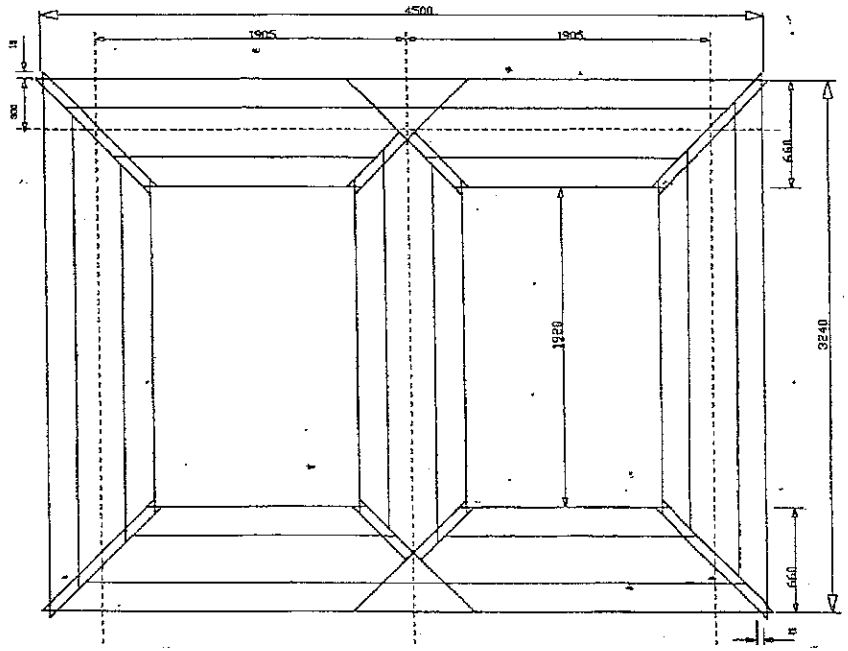
First Angle Projection

All dimensions in mm



Notes :

1 - Laminations to be cut with max dimensions along the grain

2 - For tolerances and burr level on laminations, refer Std Sht TR10141C

3 - All cores are to be builtup with mitre joints and mitring to be at 45 degrees

4 - Each packet to be built with 2 laminations per layer alternately as per P and Q arrgts.

5 - Bind the core with polyester resin impreg. weftless glass tape (to AA25716) after putting core to coil packing in position. Each band shall consist of 3 turns of 0.4 tk or 4 turns of 0.3 tk polyester impreg. weftless glass tape.For detailed instructions regarding core leg clamping/taping/banding refer Std Sht TR10142C
No of Tape bands = 11, Tape Pitch = 167 mm
Distance of first band from bottom =100 mm

6 - Refer drg no. 34997000065 for arrgt of ceramic spacers on core and yoke laminations to provide oil duct

7 - Assembled core to be tested between core and clamping structure at 2 kV for one minute unless otherwise specified

8 - Type Of Core - Three Phase Three limbed Core

Only top yoke bolted

Core Dia = 670.0 Leg Length = 1920.0

Leg Centre = 1905.0

No of Oil ducts = 1 No of steps = 15

Yoke Bolts/Window = 0

Space Factor = 0.975 Top Clearance = 37.0

Scrap Factor = 7.0%

Blading = 3/2 Grade of Core Steel= ZDKH85/0.23

REFER CORE DRG. NO.- 1499700000 16
FOR TOL. REF. STD DRG. TR 1500 35C

PINO- 12164058

REF DRG NO.

SIGN AND DATE

INVENTORY NO.

DISTRIBUTION OF PRINTS

W.O. V1065A17200

BHARAT HEAVY ELEC. LTD
BHOPAL

	NAME	SIGN	DATE	MOD/VAR
DRN				
CKD				
APPD	AE		14/07/04	

REV.	DATE	ALTERED / CHECKED / APPROVED	DEPT	UNIT/SECTION	SCALE	WEIGHT	REF.TO ASSY.DRG.	IT.NO	NO.
			TRE		N.T.S				

ZONE

TITLE
Core Dimensions

TRE310

DRAWING NO
TRE/JS/7106SA

REV
00

SHT NO 1 NO OF SHTS 1

First Angle Projection

All dimensions in mm

NO.	PKT-THK	DUCT	PKT.HT	LEGLAM	YOKLAM
1	55	2	57.0	660.0	660.0
2	23		80.0	650.0	650.0
3	33		113.0	630.0	630.0
4	24		137.0	610.0	610.0
5	20		157.0	590.0	590.0
6	17		174.0	570.0	570.0
7	16		190.0	550.0	550.0
8	13		203.0	530.0	530.0
9	18		221.0	500.0	500.0
10	16		237.0	470.0	470.0
11	13		250.0	440.0	440.0
12	13		263.0	410.0	410.0
13	11		274.0	380.0	380.0
14	12		286.0	340.0	340.0
15	9		295.0	300.0	300.0

Cross section Area-	Gross,sq.cm	Net,sq.cm
Main Leg	3247.8	3166.6
Main Yoke	3247.8	3166.6

INVENTORY NO.	SIGN AND DATE	REF DRG NO.

DISTRIBUTION OF PRINTS

W.O 71065A17200

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

BHARAT HEAVY ELEC LTD
BHOPAL

	NAME	SIGN	DATE	NO.OF VAR
DRN				
CKD				
APPD	AB			

DEPT TRC | UNITD_DIMEN.CR. | SCALE N.T.S | WEIGHT | REF.TO ASSY.DRG | IT.NO | NO.

CODE

TITLE
Core Laminations
TNEB10

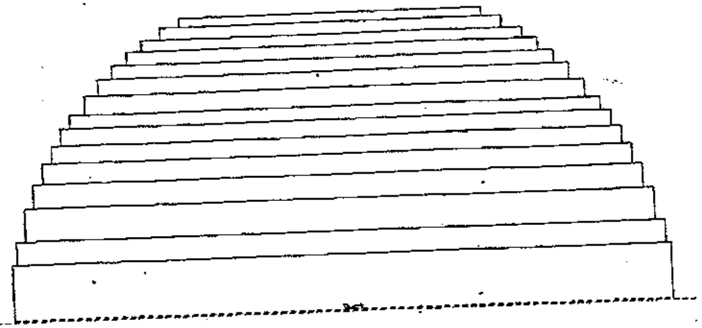
DRAWING NO TRE/55/71065A REV 00

SHT NO. 2 NO. OF SHTS. 11

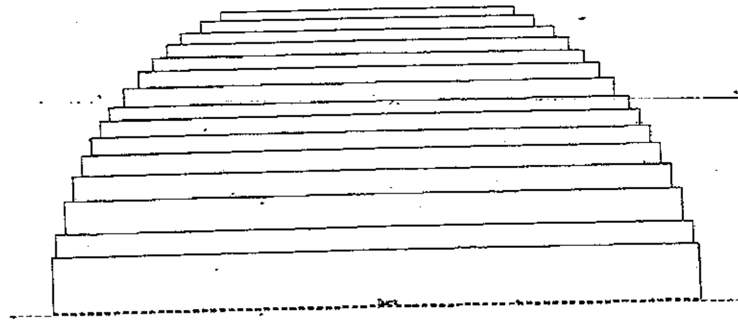
First Angle Projection

DRG.NO

All dimensions in mm



Main Leg cross section



Main Yoke cross sect

INVENTORY NO.	SIGN AND DATE	REF DRG NO.

DISTRIBUTION OF PRINTS

W.O: 71065A17200

BHEL — BHARAT HEAVY ELEC LTD, BHOPAL

REV.	DATE	ALTERED / CHECKED / APPROVED	DEPT TRE	CODE

ZONE

	NAME	SIGN	DATE	MODF VAR
DRN				
CKD				
APPD	AS			

SCALE: N.T.S

WEIGHT

REF.TO ASSY.DRG.

