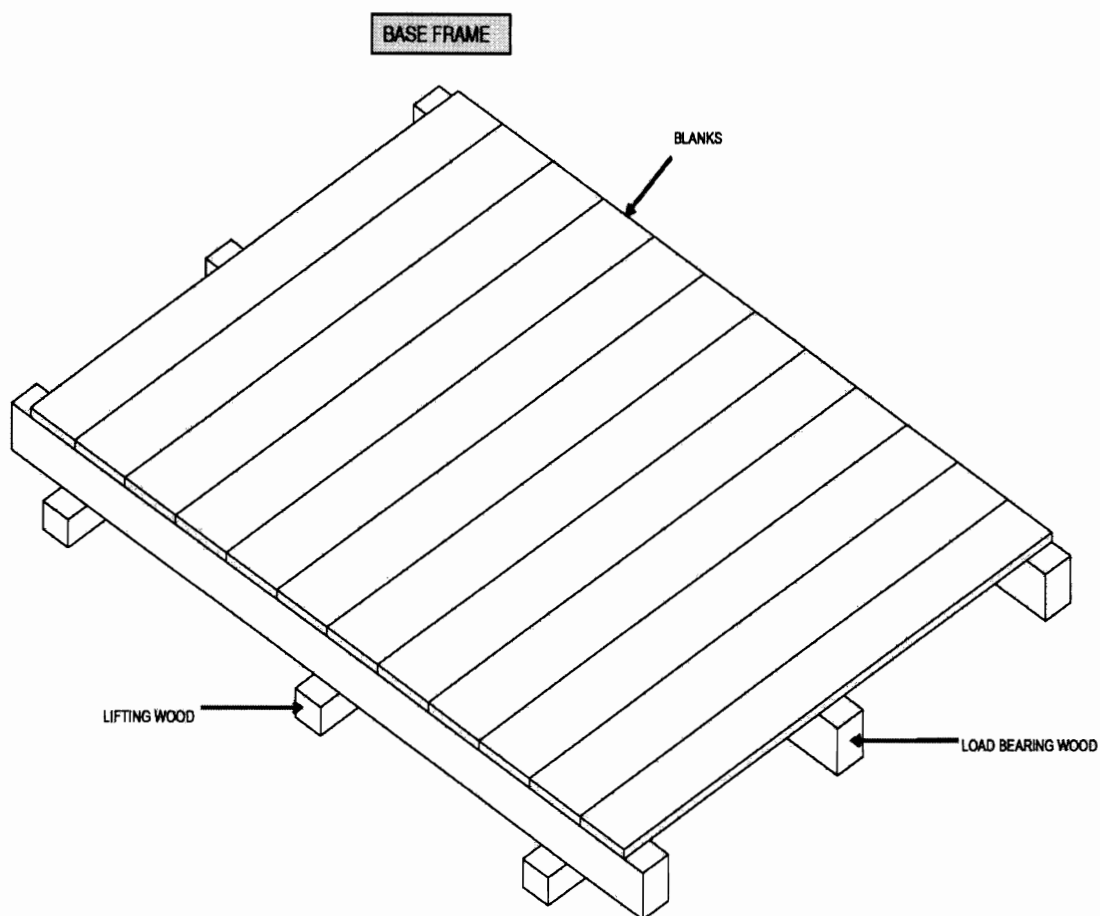


	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 36	OF 52



SHEET 08 of 10

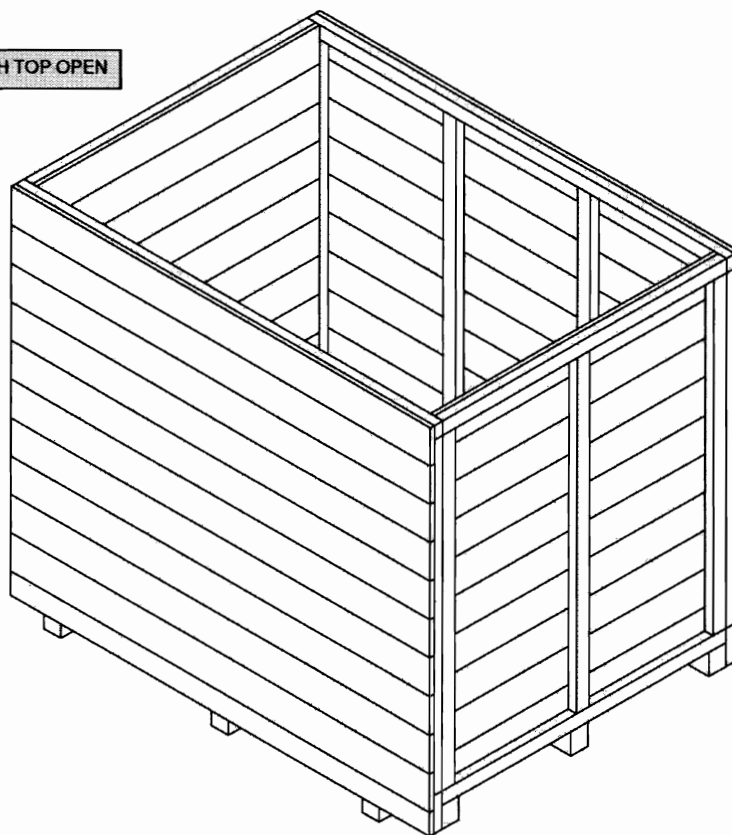
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		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 37	OF 52



SHEET 09 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001			
		VOLUME II B			
		SECTION D			
		REV. NO. 0	DATE 10/08/2010		
		SHEET 38	OF	52	

NAILING TYPE MODEL WITH TOP OPEN



SHEET 10 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 39	OF 52

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

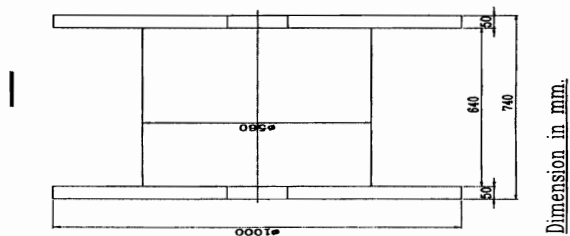
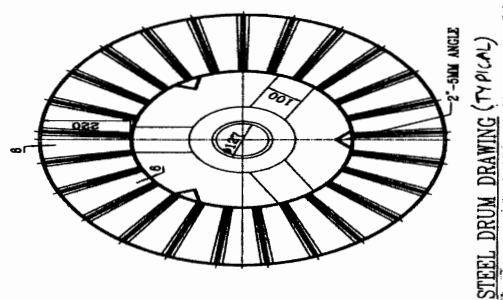
11.1 CABLES

11.1.1 **Type of Equipment** All type of cables..