IT.NO

NO.

TITLE
Cross sections

TNE310

DRAWING NO
TRE/JS/71065A

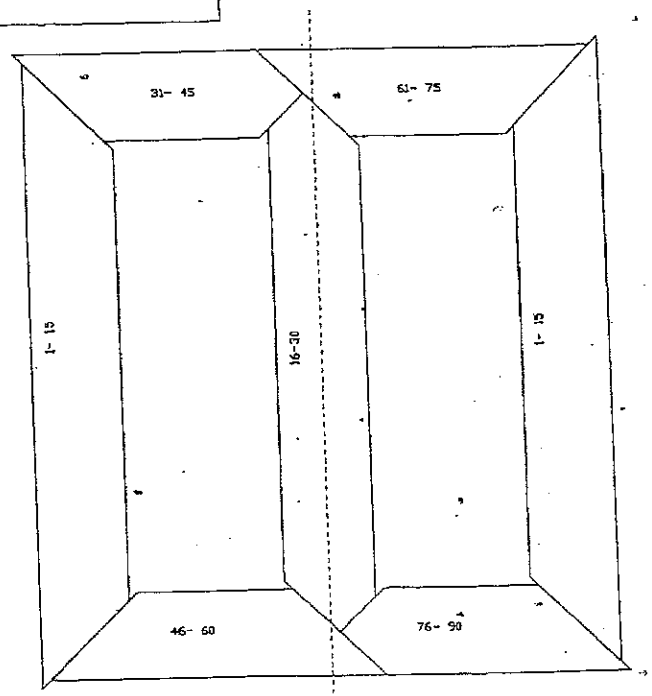
REV 00

SHT NO 3 | NO OF SHTS 11

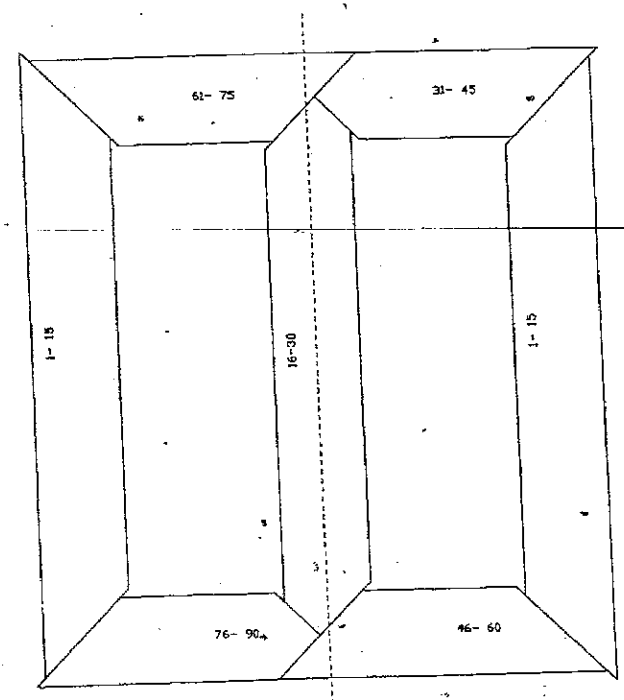
SIZE A3

First Angle Projection

All dimensions in mm



ARRANGEMENT - P



ARRANGEMENT - Q

REF DRG NO

SIGN AND DATE

INVENTORY NO.

DISTRIBUTION OF PRINTS

W.O. 71065A17200

REV.	DATE	
		ALTERED
		CHECKED
		APPROVED
ZONE		

BHARAT HEAVY ELEC. LTD

BHOPAL

	NAME	SIGN	DATE	NO OF VAR
DRN				
CKD				
APPD				

DEPT: TRE

CODE:

UNIT/DIVISION:

SCALE: N.T.S

WEIGHT:

REF TO ASSY DRG.

IT NO:

NO.

TITLE

Core Laying arrgt

TNEBIG

DRAWING NO: TRE/JS/71065A

REV: 00

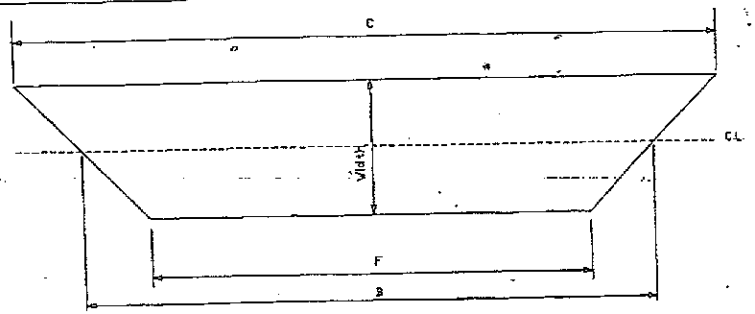
SHT NO: 4

NO OF SHTS: 11

SIZE A3

First Angle Projection

All dimensions in mm



Item	Width	Thick	B	C	F	Weight
1	660.0	220	2580.0	3240.0	1920.0	2794.2
2	650.0	92	2580.0	3230.0	1930.0	1150.8
3	630.0	132	2580.0	3210.0	1950.0	1600.3
4	610.0	96	2580.0	3190.0	1970.0	1126.9
5	590.0	80	2580.0	3170.0	1990.0	908.3
6	570.0	68	2580.0	3150.0	2010.0	745.9
7	550.0	64	2580.0	3130.0	2030.0	677.4
8	530.0	52	2580.0	3110.0	2050.0	530.4
9	500.0	72	2580.0	3080.0	2080.0	692.8
10	470.0	64	2580.0	3050.0	2110.0	578.9
11	440.0	52	2580.0	3020.0	2140.0	440.3
12	410.0	52	2580.0	2990.0	2170.0	410.3
13	380.0	44	2580.0	2960.0	2200.0	321.8
14	340.0	48	2580.0	2920.0	2240.0	314.1
15	300.0	36	2580.0	2880.0	2280.0	207.8

Total 12499.9

REF DRG NO.

SIGN AND DATE

INVENTORY NO.

DISTRIBUTION OF PRINTS

W.O. 71065A17200

BHARAT HEAVY ELEC LTD

BHOPAL

	NAME	SIGN	DATE	NO OF VAR
DRN				
CKD				
APPD				

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

DEPT TRE

CODE

SCALE N.T.S

WEIGHT

REF.TO ASSY.DRG.

IT.NO

NO.

TITLE

Main Leg Laminations

TRE810

DRAWING NO TRE/JS/71065A

REV 00

SHT NO 5

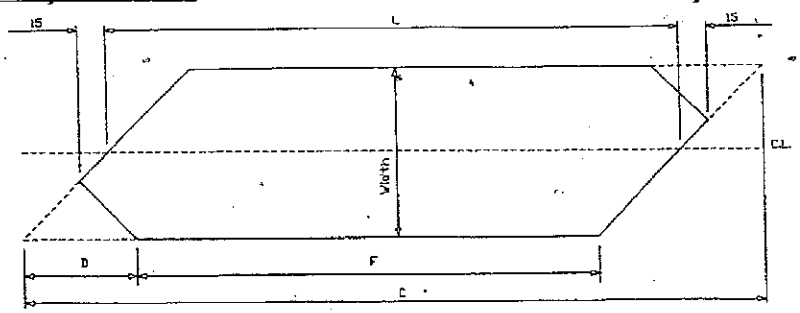
NO OF SHTS - 11

SIZE A3

First Angle Projection

All dimensions in mm

DRG.NO



Item	Width	Thick	C	D	F	L	Wt-Pnch	Wt-Cut
16	660.0	110	3210.0	690.0	1920.0	2550.0	1218.0	1380.8
17	650.0	46	3200.0	620.0	1930.0	2550.0	502.7	568.7
18	630.0	66	3180.0	600.0	1950.0	2550.0	702.2	790.8
19	610.0	48	3160.0	580.0	1970.0	2550.0	496.7	556.9
20	590.0	40	3140.0	560.0	1990.0	2550.0	402.1	448.9
21	570.0	34	3120.0	540.0	2010.0	2550.0	331.6	368.6
22	550.0	32	3100.0	520.0	2030.0	2550.0	302.5	334.7
23	530.0	26	3080.0	500.0	2050.0	2550.0	237.9	262.1
24	500.0	36	3050.0	470.0	2080.0	2550.0	312.7	342.4
25	470.0	32	3020.0	440.0	2110.0	2550.0	263.0	286.1
26	440.0	26	2990.0	410.0	2140.0	2550.0	201.3	217.6
27	410.0	26	2960.0	380.0	2170.0	2550.0	188.7	202.8
28	380.0	22	2930.0	350.0	2200.0	2550.0	149.0	159.0
29	340.0	24	2890.0	310.0	2240.0	2550.0	146.6	155.2
30	300.0	18	2850.0	270.0	2280.0	2550.0	97.8	102.7
						Total	5552.8	6177.3

REF DRG NO.

SIGN AND DATE

INVENTORY NO.

DISTRIBUTION OF PRINTS

W.O. 71065A17200

BHARAT HEAVY ELEC. LTD

BHOPAL

	NAME	SIGN	DATE	NO OF VAR
DRN				
DES				
APPD	AG			

REV.	DATE	ALTERED	DEPT	SCALE	WEIGHT	REF.TO ASSY.DRG.	IT.NO	NO.
		CHECKED	TRC	N.T.S				
		APPROVED	CODE					

ZONE

TITLE

Main Leg Laminations

TNEB:0

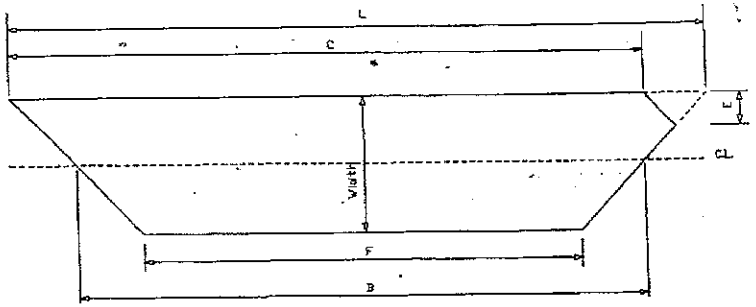
DRAWING NO TRE/JS/71065A REV 00

SHT NO 6 NO OF SHTS 11

SIZE A3

First Angle Projection

All dimensions in mm



Item	Width	Thick	B	C	L	E	F	Wt-Pnch	Wt-Cut
31	660.0	110	1905.0	1905.0	2565.0	330.0	1245.0	942.2	1031.6
32	650.0	46	1905.0	1905.0	2555.0	325.0	1255.0	388.6	424.8
33	638.0	66	1905.0	1905.0	2535.0	315.0	1275.0	542.0	590.8
34	610.0	48	1905.0	1905.0	2515.0	305.0	1295.0	382.7	416.0
35	590.0	40	1905.0	1905.0	2495.0	295.0	1315.0	309.4	335.3
36	570.0	34	1905.0	1905.0	2475.0	285.0	1335.0	254.8	275.4
37	550.0	32	1905.0	1905.0	2455.0	275.0	1355.0	232.0	250.1
38	530.0	26	1905.0	1905.0	2435.0	265.0	1375.0	182.2	195.8
39	500.0	36	1905.0	1905.0	2405.0	250.0	1405.0	239.0	255.8
40	470.0	32	1905.0	1905.0	2375.0	235.0	1435.0	200.5	213.7
41	440.0	26	1905.0	1905.0	2345.0	220.0	1465.0	153.2	162.6
42	410.0	26	1905.0	1905.0	2315.0	205.0	1495.0	143.3	151.5
43	380.0	22	1905.0	1905.0	2285.0	190.0	1525.0	112.9	118.8
44	340.0	24	1905.0	1905.0	2245.0	170.0	1565.0	110.8	115.9
45	300.0	18	1905.0	1905.0	2205.0	150.0	1605.0	73.7	76.7
							Total	4267.2	4614.8

REF DRG NO.

REVISION AND DATE

INVENTORY NO.

DISTRIBUTION OF PRINTS

V.D: 71065A17200

BHARAT HEAVY ELEC.,LTD

BHOPAL

	NAME	SIGN	DATE	MOD/VAR
DRN				
CKD				
APPD	AS			

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

DEPT: TRE

CODE:

UNITS_MASS(P):

SCALE: N.T.S

WEIGHT:

REF.TO ASSY.DRG.

ITEM NO.

TITLE

Yoke Laminations

TNE810

DRAWING NO: TRE/JS/71065A

REV: 00

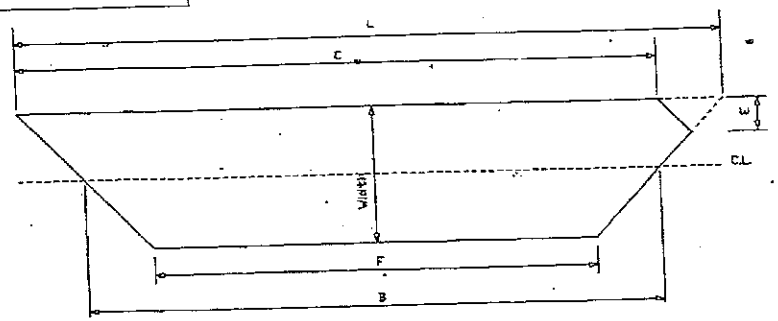
SHT NO: 7

NO OF SHTS: 11

SIZE A3

First Angle Projection

All dimensions in mm



Item	Width	Thick	B	C	L	E	F	Wt-Pnch	Wt-Cut
76	660.0	110	1905.0	1905.0	2565.0	330.0	1245.0	942.2	1031.6
77	650.0	46	1905.0	1905.0	2555.0	325.0	1255.0	388.6	424.6
78	630.0	66	1905.0	1905.0	2535.0	315.0	1275.0	542.0	590.8
79	610.0	48	1905.0	1905.0	2515.0	305.0	1295.0	382.7	416.0
80	590.0	40	1905.0	1905.0	2495.0	295.0	1315.0	309.4	335.3
81	570.0	34	1905.0	1905.0	2475.0	285.0	1335.0	254.8	275.4
82	550.0	32	1905.0	1905.0	2455.0	275.0	1355.0	232.0	250.1
83	530.0	25	1905.0	1905.0	2435.0	265.0	1375.0	182.2	195.8
84	500.0	36	1905.0	1905.0	2405.0	250.0	1405.0	239.0	255.8
85	470.0	32	1905.0	1905.0	2375.0	235.0	1435.0	200.5	213.7
86	440.0	26	1905.0	1905.0	2345.0	220.0	1465.0	153.2	162.6
87	410.0	26	1905.0	1905.0	2315.0	205.0	1495.0	143.3	151.5
88	380.0	22	1905.0	1905.0	2285.0	190.0	1525.0	112.9	118.8
89	340.0	24	1905.0	1905.0	2245.0	170.0	1565.0	110.8	115.9
90	300.0	18	1905.0	1905.0	2205.0	150.0	1605.0	73.7	76.7
							Total	4267.2	4614.8

REF DRG NO.

SIGN AND DATE

INVENTORY NO.

DISTRIBUTION OF PRINTS

BHARAT HEAVY ELEC. LTD

BHOPAL

	NAME	SIGN	DATE	NO OF VAR
DRN				
DES				
APPD				

S.O. 71065A17200

REV.	DATE	ALTERED / CHECKED / APPROVED	DEPT TRE	UNTOLERICR	SCALE N.T.S	WEIGHT	REF.TO ASST.DRG.	IT.NO	NO.
			CUST.						