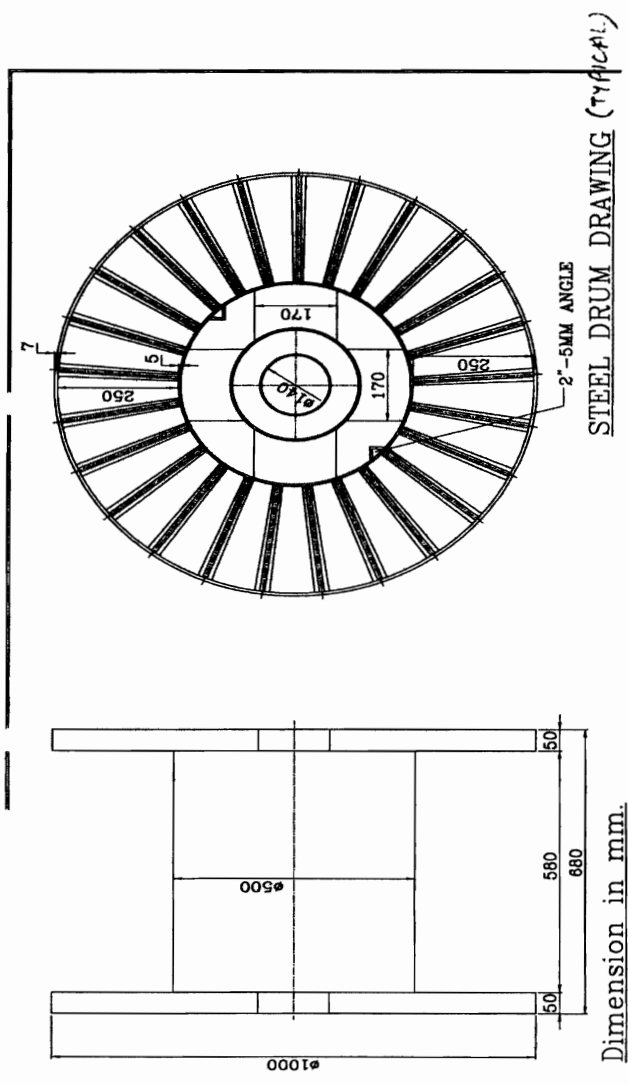
11.1.2 **Type of Construction**

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).

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 40	OF 52



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 41	OF 52



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.

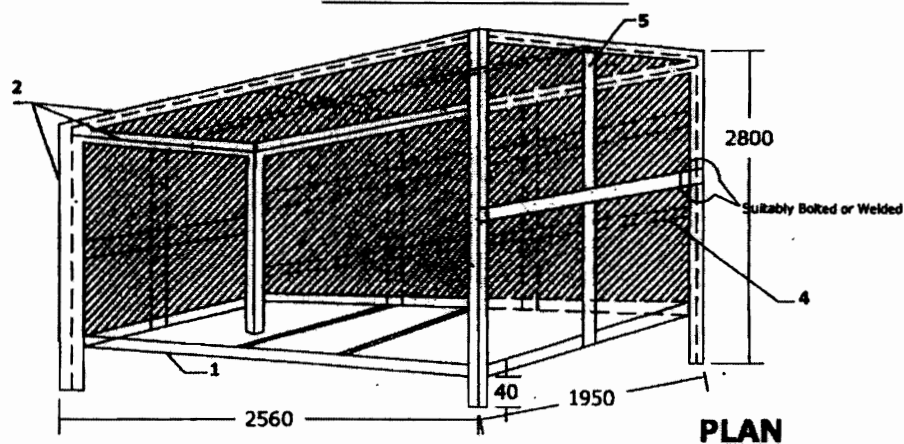
- 1) All Dimensions are in "mm" unless otherwise stated.
- 2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
- 3) Finish of Packing Box Shall be Galvanized.
- 4) Angle & Channel Section forming part of the Main frame shall be welded 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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 42	OF 52

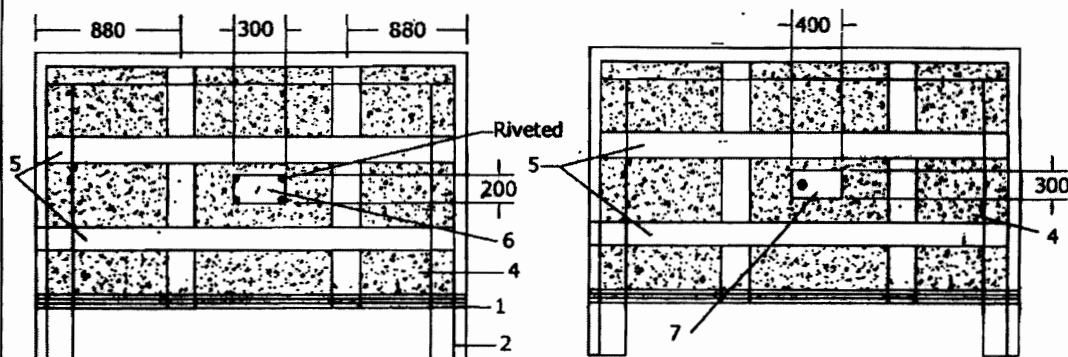
- 6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.
- 7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 43	OF 52

STEEL PACKING (TYPICAL DETAILS)

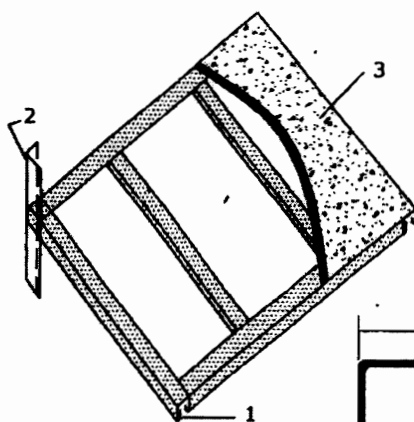


PLAN



FRONT SIDE OF BOX

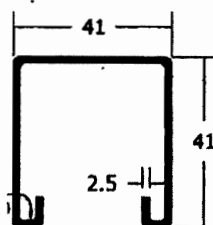
BACK SIDE OF BOX



BOTTOM FRAME ARRANGEMENT

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 Aluminium Plate for Marking.
7. Hinged Inspection Window.