TITLE

Yoke Laminations

TNE310

DRAWING NO TRE/JS/71065A

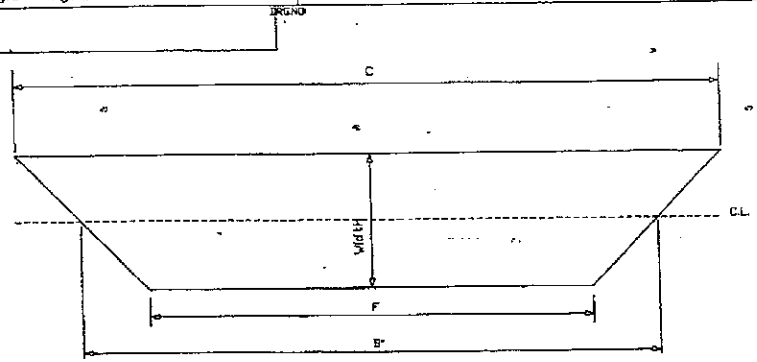
REV 00

SHT NO 8 NO OF SHTS 11

S17F A3

First Angle Projection

All dimensions in mm



It	Width	Thick	B	C	F	Wt-Cut
46	660.0	110	1905.0	2565.0	1245.0	1031.6
47	650.0	46	1905.0	2555.0	1255.0	424.8
48	630.0	66	1905.0	2535.0	1275.0	590.8
49	610.0	48	1905.0	2515.0	1295.0	416.0
50	590.0	40	1905.0	2495.0	1315.0	335.3
51	570.0	34	1905.0	2475.0	1335.0	275.4
52	550.0	32	1905.0	2455.0	1355.0	250.1
53	530.0	26	1905.0	2435.0	1375.0	195.8
54	500.0	36	1905.0	2405.0	1405.0	255.8
55	470.0	32	1905.0	2375.0	1435.0	213.7
56	440.0	26	1905.0	2345.0	1465.0	162.6
57	410.0	26	1905.0	2315.0	1495.0	151.5
58	380.0	22	1905.0	2285.0	1525.0	118.8
59	340.0	24	1905.0	2245.0	1565.0	115.9
60	300.0	18	1905.0	2205.0	1605.0	76.7

Total 4614.8

REF DRG NO.

SIGN AND DATE

INVENTORY NO.

DISTRIBUTION OF PRINTS

W.O. 71065A17200

REV.	DATE	ALTERED
		CHECKED
		APPROVED

ZONE

BHARAT HEAVY ELEC LTD

BHOPAL

	NAME	SIGN	DATE	NO.OF VAR
DRN				
DES				
APPD				

DEPT. TRC

CODE

UNTOLERANCES

SCALE N.T.S

WEIGHT

REF.TO ASSY.DRG.

IT.NO

NO.

TITLE

Yoke Laminations

TNEB10

DRAWING NO TRE/JS/71065A

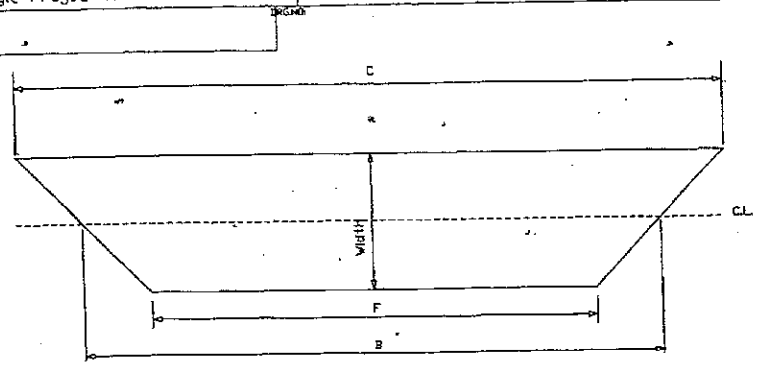
REV 00

SHT NO 9 NO. OF SHTS 11

SIZE A3

First Angle Projection

All dimensions in mm



It	Width	Thick	B	C	F	Wt-Cut
61	660.0	110	1905.0	2565.0	1245.0	1031.6
62	650.0	46	1905.0	2555.0	1255.0	424.8
63	630.0	66	1905.0	2535.0	1275.0	590.8
64	610.0	48	1905.0	2515.0	1295.0	436.0
65	590.0	40	1905.0	2495.0	1315.0	335.3
66	570.0	34	1905.0	2475.0	1335.0	275.4
67	550.0	32	1905.0	2455.0	1355.0	250.1
68	530.0	26	1905.0	2435.0	1375.0	195.8
69	500.0	36	1905.0	2405.0	1405.0	255.8
70	470.0	32	1905.0	2375.0	1435.0	213.7
71	440.0	26	1905.0	2345.0	1465.0	162.6
72	410.0	26	1905.0	2315.0	1495.0	151.5
73	380.0	22	1905.0	2285.0	1525.0	118.8
74	340.0	24	1905.0	2245.0	1565.0	115.9
75	300.0	18	1905.0	2205.0	1605.0	75.7

Total 4614.8

REF DRG NO.

SIGN AND DATE

INVENTORY NO.

DISTRIBUTION OF PRINTS

W.O. 71065A17200

BHARAT HEAVY ELECT. LTD. BHOPAL

	NAME	SIGN	DATE	NO.OF VAR
DRN				
CKD				
APPD				

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

DEPT TRE

CODE ARS

UNTOLERANCE

SCALE N.T.S

WEIGHT

REF.TO ASST.DRG.

ITEM NO.

TITLE

Yoke Laminations

THEBIG

DRAWING NO TRE/JS/71065A

REV 00

SHT NO 10

NO OF SHTS 14

SIZE A3

First Angle Projection

All dimensions in mm

NO.	Width	SLIT-WT	S-LEN(M)	NO.	Width	SLIT-WT	S-LEN(M)	NO.	Width	SLIT-WT	S-LEN(M)
1	300.0	617.5	1169.7	2	340.0	933.0	1559.7	3	380.0	955.9	1429.7
4	410.0	1218.9	1689.6	5	440.0	1308.1	1689.6	6	470.0	1719.7	2079.5
7	500.0	2058.2	2339.5	8	530.0	1575.6	1689.6	9	550.0	2012.4	2079.5
10	570.0	2216.0	2209.5	11	590.0	2698.5	2599.4	12	610.0	3348.0	3119.3
13	630.0	4754.4	4289.1	14	650.0	3418.8	2989.3	15	660.0	8301.3	7148.4

Total Slitting Weight = 37136.2 kG

Nett Core Weight = 35816.6 kG

Core steel to be drawn = 39735.7 kG
(With 7.0 % Wastage)

INVENTORY NO.	SIGN AND DATE	REF DRG NO.	DRG.NO
DISTRIBUTION OF PRINTS			
W.O: 71065A17200			
BHEL	BHARAT HEAVY ELEC LTD	BHOPAL	
REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE
DEPT: TRE	CODE: ADE	SCALE: N.T.S	WEIGHT
NAME	SIGN	DATE	NO.OF VAR
DRN / CKD / APPD			
REF.TO ASSY.DRG	IT.NO	NO.	
TITLE: Summary of Weights			
TNE310			
DRAWING NO: TRE/JS/71065A	REV: 00	SHT NO: 11	NO OF SHTS: 11

SIZE A3

COLD ROLLED GRAIN ORIENTED SHEET STEEL GR:27 L 85M

1. GENERAL:

This specification governs the quality requirements of double side insulated, cold rolled, grain oriented magnetic steel sheets of thickness 0.23mm manufactured by means of laser scribing or plasma flame irradiation or any equivalent process.

2. APPLICATION:

Used in transformer cores.

3. CONDITION OF DELIVERY:

Cold rolled and annealed.

The sheet shall be supplied in side trimmed continuous coils, with insulation coating on both sides, as specified in clause 6.

4. COMPLIANCE WITH NATIONAL STANDARDS:

There is no national standard covering this type of material.

However assistance has been drawn from ASTM A 876-03 Condition F-5, Ductility Class 1.

5. DIMENSIONS AND TOLERANCES:

5.1 Sizes:

The steel sheet shall be supplied to the dimensions specified on the order.

5.1.1 Thickness:

The thickness of the sheet shall be 0.23 mm.

5.1.2 Width:

The nominal standard width of the coil shall be 790, 840, 915 or 1000 mm.

The order shall clearly specify the width of the coil required.

5.1.3 Weight:

The nominal weight of the coil shall be between 1800 and 2500 kg.

5.2 Tolerances:

5.2.1 Thickness:

Tolerance on thickness when measured with a contact micrometer at any location, not less than 9.5 mm from an edge shall not deviate more than ± 0.025 mm from the average thickness of the test lot or coil. The outer limits of acceptable thickness shall be within the range of 0.190 to 0.254 mm.

5.2.2 Width:

The tolerance of width for side trimmed coil shall be - 0 and + 3 mm.

5.2.3 Edge Camber:

The deviation of a side edge from a straight line over 2440 mm length or fraction thereof shall not exceed 3.2 mm.

5.3 Waviness:

Sharp, short waves and buckles are extremely detrimental to the effective use of grain oriented electrical steel in flat laminations and shall be avoided in the delivered materials.

For material of width greater than 150 mm, the deviation from flatness (Wave Factor) expressed as a percentage, shall not exceed 1.5 %.

6. MANUFACTURE:

The sheet shall be of low carbon, silicon steel having silicon content around 3.15%. High permeability and low core-loss in the direction of rolling is to be achieved by appropriate metallurgical processes.

The thermally flattened material shall be coated with an inorganic surface coating type C2 and an inorganic surface coating, type C5, applied over the inherent C2 coating to provide extra surface insulation resistance on both sides as per ASTM A 876-03 condition F5.

The steel sheets shall be uniformly coated on both sides with an insulation as stated above, as part of its manufacturing process, and the magnetic domain may be finely sub-divided to achieve lower core loss by suitable means other than by mechanical scribing.

The insulation, coating shall be uniform throughout the length of the coil. There shall be no line marks, rough spots, shade difference, dots and patches etc.

7. FREEDOM FROM DEFECTS:

The material shall be clean, bright, smooth and free from dents, surface defects such as holes, scabs, pits, blisters, slivers, mill marks etc. and also free from oil, grease, dust scale and rust.

The sheet surface shall not exhibit any of these defects.

8. TEST SAMPLES:

Test samples shall be selected from the consignment as follows:

8.1 Maximum Specific Total Loss:

One from each coil.

8.2 Electrical & Mechanical Tests:

One sample per consignment/lot for Mechanical Tests and Electrical Tests (Surface Insulation Resistivity and Magnetic Permeability Tests).

8.3 The test smaples shall be sufficient in size to provide the necessary test pieces.

9. TEST METHODS:

Unless otherwise specified, the test shall be conducted in accordance with the relevant method specified in ASTM A 876-03 .

10. MECHANICAL TESTS:

10.1 Ductility:

Material shall possess good shearing and punching properties and shall be sufficiently ductile to permit normal working.

The bend test shall be carried on transversely cut test specimen of 60 mm long and between 10 mm and 30 mm wide.

The test specimen shall be initially bent through 90 degrees, this bend not being counted. The specimen shall then be bent backward and forward through 160 degrees. The specimen shall complete one bend without fracture.

10.2 Stacking Factor:

The surface quality of the material when measured in terms of stacking factor (viz. a minimum of 16 samples under a pressure of 0.35 MPa) shall be 94% minimum.

11. ELECTRICAL TESTS:

11.1 Surface Insulation Resistivity:

When tested as per ASTM A 717 - Franklin's method, the surface insulation resistivity per lamination (two surfaces) of single strip specimens (5 on each side), shall show the following readings.

Average Value - 10 ohms cm^2, Minimum.
Individual Value - 5 ohms cm^2, Minimum.

11.2 Maximum Specific Total Loss:

11.2.1 Cutting of Test Specimen:

Epstein test specimens measuring 30 mm wide and not less than 300 mm long, shall be cut from the sample with sharp shears. All the strips shall be cut parallel to the direction of rolling and tested without stress relief annealing or a sheet type specimen.

11.2.2 Testing:

When tested in accordance with ASTM A343M/A804M, the specimens prepared as described in clause 11.2.1 without stress relief annealing and shall be tested at a peak magnetic flux density of 1.7 T and a frequency of 50 Hz. The specific total loss shall not be greater than 0.85 watt/kg.

11.3 Mangentic Permeability Test

When tested in accordance with ASTM A 343M, the Magnetic permeability at AC Magnetizing Force of 800 A/m shall not be less than 1880 using 25 cm Epstein Test frame on 50 Hz. or in accordance with ASTM A 804 M using single sheet specimen

Alternately the induction value at 800 A/m magnetising force shall not be less than 1.88 Tesla

12. TYPE TEST: - Ageing*

When tested at a peak Magnetic Flux Density of 1.7T and at a frequency of 50 Hz, the specific total loss of the specimen which has been heated at a temperature of 225 deg.C for 24 hours shall not deteriorate by more than 4% of the measured specific total loss (clause 11.2) of the coil concerned.

*Note: Type tests shall be carried out when "Type Approval" to a supplier is given and repeated once in two years for the approved sources.

13. TEST CERTIFICATES:

Unless otherwise stated, three copies of certificates shall be supplied alongwith each consignment.

In addition, the supplier shall ensure to enclose one copy of the test certificate alongwith their despatch documents/shipping list to facilitate quick clearance of the material.

The test certificate shall bear the following information.

BP 10984 - Rev. 02, Order No, Supplier's Name/Grade/ Identification No, Size & Weight, Packet/Bundle No, Test Results of Dimensions & Tolerances, Freedom from Defects, Details of Insulation Coating, Type Test, Properties of (a) Specific Total Loss of each coil (b) Mechanical & Electrical properties for one random coil of each lot/ consignment, (c) Results of chemical composition for information only.

14. PACKING AND MARKING:

The material shall be supplied preferably in coils of continuous length. However, if it becomes unavoidable, 5% of the coils of the order can be supplied with maximum of two butt weld joints, and 95% of the coils shall be in one continuous length. The supplier shall ensure than the welds are made in such a manner without causing damage to the areas of coil adjacent to the weld. The welds shall be clearly marked by suitable tags projecting outside the coil.

Sheets shall be packed vertically according to the instructions and drawings given in the Annexure.

A metal label/tag shall be securely attached with each coil or drum or bundle outside its wrapping and shall be legibly marked with the following information.

BP 10984 : Cold Rolled Grain Oriented Sheet Steel
Gr: 27 L 85 M.

BHEL Order No.

Manufacturer's/Supplier's name.

Identification/Coil No.

Size and Quantity supplied.

GENERAL INFORMATION FOR CALCULATION

Density - 7.65 Kg/dm^3.

ANNEXURE

DETAILED INSTRUCTIONS FOR PACKING

The nominal weight of each coil shall be 1800-2000 kg.

The nominal internal diameter of coil shall be 508 mm.

Packing shall be sea-worthy and shall protect the coils from damage and rusting during transit.

The supplier's grade/reference shall be marked at every one metre intervals throughout the coil length. Coils shall be vertically packed according to the instructions and drawing given below.

1. An annular protection board shall be placed at either end of the coil.

2. The coil shall then be wrapped with waterproof anti-rust crepe kraft paper by lapping axially all around the circumference.

3. The coil shall then be covered by polyethelene sheet or anti-rust waterproof paper and the ends sealed properly.

4. A galvanised sheet shall be wrapped on the outside of the coil and the top and bottom of the coil. Care shall be taken to ensure that the ends of the tops and bottom of the coils extend sufficiently over the inside diameter of the coil.