DETAILS OF "C" CHANNEL

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 44	OF 52

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,

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

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

- Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
- Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
- 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.
- 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:

- Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- Then bundle will be wrapped with bitumen coated hessian craft paper.
- Bundle shall be strapped with steel straps.
- 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 45	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 46	OF 52

PACKING PROCEDURE FOR CONDUIT PIPE

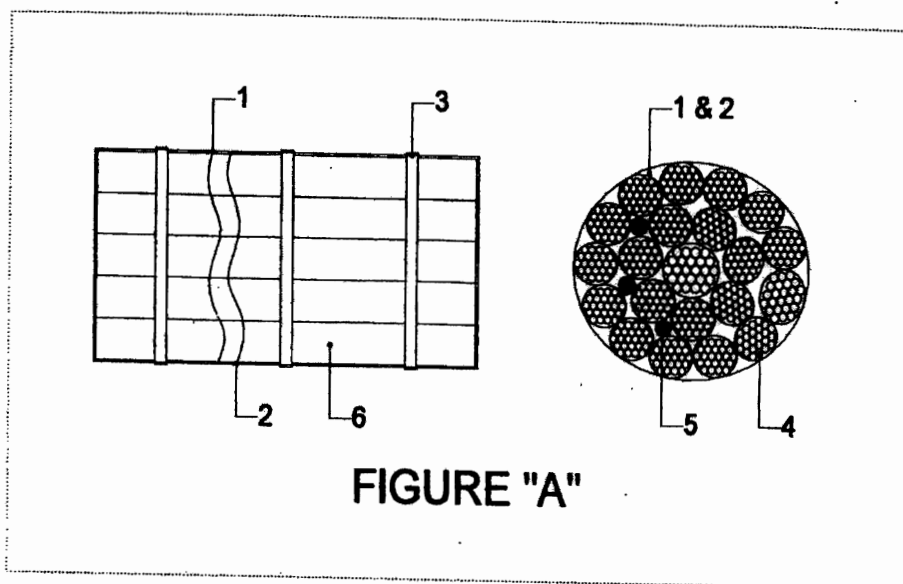


FIGURE "A"

- 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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 47	OF 52

PACKING PROCEDURE FOR STRUCTURAL STEEL

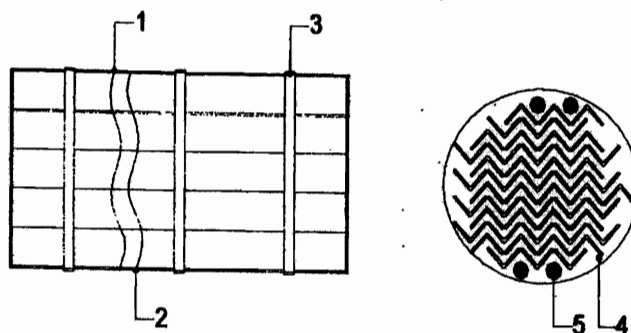
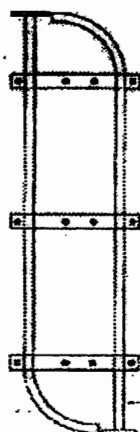


FIGURE "B"

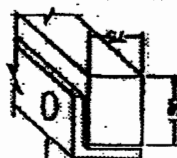
- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) STRUCTURAL STEEL.
- 5) SILICA GEL POUCHES.

	TITLE		SPECIFICATION NO. PE-TS-888-100-A001	
	TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS		VOLUME II B	
			SECTION D	
			REV. NO. 0	DATE 10/08/2010
			SHEET 48	OF 52

packing procedure for poles



POLES WRAPPED WITH POLYTHENE SHEET &
EXTENDING COATED HESSIAN CLOTH



TOP WOODEN BATTEN TO BE
FIXED WITH L50x80x6 MM ON TOP
OF IT FOR TIEING THE ROD
25 MM DIA



BOTTOM WOODEN BATTEN TO BE
FIXED ON L50x80x6 MM ANGLE

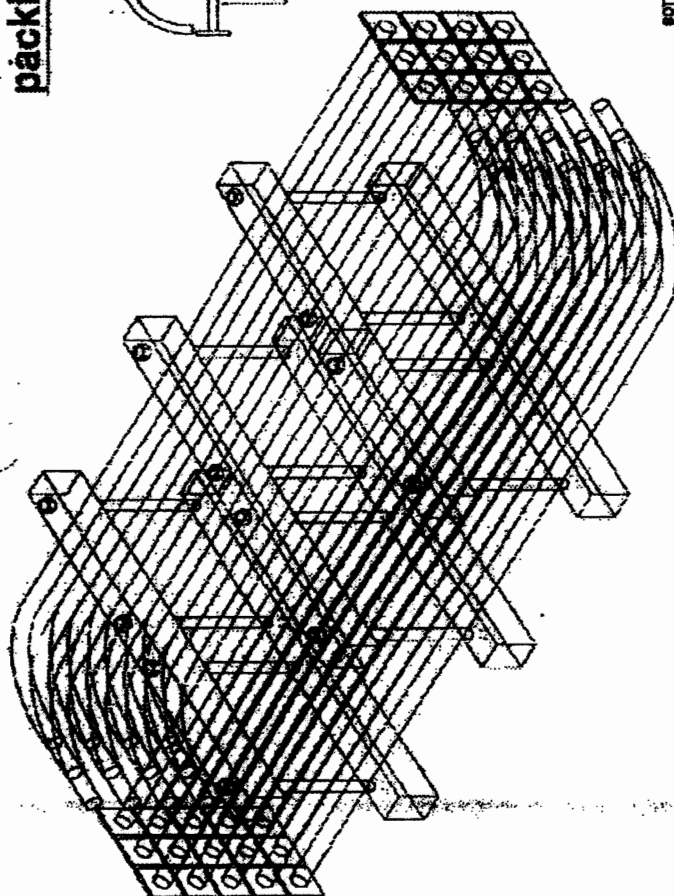


FIGURE "C"

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 49	OF 52

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 $\geq 0.175\text{mm}$) 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 50	OF 52

- d 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:

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001			
		VOLUME II B			
		SECTION D			
		REV. NO. 0	DATE 10/08/2010		
		SHEET	51	OF	52

- 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

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

useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.