5. A galvanised sheet shall be wrapped on the inside of the coil. Care shall be taken that it overlaps sufficiently over the ends of the sheet mentioned in (4) above.

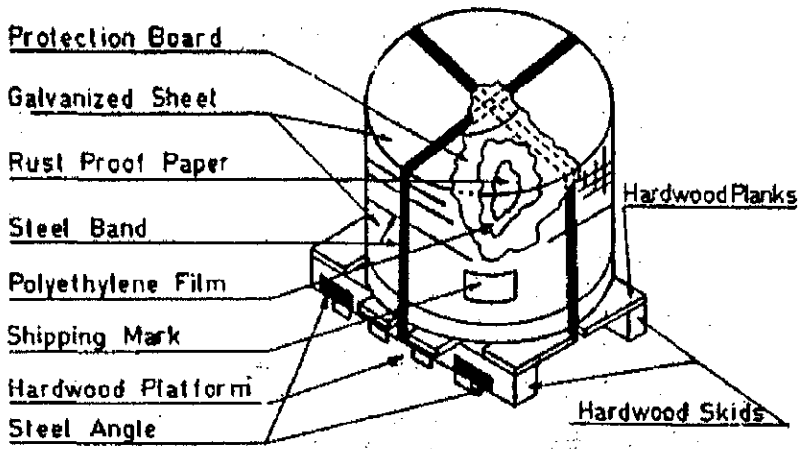
6. Steel ring made from thick angle sheets shall be placed on the rim of the inner diameter at both ends of the coil. The rings shall be held at either ends at four points by steel bands.

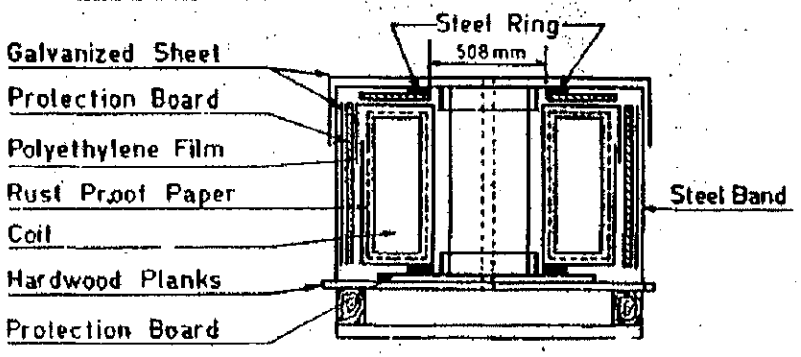
7. The coil shall then be mounted on wooden skids, held together by steel bands. Wooden skids must have cutouts to house the steel bands for tight fit and to avoid slippage.

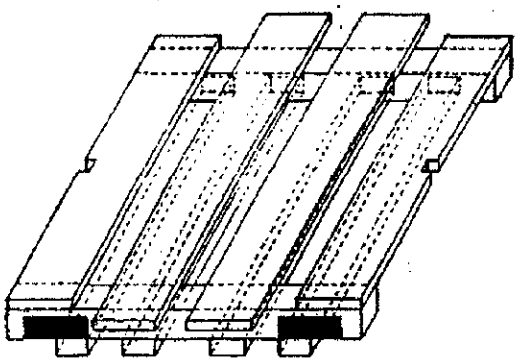
8. The packing shall ensure that there is no seepage of moisture and the coils reach BHEL in completely rust free condition. It should be strong enough to withstand handling at the docks, at sea and on the road.

9. Coils shall be sufficiently tight wound to prevent collapse to an extent that would preclude their being mounted on a mandrel appropriate to the ordered internal diameter.

10. Each package shall indicate the, Sling Position, for lifting without damage. It is preferable to fix a suitable size of, 'Sheet Steel Angle', at the position where the Sling Rope is to be fitted to avoid slippage/damage/ breakage of the wooden skid at four places.







शीर्षक TITLE **DIMENSIONS AND TOLERANCES FOR CORE**

1.0 CORE DIMENSIONS:—

1.1 DIAMETER :— THIS IS TO BE MULTIPLE OF 2mm.

1.2 LEG LENGTH:— THIS IS TO BE MULTIPLE OF 2mm.

1.3 LEG CENTRE:— THIS IS TO BE MULTIPLE OF 2mm.

1.4 NO. OF PACKETS:— THIS IS TO BE AS GIVEN BELOW —

CORE DIA IN mm.	MAIN LEG NO. OF PACKETS	MAIN YOKE & AUX. LEG /YOKE NO. OF PACKETS ★★
UPTO 500	10	4
502- 760	12	4 - 5
MORE THAN 760	15 OR MORE AS SPECIFIED	5

★★THE WIDTH AND AREA OF MAIN AND AUXILIARY YOKE PACKET AFTER MERGING SHOULD ALWAYS BE MORE THAN WIDTH AND AREA OF THE PACKET BEFORE MERGING. REFER SHEET TR15034C (PAGES 1 TO 5 FOR FIGURES.

1.5 LAMINATION WIDTH:— THIS IS TO BE MULTIPLE OF 10mm. HOW-EVER FOR MAIN YOKES AND OUTER LEGS OF 5 LIMBED CORES, THE CENTRE PACKET LAMINATION CAN BE MULTIPLE OF 5mm.

REF. DRG. NO. X10141C

पुनः Rev		DISTRIBU	
01 25-2-94	DISTRIBUTION LIST UP DATED. AKG	TXE TRP	रचित/जांच विवरण APPROVED
02 2-6-94	NOTE NO. 2.5 ADDED AKG 28/9/94	CGX FBM	
03	REVISED AS PER MITTAL COMMITTEE RECOMMENDATION	BAY 8 BAY 9	तैयार किया PREPD.

शीर्षक TITLE **DIMENSIONS & TOLERANCES FOR CORE**

2.0 TOLERANCES ON CORES:—

2.1.

CORE DIA IN mm	TOL. ON DIA IN mm	TOL. ON TOTAL BUILT UP THICKNESS IN mm
UPTO 400	+0 −3	+3 −0
402-760	+0 −4	+4 −0
ABOVE 760	+0 −5	+5 −0

2.2 TOLERANCE BETWEEN CENTRE LINE OF TOP & BOTTOM YOKE $^{+2}_{-0}$ mm.

2.3 TOLERANCE BETWEEN CENTRE LINE OF 2-CONSECUTIVE LEGS $^{+1}_{-0}$ mm.

2.4 ALL LEGS OF CORES MUST BE VERTICAL AND PARALLEL TO EACH OTHER AND WHEN THE CORE IS VERTICAL, THE TOLERANCE ON PLUMB TO BE 2mm PER METRE OF CORE HEIGHT INCLUDING YOKES, WITH A MAXIMUM OF 5mm FOR MAIN LEG AND 8mm FOR AUXILIARY LEG.

2.5 TOLERANCE ON INDIVIDUAL CORE PACKET ± 0.5 MM.

शीर्षक TITLE **DIMENSIONS AND TOLERANCES FOR CORE**

REF. DRG. NO. TR 10141C & BC 5-3

3.0 TOLERANCES ON LAMINATIONS

3.1 LENGTH–

+0
–2.0 mm.

3.2 WIDTH–

+0
–0.5 mm

3.3 HOLES (A) ON HOLE DIA ±0.1 mm
(B) DISTANCE BETWEEN FIRST AND LAST HOLE ±0.25 mm
(C) DISTANCE BETWEEN SUCCESSIVE HOLES ±0.1 mm
(D) OFF-SET PERPENDICULAR TO CENTRE LINE ±0.1 mm

3.4 ANGLE OF MITRE - ANGLE 45° ±1 MINUTE.
THIS CAN BE MEASURED AS FOLLOWS: USING A FIXED 45° SET-SQUARE, THE DEVIATION OF ANGLE OF THE MITRE OVER A MAX. WIDTH OF 1000 mm SHALL NOT EXCEED 0.5 mm GAP (AS SHWON IN THE FIG. 1&2 WHEN MEASURED BY A FILLER GAUGE) OR PROPORTIONATE THERE OF FOR OTHER WIDTH.

FIGURES:–

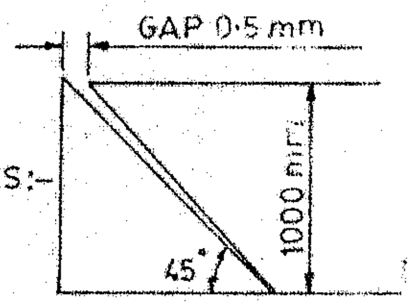


FIG. 1

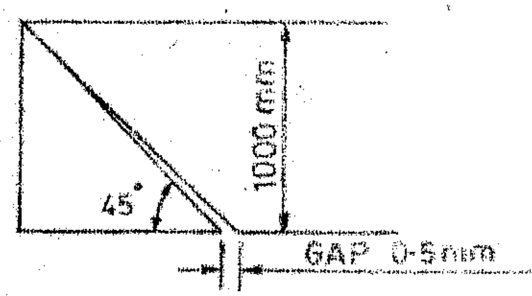


FIG. 2

3.5 EDGE BOW:– THIS SHOULD NOT EXCEED 0.50 mm/METRE OR PROPORTIONATE THERE OF, WITH A MAXIMUM OF 1.5 mm

3.6 BURR LEVEL:– THE MAXIMUM PERMISSIBLE BURR LEVEL IS 30 MICRONS.

REV		DISTRIBU.	
01 25-2-94	DISTRIBUTION LIST UPDATED AKG	TRE TRP.	स्वीकृत किया APPROVED:
02 2-6-94	NOTE NO 2.5 ADDED AKG 28/8/94	CQX TEM	तैयार किया PREPD. / जारी किया ISSUED / दिनांक DATE
03 26-4-05		BAY-8 BAY-9	ईआर/एसटीडी ERE/STD 17-6-97

BHARAT HEAVY ELECTRICALS LIMITED, JHANSI

QP/PT/CRGO/890

STANDARD MANUFACTURING QUALITY PLAN FOR SUBMISSION TO CUSTOMER

QUALITY PLAN FOR CRGO LAMINATION (Power, DT Transformer)

MATERIAL INSPECTION / IN-PROCESS INSPECTION / FINAL INSPECTION

SUB VENDORS / VENDORS / CONTRACTORS WORKS

QP.No.: QP/PT/CRGO/890
REV.No:00
DATE: 26.04.11

Sl. No.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY M	AGENCY C	AGENCY N	REMARKS
1.1	RAW MATERIAL CRGO LAMINATION (Grade-ZDKH 90. or Grade-ZDKH 85 or Grade –MOH or Grade M4)	A) Visual Check (Material should be free from defect)	B	V	100 %	-For Grade-ZDKH 90 : BP10985 & JS10999 -For Grade-ZDKH 85 : BP10984	-For Grade-ZDKH 90 : BP10985 & JS10999 -For Grade-ZDKH 85 : BP10984	Mill Manufacturer TC	V	V	-	
		B) Waviness	B	V	100%				V	V	-	
		C) Specific loss	B	T	One Sample/ Supplier different size	-For Grade –MOH: BP10987 & 10988 -For Grade M4: CPS-AA 10905 (As per PO)	-For Grade –MOH: BP10987 & 10988 -For Grade M4: CPS-AA 10905 (As per PO)		V	V	-	
		D) Bend test	B	T					V	V	-	
		E) Ageing test (Type test)	B	T					V	V	-	
		F) Surface Resistivity	B	T					V	V	-	
		G) Stacking Factor	B	T					V	V	-	
		H) Magnetic Permeability Test	B	T					V	V	-	
		I) Verification of purchase documents	B	V	100%	Purchase Order	Purchase Order	Supplier TC	V	V	-	
1.2	LAMINATION ON FINISHED / LABOUR BASIS	A) Tests /Inspection after slitting & cropping				-For Grade-ZDKH 90 : BP10985 & JS10999 -For Grade-ZDKH 85 : BP10984 -For Grade –MOH: BP10987 & 10988 -For Grade M4: CPS-AA 10905 (As per PO)	-For Grade-ZDKH 90 : BP10985 & JS10999 -For Grade-ZDKH 85 : BP10984 -For Grade –MOH: BP10987 & 10988 -For Grade M4: CPS-AA 10905 (As per PO)	Supplier TC				
		1) Thickness	B	I	One Sample/ Supplier different size				P	V	.	
		2) Surface insulation resistivity	B	T					P	V	.	
		3) Watt loss	B	T					P	V	.	
		4) Magnetic permeability	B	T					P	V	.	
		B) Dimensional check (Tolerances)										
		1) Length	B	I	One Sample/ Supplier different size	TR 15035C	TR 15035C As per computer sheet/Drg.	As per checklist for CRGO Lamination (CQX / 181-A)	P	V	-	
		2) Width	B	I					P	V	.	
		3) Holes	B	I					P	V	.	
		4) Angle of Mitre	B	I					P	V	.	
		5)Edge Bow	B	I					P	V	.	
		C) Dimensional check for each stage of lamination cutting							P	V	.	
		1) Burr level	B	I	100%	As per computer sheet/Drg		Dimensional report (CQX / 181-B)				
		2) Stack height	B	I								

Prepared by

(Sunil Kumar)

QC ENGINEER

Checked & Approved by

(R R Verma)

MANAGER (CQX)

BHARAT HEAVY ELECTRICALS LIMITED, JHANSI

BHEL/CQX/ QP/PT/CRGO/890

STANDARD MANUFACTURING QUALITY PLAN FOR SUBMISSION TO CUSTOMER

QUALITY PLAN FOR CRGO LAMINATION (Power DTT & ESP Transformer)

MATERIAL INSPECTION / IN-PROCESS INSPECTION / FINAL INSPECTION

SUB VENDORS / VENDORS / CONTRACTORS WORKS

QP.No.:QP/PT/CRGO/890
REV.No:00
DATE: 26.04.11
PAGE: 02 OF 02

Sl. No.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY M	AGENCY C	AGENCY N	REMARKS
1.3	Packing & Dispatch	1) Packing should be in Sturdy wooden pallets with proper covering & bind the core with resin impregnated fibre glass after putting core to coil packing in position tape (packing as per TR15031C).	B	V	100%	Purchase Order	Purchase Order	Dimensional report (CQX / 891-B)	P	V	-	Dimensional report (CQX / 181-C) should be pasted on each pallet respectively.
			B	I					P	V	-	
		2) Stacked in ready to built core condition & stack should be suitable to prevent ingress of dust and moisture as well as to avoid slippage/damage of the core lamination during transit & handling.	B	I					P	V		
		3) Width of wooden pallet (Total width of pallet should be 50 mm more than max. width of sheet to avoid damage during handling)	B	I					P	V		
		4) Following information should be provided on packing, a) PO no. b) Set No. c) Supplier name d) Identification no.										