260234/2021/PS-PEM-EL



DOCUMENT TITLE

TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES

SPECIFICATION NO. PE-TS-421-507-E001A

VOLUME II

SECTION II

REVISION 00

DATE: 30.03.2021

SHEET -

SECTION-II

STANDARD TECHNICAL SPECIFICATION



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR HT
XLPE POWER CABLES**

SPECIFICATION NO. PE-TS-421-507-E001A

VOLUME II

SECTION II

REVISION 00

DATE: 30.03.2021

SHEET 1 of 2

1.0 TECHNICAL REQUIREMENTS

- 1.1 Technical requirements for HT XLPE POWER CABLES shall be as indicated in this section, in addition to those specified in Section-I & Datasheet-A.

2.0 CODES & STANDARDS

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of HT XLPE POWER CABLES shall conform to the latest revision of relevant standards and codes of practices mentioned in Data Sheet – A.
- 2.2 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

3.0 QUALITY ASSURANCE REQUIREMENTS

- 3.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E001 as attached with the specification without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.
- 3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.
- 3.3 Type testing requirements, routine / sample testing and special testing requirements shall be as per Annexure to QAP. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price (except UV Radiation & Hydrolytic Stability test).
- 3.4 The charges of UV Radiation test & Hydrolytic Stability test (if applicable) shall be reimbursed extra at actual against original money receipt of Govt. Lab. (CPRI/ ERDA etc).
- 3.5 Cost of cables consumed for testing shall be to bidder's account.

4.0 Packing

- 4.1 Cables shall be supplied in non-returnable heavy construction steel drums. 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. Polyethylene sheet shall be wrapped over the cables and then sealed properly. For Typical details of Steel drums, Annexure-I to Section-II, may be referred by the bidder. Bidder may modify, to choose appropriate dimensions of steel drums to suite various sizes/weight/ lengths of HT XLPE power cables.

5.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

- 5.1 Documents/drawings to be submitted as part of technical offer & after placement of order for BHEL & customer's approval shall be as part of NIT.
- 5.2 Following documents/drawings shall be submitted after placement of order for BHEL & customer's approval

Sl. No.	Drawings/Document Description	Drawings / Document Number
1.	Technical Data Sheet for HT XLPE Power Cables	PE-V1-421-507-E101

260234/2021/PS-PEM-EL



DOCUMENT TITLE

TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES

SPECIFICATION NO. PE-TS-421-507-E001A

VOLUME II

SECTION II

REVISION 00

DATE: 30.03.2021

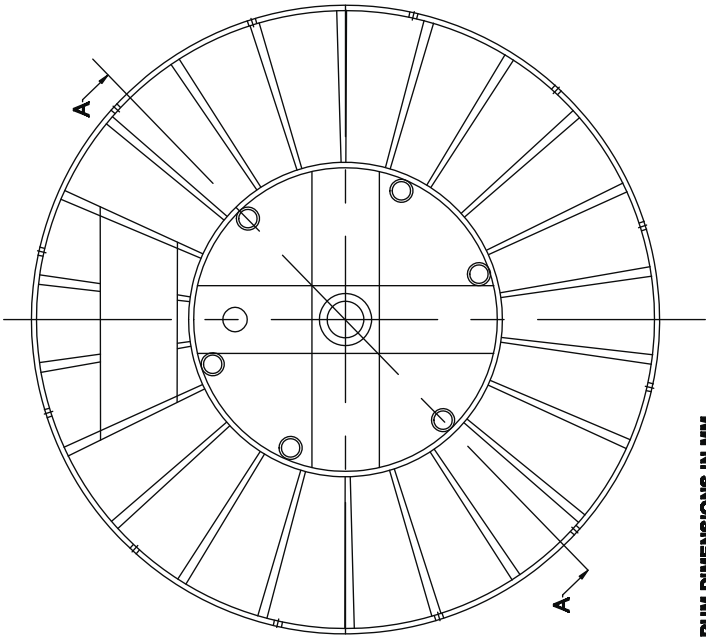
SHEET 2 of 2

Sl. No.	Drawings/Document Description	Drawings / Document Number
2.	Cross-sectional Drawings for HT XLPE Power Cables	PE-V1-421-507-E102
3.	Manufacturing Quality Plan for HT XLPE Power Cables	PE-V1-421-507-E103
4.	Type Test Reports for Tests conducted under this contract	PE-V1-421-507-E104

5.3 All drawings/ documents indicated above shall be submitted through Document Management System (DMS).

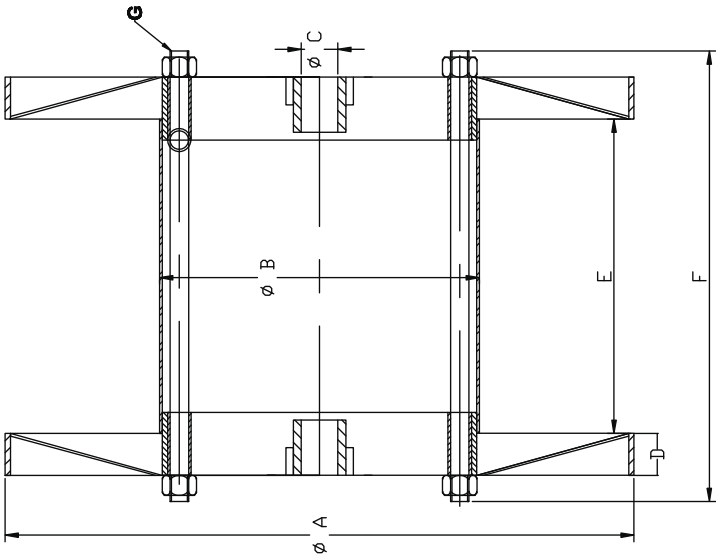
ANNEXURE-I TO SECTION-II

- Dwg. not to scale.
- ALL DIMENSIONS ARE IN MM.



APPROXIMATE DRUM DIMENSIONS IN MM
ALL DIMENSIONS AND VALUES ARE
TYPICAL AND ARE DEPENDENT ON
CABLE WEIGHT.

A	FLANGE	2200
B	BARREL	1200
C	CENTRAL HOLE	100
D	FLANGE	50
E	TRAVERSE	1400
F	GROSS WIDTH	1600
G	STUD SIZE	16 MM.



260234/2021/PS-PEM-EL



DOCUMENT TITLE

TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES

SPECIFICATION NO. PE-TS-421-507-E001A

VOLUME II

SECTION II

REVISION 00

DATE: 30.03.2021

SHEET -

ANNEXURE-II

QUALITY PLAN

		STANDARD QUALITY PLAN		BHEL DOC NO.:		PROJECT:			SPECIFICATION												
SHEET 2 OF 10		BIDDER/ VENDOR		SYSTEM		TITLE: 2 X 660MW BIFPCL MAITREE STPP			NUMBER : PE-TS-421-507-E001A, R0												
SL. NO.		COMPONENT/ OPERATION		CHARACTERISTIC CHECK		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		AGENCY		REMARKS	
1		2		3		4		5		6		7		8		9		10		11	
Instructions: 1. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no. 2. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.																					
1.0		RAW MATERIALS & BOUGHT OUT ITEMS																			
1.1		Copper Rods (Conductor)		GENERAL : 1. Physical properties 2. Elec.Properties SPECIFIC CHECKS : a) Make b) Grade c) Resistivity		MA		Physical Tests		Sample/ Batch		IEC-60502-2, IEC-60228 & Appd Datasheet		IEC-60502-2, IEC-60228 & Appd Datasheet		Inspection Report/ Test Cert.		P V V			
						MA		Electrical Tests		Sample/ Batch		-do-		-do-		-do-		P V V			
						MA		Verify		100%		Manufacturer approved source		Manufacturer approved source		COC/ Test Cert.		V - V			
						MA		-do-		-do-		IEC-60502-2, IEC-60228 & Appd Datasheet		IEC-60502-2, IEC-60228 & Appd Datasheet		-do-		V - V			
						MA		Electrical Tests		Manufacturer std.		IEC-60228		IEC-60228		-do-		P V V			
1.2		XLPE Compound for insulation		GENERAL : 1. Physical properties 2. Elec.Properties 3. Water Tree Test (accelarated) SPECIFIC CHECKS : a) Make b) Type/ Grade c) Shelf life/ Storage condition		MA		Physical Tests		Sample/ Batch		IEC-60502-2 & Mfs Std./ Approved datasheet		IEC-60502-2 & Mfs Std./ Approved datasheet		Inspection Repor/ Test Cert.		P V -			
						MA		Electrical Tests		Sample/ Batch		-do-		-do-		-do-		P V -			
						MA		Electrical Tests		Sample*		Approved datasheet		Approved datasheet		Test Cert.		V V V		* Sample from each voltage grade \$ Test Certificates shall be submitted	
						MA		Verify		100%		Manufacturer approved source		Manufacturer approved source		COC/ Test Cert.		V V V			
						MA		-do-		-do-		Approved datasheet		Approved datasheet		-do-		V V V			
						MA		-do-		-do-		Compound Manufacturer std.		Compound Manufacturer std.		-do-		V V V			
BHEL				PARTICULARS				BIDDER/VENDOR													
				NAME																	
				SIGNATURE																	
				DATE								BIDDER'S/VENDORS COMPANY SEAL									

		STANDARD QUALITY PLAN		BHEL DOC NO.:		PROJECT:			SPECIFICATION			
				BIDDER/ VENDOR : M/s CMI LTD.		TITLE: 2 X 660MW BIFPCL MAITREE STPP			NUMBER : PE-TS-421-507-E001A, R0			
SHEET 3 OF 10		SYSTEM		QUALITY PLAN			SPECIFICATION			TECHNICAL SPECIFICATION FOR		
				NUMBER: PE-QP-999-507-E001B, R0			HT XLPE POWER CABLES			SECTION VOLUME III		
SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	M	C	B	11
1.3	Semi Conducting Compound	GENERAL : 1. Physical properties SPECIFIC CHECKS : 1. Make 2. Type/ Grade 3. Shelf life/ Storage condition	MA	Physical Tests	Sample/ Batch	IEC-60502-2 & Mfs Std./ Approved datasheet	IEC-60502-2 & Mfs Std./ Approved datasheet	Inspection Report/ Test Cert.	P	V	V	(Fillers material chosen shall be compatible with the temerature rating of the cable and shall have no deleterious effect on any other componenet of the cable)
		1. Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	P	V	V	
		2. Type/ Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	P	V	V	
		3. Shelf life/ Storage condition	MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	P	V	V	
1.4	Copper Tape	GENERAL : 1. Physical properties 2. Elec.Properties 3. Dimension SPECIFIC CHECKS : 1. Resistivity	MA	Physical Tests	Sample/ Batch	IEC-60502-2 & Mfr. Std./ Approved datasheet	IEC-60502-2 & Mfr. Std./ Approved datasheet	Inspection Report/ Test Cert.	P	V	-	
		2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	P	V	-	
		3. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	P	-	-	
		1. Resistivity	MA	Electrical Tests	Manufacturer std.	IEC-60502-2	IEC-60502-2	-do-	V	V	V	
1.5	Fillers (as applicable)	1. Make 2. Type/ Grade	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	P	V	-	
		2. Type/ Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	P	-	-	
1.6	PVC Compound (for sheath)	GENERAL : 1. Physical properties 2. Elec.Properties 3. FRLS Properties (as applicable)	MA	Physical Tests	Sample/ Batch	IEC-60502-2 & Mfr. Std./ Approved datasheet	IEC-60502-2 & Mfr. Std./ Approved datasheet	Inspection Report/ Test Cert.	V	-	-	
		2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	V	-	-	
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	Sample/ Batch	-do-	-do-	-do-	P	V	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		STANDARD QUALITY PLAN SHEET 4 OF 10		BHEL DOC NO.:		PROJECT:			SPECIFICATION			
				BIDDER/ : M/s CMI LTD.		TITLE: 2 X 660MW BIFPCL MAITREE STPP			NUMBER : PE-TS-421-507-E001A, R0			
				VENDOR		QUALITY PLAN			SPECIFICATION TECHNICAL SPECIFICATION FOR			
		SYSTEM		ITEM : HT XLPE Power Cables			SECTION			VOLUME III		
SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	M	C	B	11
1.7	Galvanised steel wire/strip for Armour (As applicable)	SPECIFIC CHECKS :										
		a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	V	V	-	
		b) Type/ Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	V	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	P	V	V	
		GENERAL :										
		1. Make	MA	Verify	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Inspection Report/ Test Cert.	V	V	V	
		2. Dimension	MA	Measurement	-do-	IEC-60502-2 & Approved datasheet	IEC-60502-2 & Approved datasheet	-do-	P	-	-	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	-do-	-do-	-do-	P	-	-	* Sample from each armour size/ Batch / Lot
		4. Galvanization Quality	MA	Galv. Tests	-do-	IEC-60502-2 & Mfr. Std.	IEC-60502-2 & Mfr. Std.	-do-	V	-	-	
1.8	Steel Drum	1. Dimension	MA	Meas.	Mfr's Plant Std.	Approved drawing of steel drum / BHEL specification	Approved drawing of steel drum / BHEL specification	Inspection Report/ Test Cert.	P	-	-	
		2. Surface finish	MA	Meas.	-do-	Surface shall be smooth	Surface shall be smooth	-do-	P	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

260234/2021/PS-PEM-EL

		STANDARD QUALITY PLAN		BHEL DOC NO.:		PROJECT TITLE: 2 X 660MW BIFPCL MAITREE STPP			SPECIFICATION : NUMBER : PE-TS-421-507-E001A, R0			
SHEET 5 OF 10		BIDDER/ VENDOR : M/s CMI LTD.		QUALITY PLAN NUMBER: PE-QP-999-507-E001B, R0			SPECIFICATION TECHNICAL SPECIFICATION FOR TITLE HT XLPE POWER CABLES					
SYSTEM		ITEM : HT XLPE Power Cables			SECTION VOLUME III							
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	M	C	B	11
2.0	IN PROCESS											
2.1	Wire Drawing	1. Size	MA	Dimensional	Plant Mfg. Std.	IEC-60502-2, IEC-60228 & Appd. Datasheet	IEC-60502-2, IEC-60228 & Appd. Datasheet	Inspection Report	P	-	-	
		2. Surface finish	MA	Visual	-do-	Surface shall be smooth	Surface shall be smooth	-do-	P	-	-	
		3. % of Elongation	MA	Mechanical	-do-	IEC-60502-2, IEC-60228 & Appd. Datasheet	IEC-60502-2, IEC-60228 & Appd. Datasheet	-do-	P	-	-	
2.2	Stranding of wires	1. No. of wires	MA	Counting	Plant Mfg. Std.	IEC-60502-2, IEC-60228 & Appd. Datasheet	IEC-60502-2, IEC-60228 & Appd. Datasheet	Inspection Report	P	-	-	
		2. Resistance	CR	Electrical	-do-	-do-	-do-	-do-	P	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Meas.	One Sample of each size/ lot	Mfrs Std. / Appd. Datasheet	Mfrs Std. / Appd. Datasheet	-do-	P	-	-	
		4. Surface Finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	-do-	P	-	-	
		5. Dimension	MA	Measurement	One Sample of each size/ lot	IEC-60502-2, IEC-60228 & Appd. Datasheet	IEC-60502-2, IEC-60228 & Appd. Datasheet	-do-	P	-	-	
2.3	Conductor Screening	1. Surface Finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inspection Report	P	-	-	
		2. Radial Thickness	CR	Mechanical	One Sample of each size/ lot	IEC-60502-2 & Appd. Datasheet	IEC-60502-2 & Appd. Datasheet	-do-	P	-	-	
2.4	Core Insulation (XLPE) (No repair permitted)	1. Surface finish	MA	Visual	100%	Free from bulging, burnt particles, lumps, cuts & scratches	Free from bulging, burnt particles, lumps, cuts & scratches	Inspection Report	P	V	-	
		2. Eccentricity & Ovality #	CR	Measurement	One Sample of each size/ lot	IEC-60502-2 & Appd. Datasheet	IEC-60502-2 & Appd. Datasheet	-do-	P	V	-	# To be checked at starting & finished end of extruded length.
		3. Insulation Thickness	CR	Measurement	-do-	-do-	-do-	-do-	P	-	-	
		4. Dia over insulation	MA	Measurement	-do-	-do-	-do-	-do-	P	-	-	
		5. Tensile Strength & % Elongation	MA	Mechanical	100%	-do-	-do-	-do-	P	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

260234/2021/PS-PEM-EL

		STANDARD QUALITY PLAN		BHEL DOC NO.:		PROJECT TITLE: 2 X 660MW BIFPCL MAITREE STPP			SPECIFICATION : NUMBER : PE-TS-421-507-E001A, R0			
				BIDDER/ VENDOR : M/s CMI LTD.		QUALITY PLAN NUMBER: PE-QP-999-507-E001B, R0			SPECIFICATION TECHNICAL SPECIFICATION FOR TITLE HT XLPE POWER CABLES			
SHEET 6 OF 10				SYSTEM		ITEM : HT XLPE Power Cables			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	M	C	B	11
2.5	Insulation Screening	NON METTALIC 1. Surface finish 2. Thickness METALLIC 1. Dimension of tape 2. Overlap of Tape Band 3. Tightness of Tape	MA CR CR MA MA	Visual Measurement Measurement -do- Visual	100% One Sample of each size/ lot One Sample of each size/ lot -do- -do-	Surface shall be smooth IEC-60502-2 & Appd. Datasheet Mfrs Std. / Appd. datasheet -do- Mfs Std.	Surface shall be smooth IEC-60502-2 & Appd. Datasheet Mfrs Std. / Appd. datasheet -do- Mfs Std.	Inspection Report -do- Inspection Report -do- -do-	P P P P P	- - - - -	- - - - -	(Pimple, fish eye, porosity & burnt particles not permitted.)
2.6	Core Laying	1. Dia over laid up core 2. Sequence of lay & direction 3. Lay Length	MA MA MA	Measurement Visual & Meas. Measurement	One Sample of each size/ lot -do- -do-	IEC-60502-2 & Appd. Datasheet IEC-60502- & Mfr. Std. -do-	IEC-60502-2 & Appd. Datasheet IEC-60502-2 & Mfr. Std. -do-	Inspection Report -do- -do-	P P P	- - -	- - -	
2.7	InnerSheath Extrusion (as applicable)	1. Surface finish 2. Thickness 3. Dia over inner sheath	MA CR MA	Visual Measurement -do-	100% One Sample of each size/ lot -do-	Surface shall be smooth IEC-60502-2 & Appd. Datasheet -do-	Surface shall be smooth IEC-60502-2 & Appd. Datasheet -do-	Inspection Report -do- -do-	P P P	- - -	- - -	
2.8	Armour(as applicable)	1. No.of wires/Strips 2. Lay length & Direction 3. Dia over armouring 4. Coverage	MA MA MA MA	Counting Visual & Meas. Measurement Measurement	At the start of the process -do- -do- -do-	IEC-60502-2 & Appd. Datasheet IEC-60502- & Mfr. Std. IEC-60502-2 & Appd. Datasheet -do-	IEC-60502-2 & Appd. Datasheet IEC-60502-2 & Mfr. Std. IEC-60502-2 & Appd. Datasheet -do-	Inspection Report -do- -do- -do-	P P P P	- - - -	- - - -	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

260234/2021/PS-PEM-EL

		STANDARD QUALITY PLAN		BHEL DOC NO.:		PROJECT		SPECIFICATION :				
				BIDDER/ VENDOR : M/s CMI LTD.		TITLE: 2 X 660MW BIFPCL MAITREE STPP		NUMBER : PE-TS-421-507-E001A, R0				
SHEET 7 OF 10		SYSTEM		QUALITY PLAN		NUMBER: PE-QP-999-507-E001B, R0		SPECIFICATION TECHNICAL SPECIFICATION FOR				
				ITEM : HT XLPE Power Cables				TITLE HT XLPE POWER CABLES				
								SECTION VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS		
1	2	3	4	5	6	7	8	9	10	11		
2.9	Outer Sheath Extrusion (No repair permitted)	1. Surface finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inspection Report	P	-	-	(Pimple, fish eye, porosity & burnt particles not permitted.)
		2. Sheath Thickness	CR	Measurement	One Sample of each size/ lot	IEC-60502-2 & Appd. Datasheet	IEC-60502-2 & Appd. Datasheet	-do-	P	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-do-	-do-	-do-	P	-	-	
		4. Embossing/ Sequential Marking	MA	Visual	100%	Approved data sheet	Approved data sheet	-do-	P	-	-	
3.0	Finished Cable (INTERNAL)	1. Routine Test (Refer Note-F)	CR	Electrical Tests & Measurement	100%	IEC-60502-2 & Appd. Datasheet	IEC-60502-2 & Appd. Datasheet	Test Report	P	V	V	
4.0	Final Inspection (EXTERNAL)	1. Finish	MA	Visual	One drum in each Lot	IEC-60502-2 & Appd. Datasheet	Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches	Test Report	P	W	V	
		2. Length	MA	Measurement	-do-	-do-	Approved Data Sheet	-do-	P	W	V	
		3. Dimension	MA	-do-	As per IEC	-do-	-do-	-do-	P	W	V	
		4. Armouring (as applicable)- Coverage No.of Wires/Strips	MA	Visual & Meas.	-do-	-do-	-do-	-do-	P	W	V	
	BHEL		PARTICULARS		BIDDER/ VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

बी एच ई एल BHEL		STANDARD QUALITY PLAN		BHEL DOC NO.:			PROJECT TITLE:2 X 660MW BIFPCL MAITREE STPP			SPECIFICATION : NUMBER : PE-TS-421-507-E001A, R0		
				BIDDER/ VENDOR : M/s CMI LTD.			QUALITY PLAN NUMBER: PE-QP-999-507-E001B, R0			SPECIFICATION TECHNICAL SPECIFICATION FOR TITLE HT XLPE POWER CABLES		
		SHEET 8 OF 10		SYSTEM			ITEM : HT XLPE Power Cables			SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	B	
1	2	3	4	5	6	7	8	9	10			11
5.0	Packing	5. Marking & Colour Coding	MA	Visual	As per IEC	-do-	Approved Data Sheet	-do-	P	W	-	# Refer Annexure to QAP enclsloed
		6. Sample Tests (Refer Note-F)	CR	Phy, Elect. Tests FRLS Tests	-do-	-do-	-do-	-do-	P	W	-	
		7. Type Tests (Refer Note-F)	CR	Physical & Electrical Tests	Sample #	-do-	-do-	-do-	P	W	V	
		Sealing Identification	MA	Visual	100%	As per IEC	As per IEC	-do-	P	W	-	

NOTES:-

- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IEC / BHEL SPECIFICATION, VENDOR TO CERTIFY THE SAME.
- (B) NO REPAIR OF CORE INSULATION PERMITTED
- (C) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.
- (D) FILLERS/DUMMY CORES ETC. SHALL BE AS PER APPROVED DATA SHEET
- (E) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION.
- (F) **FOR LIST OF ROUTINE, TYPE & SAMPLE TESTS, REFER ANNEXURE TO QAP ENCLOSED.**
- (G) MATERIALS SHALL BE PROCURED IN COMPLIANCE TO FUNCTIONAL TECHNICAL SPECIFICATION.
- (H) INSPECTION AND TESTS SHALL BE IN COMPLIANCE WITH VENDOR'S APPROVED DOCUMENT/ QUALITY CONTROL PROCEDURE FOR THE PRODUCT.
- (I) DOCUMENTS GIVEN AS REFERENCE DOCUMENT AND ACCEPTANCE NORMS ARE VENDOR'S SPECIFICATION UNLESS OTHERWISE STATED.
- (J) GAUGES AND MEASURING INSTRUMENTS, WITH VALID CALIBRATION ONLY SHALL BE USED.
- (K) FINISHED PRODUCTS SHALL BE PACKED TO COMPLY WITH APPROVED PACKING SCHEDULE.

LEGEND : M : Manufacturer / Sub Supplier, C : main Supplier, B : BIFPCL/ Owners Engineer, P : Perform, W : Witness and V : Verification as Appropriate

		BHEL			PARTICULARS	BIDDER/ VENDOR				
					NAME					
					SIGNATURE					
					DATE					
										BIDDER'S/VENDORS COMPANY SEAL

	DOCUMENT TITLE TEST FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS- 421-507-E001	
		VOLUME II	
		SECTION II	
		REVISION 00	Date: 21.02.2018

TYPE/ SAMPLE/ ROUTINE TEST REQUIREMENTS**A. Type Test Conduction:**

- Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.
- Sampling:
 - Type test to be conducted on one size of each voltage grade/ lot.
 - FRLS test & Electrical tests to be conducted on every size & voltage grade of cables.
 - Flammability Test to be conducted only on one sample/ lot/voltage grade.
 - Water Tree Test: Test Report to be submitted for insulation for each type of cable i.e for each voltage grade.

B. Sample Test Conduction:

- Tests for which "S" is indicated in the 'Test Conduction Required As' column below shall be conducted as Sample tests.
- Sampling:
 - Sample tests shall be carried out as per sampling plan mentioned in IEC-60502-2.
 - Flammability Test to be conducted only on one sample taken from each offered lot of all sizes.

C. Routine Test Conduction:

- Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.

<u>S. No.</u>	<u>TEST</u>	<u>APPLICABLE FOR</u>	<u>TEST CONDUCTION REQUIRED AS</u>	<u>REFERENCE STANDARD</u>	<u>REMARKS</u>
1.0	Tests for Conductor				
I.	Resistance test	For Cu	T, S, R	IEC-60502-2/ IEC-60228	
2.0	Physical Tests for XLPE Insulation & PVC sheath				
I.	Test for thickness	Applicable for XLPE insulation, PVC inner sheath & PVC outer sheath	T, S	IEC-60502-2/ IEC-60811-201/ IEC-60811-202	
II.	Tensile strength and elongation test at break	Applicable for XLPE insulation & PVC outer sheath			
(a)	Before ageing		T	IEC-60502-2/ IEC-60811-401/ IEC-60811-501	
(b)	After ageing		T	IEC-60502-2/ IEC-60811-401/ IEC-60811-501	
III.	Ageing in air oven	Applicable for XLPE insulation & PVC outer sheath	T	IEC-60502-2/ IEC-60811-401	

	DOCUMENT TITLE TEST FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS- 421-507-E001	
		VOLUME II	
		SECTION II	
		REVISION 00	Date: 21.02.2018

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
IV.	Loss of mass in air oven test	For PVC outer sheath only	T	IEC-60502-2/ IEC-60811-409	
V.	Hot deformation test	For PVC outer sheath only	T	IEC-60502-2/ IEC-60811-508	
VI.	Heat shock test	For PVC outer sheath only	T	IEC-60502-2/ IEC-60811-509	
VII.	Shrinkage test	For XLPE insulation & PVC outer sheath only	T	IEC-60502-2/ IEC-60811-502/ IEC-60811-503	
VIII.	Hot set test	For XLPE insulation only	T, S	IEC-60502-2/ IEC-60811-507	
IX.	Water absorption (gravimetric) test	For XLPE insulation only	T	IEC-60502-2/ IEC-60811-402	
X.	Behaviour at low temperature	For PVC outer sheath only	T	IEC-60502-2/ IEC-60811-504/ IEC-60811-505/ IEC 60811-506	
3.0	<u>Improved Fire performance (FR-LSH) Tests</u>				
I.	Oxygen index test	For outer sheath only	T, S	ASTMD 2863	
II.	Smoke density test	For outer sheath only	T, S	IEC 61034/ ASTMD 2843	
III.	Acid gas generation test (Halogen Test)	For outer sheath only	T, S	IEC-60754-1	
IV.	Temperature Index Test	For outer sheath only	T	ASTMD 2863	
4.0	<u>Flammability Tests</u>				
I.	Flammability test for single cable	For complete cable	T,S	IEC-60502-2 / IEC:60332 Part-1	
II.	Swedish chimney test	For complete cable	S	SEN SS 424 1475 (Class F3)	
III.	Flammability test	For complete cable	S	IEEE: 60383	
5.0	<u>Electrical Tests</u>				
I.	AC Voltage Test for 5 min	For complete cable	T, S, R	IEC-60502-2	
II.	Insulation Resistance Test (Volume resistivity method)	For complete cable	T, S	IEC-60502-2	
III.	Partial discharge test		T,R	IEC-60502-2/ IEC-60885-3	
IV.	Bending Test		T	IEC-60502-2	
V.	Dielectric Power Factor Test (Tan δ) (i) As a function of voltage (ii) As a function of temperature		T	IEC-60502-2	
VI.	Heat Cycle Test		T	IEC-60502-2	
VII.	Impulse Withstand Test		T	IEC-60502-2	

260234/2021/PS-PEM-EL

	DOCUMENT TITLE TEST FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS- 421-507-E001	
		VOLUME II	
		SECTION II	
		REVISION 00	Date: 21.02.2018

<u>S. No.</u>	<u>TEST</u>	<u>APPLICABLE FOR</u>	<u>TEST CONDUCTION REQUIRED AS</u>	<u>REFERENCE STANDARD</u>	<u>REMARKS</u>
VIII..	High voltage test for 4 hour	For complete cable	T, S	IEC-60502-2	
6.0	Water Tree Test (accelerated)	For XLPE Insulation only (In raw material stage)	T	AS PER APPROVED DATASHEET-A	Type test report to be submitted.