LEGEND:

CLASS
A : CRITICAL
B : MAJOR
C : MINOR

TYPE OF CHECK
V : VISUAL
I : MEASUREMENT
T : TEST

AGENCY
M : MANUFACTURER / SUB CONTRACTOR
C : CONT/ NOMINATED INSPECTION AGENCY
N : CUSTOMER

SCOPE OF AGENCY
P : PERFORMER
V : VERIFICATION
W : WITNESS
PO : PURCHASE ORDER

FORMAT OF RECORD
TC : TEST CERTIFICATE
OS : OBSERVATION SHEET
DRG : DRAWING
CHECK LIST : CHECK LIST
AA/JS/PS/BP : BHEL PURCHASE SPECIFICATION

Prepared by
(Sunil Kumar)
QC ENGINEER

Checked & Approved by
(R R Verma)
MANAGER (CQX)

CQ/FISI-A
Rev No. 00

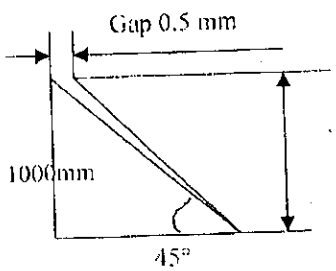
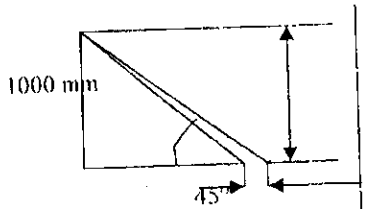
CENTRAL QUALITY SERVICES
BHEL JHANSI

Sub: Checkpoints of Transformer Core Lamination Sheets Tolerances.

Name of supplier: Material (CRGO Lamination)

PO No :

All the laminations made as per computer sheet pages 1 to 6 comply with the following requirements of TR15035 C.

Clause	Tolerances as per TR15035C	Comments of Inspector
3.0		
3.1)	Length +0/-2.0	
3.2)	width 0/-0.5	
3.3)	Holes	
a)	On holes dia +0.1mm	
b)	Distance between first and last hole +0.25 mm	
c)	Distance between successive holes + 0.1mm	
d)	Off set perpendicular to centre line + 0.1mm	
3.4)	Angle of Mitre- Angle 45 + 1 minute (See fig 1 & 2)  Fig. 1  Fig. 2 Gap 0.5 mm	
3.5)	Edge Bow 0.50 mm / meter or proportionate there of with a max of 1.5mm)	
3.6)	Burr Level up to 30 microns	
3.7)	Inspector has to ensure compliance of proper check of TC & documents provided by supplier.	

Inspector's Signature, Name, Date

CQX/181-B
Rev. No.: 00

DIMENSIONAL REPORT OF CRGO LAMINATION
AFTER CROPPING
(FOR 3 LIMB CORE)

PO No. :

Item no. of PO :

Supp. Name :

Date of observation:

WO No.:

Set NO. :

All nomenclature / Dimension as per computer sheet

Sl. NO.	Width (mm)	Leg/Yoke Punch Drg. No. (As per computer sheet)	Shape Confirmation (Put Y for confirm)	Dimension 'A' as per computer sheet		Dimension 'C' as per computer sheet		Required Stack height For Lam width (mm)	Observed Stack height (mm)	Pallet Nos. – Containing the sheets (To be filled after stacking) For details please see after stacking record CQX/891-B.
				Reqd.	Obsd.	Reqd.	Obsd.			
		DRG NO 1 (L1 + L2)								
		DRG NO 2 (L2)		----	----					
		DRG NO 3 (Y1 + Y2)		----	----					
		DRG NO 4 (Y2 + Y3)								
		DRG NO. 1								
		DRG. NO. 2		---	---					
		DRG. NO. 3		---	---					
		DRG.NO. 4								
		DRG. NO. 1								
		DRG. NO. 2		---	---					
		DRG. NO. 3		---	---					
		DRG.NO. 4								
		DRG. NO. 1								
		DRG. NO. 2		---	---					
		DRG. NO. 3		---	---					
		DRG.NO. 4								

Total Pallet Nos. :

Total Net Wt. :

Total Gross Wt. :

Prepared by:

Sign:

Designation:

Inspected / Checked By:

CQX/181 C
Rev No.: 00

DIMENSIONAL REPORT OF CRGO LAMINATION AFTER STACKING (FOR 3 LIMB CORE)

PO No. :

Item no. of PO :

Supp. Name :

Date of observation :

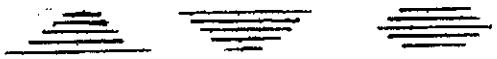
WO No. , KVA rating & Set No.:

Pallet No. :

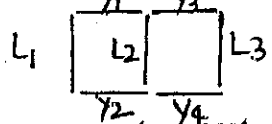
Limb/Yoke:

(Put ✓ on used type of stacking)

Stacked as : Straight / Reversed / Combined



Stacking of Lamination : L1 / L2 / L3 / Y1 / Y2 / Y3 / Y4



All dimension & Nomenclature as per computer sheet

Item No. (As per computer sheet)	Leg/Yoke Punch Drg. No. (As per computer sheet)	Width of Lam (mm)	Required step Stack height (mm) (L1/4, L2/2, L3/4, Y1/4, Y2/4, Y3/4, Y4/4) (As per computer sheet)	Observed step Stack height (mm)	Weight of Lamination (KG)	Remarks

Net Weight (Kgs) :

Pallet Weight(Kgs):

Gross Weight(Kgs):

Inspector has to ensure compliance of
1) All points of Sl. No. 1.3 of QAP regarding packing & dispatch before clearance of material.
2) Anti rust panting on cut edge after stacking.

Prepared by:

Sign:

Designation:

Inspected / Checked by:

CQX/181-B
Rev. No.: 00

DIMENSIONAL REPORT OF CRGO LAMINATION AFTER CROPPING
(FOR 5 LIMB CORE)

PO No. :

Date of observation:

WO No.:

Item no. of PO :

Supp. Name :

Set NO. :

All nomenclature / Dimension as per computer sheet

Sl. NO.	Width (mm)	Leg/Yoke Punch Drg. No. (As per computer sheet)	Shape Confirmation (Put Y for confirm)	Dimension 'A' as per computer sheet		Dimension 'C' as per computer sheet		Required Stack height for Lam width (mm)	Observed Stack height (mm)	Pallet Nos. – Containing the sheets (To be filled after stacking) For details please see after stacking record CQX/891-B.
				Reqd.	Obsd.	Reqd.	Obsd.			
		DRG NO 1								
		DRG NO 2								
		DRG NO 3								
		DRG NO 4								
		DRG NO 5								
		DRG NO 6								
		DRG NO 7								
		DRG NO 8								
		DRG NO 9								
		DRG NO. 1								
		DRG NO. 2								
		DRG NO. 3								
		DRG NO. 4								
		DRG NO. 5								
		DRG NO. 6								
		DRG NO. 7								
		DRG NO. 8								
		DRG NO. 9								

Total Pallet Nos. :

Total Net Wt. :

Total Gross Wt. :

Prepared by:

Inspected / Checked By:

Sign:

Designation:

CQX/181-C
Rev: 00

DIMENSIONAL REPORT OF CRGO LAMINATION AFTER STACKING (FOR 5 LIMB CORE)

PO No. :

Item no. of PO :

Supp. Name :

Pallet No. :

Limb/Yoke:

(Put ✓ on used type of stacking)

Stacked as : Straight / Reversed / Combined

Date of observation :

Rev. No.: 00

WO No. , KVA rating & Set No.:

Stacking of Lamination : L1 /L1A/L1B/L2/ L2A /L2B/ L3 /L3A/L3B/L4/L5/ Y1 Y2 / Y3 / Y4/Y5/Y6/Y7/Y8

All dimension & Nomenclature as per computer sheet

Item No. (As per computer sheet)	Leg/Yoke Punch Drg. No. (As per computer sheet)	Width of Lam (mm)	Required Stack height (mm)	Observed Stack height (mm)	Weight of Lamination (KG)	Remarks

Inspector has to ensure compliance of

1) All points of Sl. No. L3 of QAP regarding packing & dispatch before clearance of material.

2) Anti rust painting on cut edge after stacking.

Prepared by:

Sign:

Designation:

Net Weight (Kgs) :

Pallet Weight(Kgs):

Gross Weight(Kgs):

Inspected / Checked by: