



**GUJARAT ENERGY TRANSMISSION
CORPORATION LTD.**

**Sardar Patel Vidyut Bhavan, Race Course,
Vadodara: 390 007**

TECHNICAL SPECIFICATIONS

OF

SUB STATION STRUCTURES

**TECHNICAL SPECIFICATIONS FOR DESIGN, FABRICATION,
GALVANISING, FABRICATED STRUCTURE MATERIALS, BOLTS –
NUTS, ANCHOR BOLTS AND ACCESSORIES & ATTACHMENTS.**

1.0 SCOPE:

- 1.1 The scope for supply work covered under this section consists of:
- (i) Preparation of fabrication sketches and get their approvals,
 - (ii) Procurement of raw-materials like steel, zinc, etc. required for fabrication and galvanizing,
 - (iii) Procurement of bolts-nuts, accessories and attachments for insulator string, earth wire clamp etc., (for gantry structures)
 - (iv) Preparation of 'PROTO-MODEL' assembly based on its approved structural drawings, bills of materials and fabrication sketches.
 - (v) Mass fabrication of structure members as per approved fabrication sketches and their galvanizing,
 - (vi) Inspection of finished structure materials.
 - (vii) Inspection of bolts-nuts, accessories and attachments at manufacturer's works.
 - (viii) Dispatch of all materials to destination, including transit insurance.
 - (ix) Guarantee of all above activities carried out from (i) to (viii).
- 1.2 The steel shall confirm to IS 2062 grade-A..
- 1.3 All the work shall be carried out in accordance with the revised and latest provisions under respective Indian Standard.
- 1.4 The contractor shall be fully responsible for supply of complete structure inclusive of bolts-nuts, accessories and attachments for the final quantities ordered.
- 1.5 The contractor shall make his own arrangement for procurement of required Bolt-Nuts, accessories, attachments like 'D' shackles. 'U' bolts, anchor bolts, step bolts etc. well in advance and supply as per scheduled completion period along with the inspection at sub vender's premises.
- 1.6 The bolt nuts shall be procured from the GETCO approved vender.

2.1 DRAWINGS AND BILLS OF MATERIALS:

- 2.1.1 The successful bidder has to submit copies of drawings and documents as stated in 1.1 (I) for GETCO's approval before commencing the mass production.
- 2.1.2 Proto-Model shall be prepared and got inspected for the approval along with fabrication sketches, structural drawings and bills of material.

2.2 DESIGN, FABRICATION, STAMPING AND GALVANISING OF MATERIALS:

- 2.2.1 Two sets of anchor bolt setting templates should be designed, fabricated, and supplied for each type of column and equipment support structure.
- 2.2.2 Any extension or other type of structure, if required, to be supplied against this Tender the successful contractor shall design and prepare Proto - Model at no extra cost to the GETCO.
- 2.2.3 All the activities like straightening, cutting, drilling punching, bending, notching, stamping galvanizing etc. shall be carried out according to technical part of this Specification.
- 2.2.4 All the galvanized steel structures shall be bolted type however, welding may be considered for following cases (If it is specifically mentioned in the drawing).
 - 1. Base plate of 400kV gantry Structures and equipment structures.
 - 2. Base plate of 220kV Equipment structures.
 - 3. Base plate of 132kV Equipment structures.
 - 4. Base plate of 66kV Gantry Structures (Ph-ph distance 1.8m).
 - 5. Base plate of 11kV out door structures.

3.0 TYPE OF STRUCTURES:

- 3.1 All the structures shall be **lattice type**, fully galvanised using only structural mild steel sections for members. The use of high tensile steel is not permitted. Hexagonal head bolts with nuts and spring washers shall be used for connections.

- 3.2 The 400/220/132/66kV structures are required for the switch yard of S/S referred in schedule /drawings. The successful bidder will have to match these structure drawings with the existing structures of the switch yard.

3.3 **WEIGHTS :**

- 3.3.1 The unit weights of each type of structure, including bolt-nuts, accessories, attachments and anchor bolts shall be furnished and / or to be approved by the GETCO. The weight of structure shall mean the weight calculated by using the black sectional (i.e. ungalvanized) weights of a steel members of the sizes indicated in the fabrication drawings and bills of materials without taking into consideration the reduction in weight due to drilling of bolts, holes, skew cuts, chambering etc. or increase in weight due to galvanizing, but taking into consideration the weight of the special fitting, bolts, nuts, washers and other accessories. The unit weight of structures shall be as per cl.no.3.14 of the specification. However, change in unit weight with respect to design calculation may be submitted and got approved from GETCO.

3.3.2

3.4 **MATERIAL:**

- 3.4.1 The steel required for fabrication of structure member shall conform to IS: 2062 - Grade A.
- 3.4.2 The zinc required for galvanizing shall be of Zn-99.95% and shall conform to IS: 209-1966.
- 3.4.3 The bolts and nuts shall conform to IS: 6639-1972 or IS: 12427-1988. The bolts and nuts shall be of minimum class 5.6.
- 3.4.4 The plain washers shall conform to IS: 2016-1967. Heavy washers shall conform to IS: 6610-1972. Spring washers for bolts and nuts shall conform to IS: 3063-1972.
- 3.4.5 All bolts and nuts shall have hexagonal heads. The heads, being forged out of the solid, truly concentric and square with the shanks, must be perfectly straight.
- 3.4.6 Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the place of contact of the member.
- 3.4.7 All bolts shall be threaded as per IS: 1363 (1967) to take full depth of the nut and be threaded enough to permit firm gripping of the member, but no further

threaded portion of each bolt shall project through the nut at least 6mm. when fully tightened. All nuts shall fit hand tight to the point where the shank, of the bolt connects to the head. Flat and tapered washers shall be provided where necessary.

- 3.4.8 The diameter of bolts shall be 12 mm, 16mm and 20mm. The thickness of spring washers shall be 2.5 mm, 3.5 mm and 4 mm respectively. Spring washers shall be provided under all nuts. These washers shall be positive lock type electro-galvanized.
- 3.4.9 Each structure shall be provided with step-bolt of not less than 16mm diameter. The step-bolt shall be fixed on one leg up to top of structure as indicated in approved drawing. Each step-bolt shall be provided with two nuts and one washer.
- 3.4.10 The attachments like 'U' bolt, 'D' shackle, strain plate etc. shall be as per approved drawings.

3.5 **FABRICATION WORKMANSHIP :**

- 3.5.1 The details of fabrication shall conform to IS:802 (Part-II) - 1978.
- 3.5.2 All the structure members shall be accurately fabricated to bolt together easily at site without any undue strain on the bolts.
- 3.5.3 The diameter of the bolt-hole shall be equal to the diameter of bolt plus 1.5 mm.
- 3.5.4 All similar parts of structure shall be made strictly inter-changeable.
- 3.5.5 All steel sections before any work is done on them, shall be carefully, leveled, straightened and made true to detailed drawings by methods which will not injure the materials so that when assembled the adjacent matching surfaces are in close contact throughout. No rough edges shall be permitted in the entire structure.
- 3.5.6 Welding shall be done as per IS:816 (latest rev.) Or electric welding. Edge preparation of welding shall be done as per IS:623 (latest rev.)

3.6 **PROTO-MODEL ASSEMBLY :**

Before proceeding with mass fabrication the contractor shall fabricate one structure of each type (i.e. superstructure) for the purpose of checking accuracy and workmanship. This structure should be strictly according to the respective structural drawing and bills of material provided and approved by the GETCO.

The contractor shall be solely responsible for preparation and inspection of such PROTO-MODEL assembly.

3.7 **DRILLING AND PUNCHING:**

3.7.1 Holes for bolts shall be drilled or punched with a jig but drilled holes shall be preferred. The following maximum tolerance of accuracy of punched holes is permissible.

- a) Holes must be perfectly circular and no tolerance in this respect is permissible.
- b) The maximum allowable difference in diameter of the holes on the two sides of plates or angle is 0.8 mm i.e. the allowable taper in punched holes should not exceed 0.8mm of diameter.
- c) Holes must be square with the plates or angles and have their walls parallel.

3.7.2 All burs left by drills or punch shall be removed completely. When the structure members are in positions, the holes shall be truly opposite to each other. Drilling or ramming to enlarge defective holes shall not be permitted.

3.8 **ERECTION MARK:**

3.8.1 Each individual structure member shall carry a code number conforming to the component number given to it in the bills of material and fabrication drawing. This code number shall be marked with marking dies, having 16 mm size-letter before galvanizing and shall be legible after galvanizing. The letters indicated for different types of structure shall only be used.

Erection mark shall be "AAA - BB-CCCC-DDD" where,

AAA = Contractor's own Code-Numerical/Alphanumeric

B = '06' for 66kV, '1' for 132kV '2' for 220kV &
'4' for 400kV -Numerical

CCCC = Structure type (as per respective table of weights)
-Alphanumeric

DDD = Member number -Numerical.

This mark shall be got approved from the GETCO.

3.8.2 Each structure member shall also be marked with indelible ink through stencil of 16 mm size alphabet /numerical.

3.9 **BENDING:**

3.9.1 Mild steel angle sections up to 75 x 75 mm (up to 6 mm thick) shall be bent cold up to and including bend angle of 10 Deg. angles above 75x75

mm (thickness up to 6 mm) and up to and including 100 x 100 mm (thickness up to 8 mm) may also be bent cold up to the bend angle of 5 Deg. All other angle sections and bend angles not covered above shall be bent hot.

3.9.2 All plates up to 12 mm thickness shall be bent cold up to a maximum bend angle of 15 Deg. Greater bends and other thicknesses shall be bent hot.

3.9.3 All hot bent material shall be air cooled. The bends shall be of even profile and free from any surface damages.

3.10 **GALVANIZING:**

3.10.1 The galvanizing shall be done to all the structure members after the fabrication work is completed. The nuts may be tapped or re-run after galvanizing. Threads of bolts and nuts shall have neat fit and can be turned with finger throughout the length of the threads of bolts and they shall be capable of developing full strength of bolts.

3.10.2 The zinc deposition should not be less than specified per galvanized surface area of the fabricated structure member.

3.10.3 The galvanizing of the structure members shall conform to IS: 2629-1966 & IS: 4759-1968. All galvanized members shall withstand tests as per IS: 2633-1972. The weight of zinc coating shall be determined as per the method stipulated in IS: 2633-1964. Spring washers shall be electro galvanized as per IS:1573-1970

3.10.4 Unless otherwise specified the fabricated structures shall have a minimum overall Zinc coating of 610 gm per sq. m of surface except for plates & sections below 5mm which shall have Zinc coating of 460 gm per sq. m of surface. The average zinc coating for all sections & plates 5mm & above shall be maintained minimum 87 microns and that for sections below 5mm shall be maintained minimum 65 microns.

3.10.5 For specified Marine Environment or 31mm creepage distance in BOQ, under marine environment, the fabricated structures shall have a minimum overall Zinc coating of 900 gm/sq. m of surface except for plates and sections below 5 mm which shall have a minimum overall Zinc coating 610 gm/sq. m of surface area. The average Zinc coating for all sections and plates 5 mm and above shall be maintained minimum 127 microns and that for plates and sections below 5 mm shall be maintained minimum 87 microns.

3.10.5.1 Zinc coating for 11kv Outdoor structures shall be carried out as per cl. 3.10.5 irrespective of location.

3.10.6 The foundation bolt shall be galvanized as per IS 1367(Part-XIII)-1983. i.e. 375gms/sqMtr (54Microns). The weight of zinc coating shall be determined as per the method stipulated in IS: 2633-1964.

3.10.7 All the stubs, cleats and stub-setting templates shall be fully galvanized.

3.11 CONFORMITY:

3.11.1 The contractor shall ensure that the specified materials and workmanship of all structures actually supplied strictly conform to drawings/data supplied by the GETCO. In case any deviation is detected during the process of supply or even after erection, the Contractor shall replace such defective structure free of cost to the GETCO. All expenditure or losses incurred in erection to and fro transportation and any other expenditure or losses incurred by the GETCO on this account shall be borne by the Contractor. No extensions in delivery period shall be allowed on this account.

3.12 GENERAL GUIDE-LINE FOR INSPECTION:

3.12.1 Fabricated Structure Members:

- (i) Visual examination and quantity verification of offered lot.
- (ii) Sample selection from the offered lot at a ratio of 40 MT (or part thereof) 1 no. for all tests.
- (iii) Dimension, fabrication and triunes verification of structure member from fabrication sketch.
- (iv) Galvanizing test of each sample i.e. dip test, hammer test and mass of zinc test.
- (v) Random verification Zinc coating over galvanized surface by Elcometer.
- (vi) Tensile test and bend test of each sample.
- (vii) Chemical composition test of at least one sample per lot offered for inspection.
- (viii) Verification of manufacturer's test certificate for mild steel used in structure members.

3.12.2 Bolts-Nuts, Washers, Accessories, and Attachments etc.: (To be carried out at manufacture's works.)

- (i) Visual examination and quantity verification of offered lot.
- (ii) Sample selection from the offered lot as per relevant IS for each item.
- (iii) Dimension, fabrication and trueness verification from fabrication sketch.
- (iv) Galvanizing test of each sample.
- (v) Other acceptance tests for respective item as per relevant Indian Standard.

3.13 **STANDARDS:**

The design, fabrication, galvanizing and testing of material used for manufacture of structures shall conform to the latest edition of the following standards (as mentioned up-to-date) except where otherwise specified in the Specification.

1.	Specification for zinc	IS : 209-1966
2.	Code of practice for use of structural steel in general Building Construction.	IS : 800-1962
3.	Code of practice for use of structural steel in overhead transmission line towers.	IS : 802-1978 (Part II)
4.	Hexagon head bolts, screws and nuts of product grade 'C'.	IS : 1363-1984 (Part 3)
5.	Technical supply conditions for threaded fasteners (First Revision)	IS : 1367-1967
6.	Plain washers	IS : 2016-1967
7.	Steel for general structural purposes Specification.	IS : 2062-1992
8.	Recommended practice for hot-dip galvanizing of iron and steel.	IS : 2629-1966
9.	Methods of testing weight thickness and uniformity of coating on hot-dip galvanized articles.	IS : 2633-1972
10.	Single Coil Rectangular Section spring washers for bolts, nuts, screws.	IS : 2063-1972
11.	Specification for hot-dip zinc containing on structural steel and other allied products.	IS : 4759-1968
12.	Specification for hot-dip galvanized coating on fasteners.	IS : 5358-1969
13.	Code of practice for design, installation and maintenance of overhead power lines.	IS : 5613-1976
14.	Heavy washers for steel structures.	IS : 6610-1972

15.	Hexagonal bolts for steel structures.	IS : 6639-1972
16.	Methods for determination of weight of zinc coating of zinc coated iron and steel articles.	IS : 6745-1972
17.	Transmission Tower bolts.	IS : 12427-1988

3.14 STRUCTURE DETAILS

<u>WEIGHT OF GANTRY STRUCTURES FOR 400 KV SWITCHYARD WITH TWO BUS WITH ONE AND HALF CB SCHEME</u>					
SR.N O.	STRUCTURE	STEEL KG	B/N KG	A/B KG	TOTAL KG
1	COLUMN TM	6199.70	683.7	409.92	7293.32
2	COLUMN TN	8242.67	871.6	738	9852.27
3	COLUMN TJ	6959.95	734.6	1182.5	8877.05
4	COLUMN TI	4759.01	445.2	316.26	5520.47
5	COLUMN TC	2482.03	339.1	172.49	2993.62
6	BEAM BH	3286.20	101	0	3387.20
7	BEAM BM	3159.21	93.9	0	3253.11
<u>WEIGHT OF GANTRY STRUCTURES FOR 400 KV SWITCHYARD WITH DOUBLE MAIN TRANSFER BUS SCHEME</u>					
SR.N O.	STRUCTURE	STEEL KG	B/N KG	A/B KG	TOTAL KG
1	COLUMN C2	6936.38	239.4	288.05	7463.83
2	COLUMN C3	8051.04	295.89	576.10	8923.03
3	COLUMN C7	2299.83	93.92	144.06	2537.81
4	COLUMN C8	2246.65	90.73	144.10	2481.48
5	COLUMN C9	3673.81	162.28	288.00	4124.09
6	COLUMN C11	6217.97	217.60	400.50	6836.07
7	BEAM B1	3289.05	96.66	0.00	3385.71
8	BEAM B2	3327.04	103.76	0.00	3430.80
9	BEAM B3	3072.70	114.06	0.00	3186.76
10	BEAM B4	3593.38	151.73	0.00	3745.11
11	BEAM B5	3142.80	138.03	0.00	3280.83
12	LM 50 mtr	5429.37	388.60	215.85	5818.02
<u>THE STRUCTURES REQUIRED FOR QUAD MOOSE CONDUCTOR (LINE PURPOSE) AND AL59 CONDUCTOR (FOR TRANSFER BUS & BUS COUPLER)</u>					
1	COLUMN C2Q	10503.64	312	1477.15	12292.79
2	COLUMN C3Q	11220.24	347	1477.15	13044.39

3	COLUMN C4QT	11286.26	347	1477.15	13110.41
4	COLUMN C7Q	2969.68	107.11	295.04	3271.8
5	COLUMN C9Q	4890.08	154.5	700	5744.6
6	BEAM B1Q	6074.12	182.2	0	6256.3
7	BEAM B2Q	3627.26	132.34	0	3759.6
8	BEAM B4Q	4830.22	151.44	0	4981.7

WEIGHT OF EQUIPMEMNT STRUCTURES FOR 400 KV SWITCHYARD

SR.N O.	STRUCTURE	STEEL KG	B/N KG	A/B KG	TOTAL KG
1	400 KV LA	206.13	9.9	70.16	286.19
2	400 KV CT	242.37	8.9	39.465	290.74
3	400 KV CVT	176.56	10.9	39.465	226
4	400 KV PI	207.67	9.9	12.69	230.26

Details of Unit Weights (Approx.) for structures for 220kV Switchyard with Two Main (with ACSR Quadruple Moose) and Transfer Bus (ACSR Twin Moose) scheme. (Pl.refer GETCO'S Schedule/drawing for quantities)

**WEIGHT OF GANTRY AND EQUIPMENT STRUCTURES FOR 220 KV
SWITCHYARD**

SR.N O.	STRUCTURE	STEEL KG	B/N KG	A/B KG	TOTAL KG
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(I) GANTRY STRUCTURES (3-BUS SCHEME)

1	2CPA2	2156.26	97.7	128	2381.96
2	2CPA3	2116.84	95.81	96.948	2309.59
3	2CPA4	2411.04	108.09	128	2647.13
4	2CB1	1237.6	47.653	128	1413.25
5	2CB2	1008.18	35.781	58.312	1102.27
6	2BB1	1561.91	75.728	0	1637.64
7	2BB2	1267.79	54.71	0	1322.50
8	2BA2	1125.34	49.076	0	1174.41

Other structure as per existing layout

9	2BA1(18mtr)	981.283	47.405	0	1028.69
10	LM 25 mtr	3283.97	137.57	36.2626	3457.7996

Details of Unit Weights (Approx.) for structures for 220kV Switchyard with Two Bus (with ACSR Twin Moose) scheme.

(Pl.refer the requirement of str from GETCO'S drawing)

**WEIGHT OF GANTRY AND EQUIPMENT STRUCTURES FOR 220 KV
SWITCHYARD**

SR.N O.	STRUCTURE	STEEL KG	B/N KG	A/B KG	TOTAL KG
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(I) GANTRY STRUCTURES

1	CPA1X	1828.19	88.292	114.272	2030.76
2	CPB1X	1004.8	63.619	70.16	1138.58
3	CPC1X	1417.64	77.62	70.16	1565.42
4	BA1(14.6M)	946.30	47.84	0.00	994.13
(II) 220 KV EQUIPMENT STRUCTURES					
1	220 KV LA	164.63	9.5	9.23	183.36
2	220 KV CT	157.65	8	9.23	174.88
3	220 KV ISO with E/S	946.66	28.6	12.7	987.96
	220 KV ISO without E/S/TANDEM	907.09	27.4	12.7	947.19
4	220 KV PT	189.93	10.6	9.23	209.76
5	220 KV PI	154.17	4.32	9.23	167.720
6	220 KV CVT	181.943	10.6	40.64	233.183
Details of Unit Weights (Approx.) for structures for 132kV Switchyard with Single Bus (with ACSR Moose/Zebra) scheme.					
(Pl.refer the requirement of str from GETCO'S drawing)					
<u>WEIGHT OF GANTRY AND EQUIPMENT STRUCTURES FOR 132 KV AND 66KV SWITCHYARD</u>					
SR.N O.	STRUCTURE	STEEL KG	B/N KG	A/B KG	TOTAL KG
(I) GANTRY STRUCTURES					
1	06/1CPA2	917.296	47.254	71.564	1036.110
2	1CPB2	629.170	28.300	53.700	711.170
3	06/1CPC2	839.968	50.947	53.700	944.620
4	1BA2	566	34.370	0	600.370
5	1BC2	374.751	18.697	0	393.450
(II) 132 KV EQUIPMENT STRUCTURES					
1	132 KV LA	148.70	8.00	9.23	165.93
2	132 KV CT	137.00	8.00	9.23	154.23
3	132 KV ISO without E/S	527.00	27.00	26.28	580.28
4	132 KV PT	147.00	8.00	9.23	164.23
5	132 KV PI	135.21	4.32	9.23	148.76
(I) 66KV GANTRY STRUCTURES (PH-PH DISTANCE 2.15M)					
1	6CPA3	636.982	37.931	57.474	732.390
2	6CPB3	526.210	27.877	71.520	625.610
3	6BA3	334.111	25.023	0	359.130
4	6FB1	397.513	34.014	0	431.527
5	6FB2	420.833	30.733	0	451.570

6	6FC	566.544	27.526	68.538	662.610
7	6'S'	680.640	19.130	35.408	735.180
(II) 66 KV EQUIPMENT STRUCTURES.					
1	66 KV LA	135.40	4.45	9.23	149.08
2	66 KVCT	149.61	7.98	9.23	166.82
3	66 KV ISO with E/S	300.12	8.2	9.23	317.55
4	66 KV ISO without E/S	281.08	8.2	9.23	298.51
5	66 KV PT	149.48	7.98	9.23	166.69
6	66 KV PI	139.73	4.32	9.23	153.28
7	LM 15 MTR	1502.57	69.11	36.92	1608.6
(III) 66KV GANTRY STRUCTURES (PH-PH DISTANCE 1.80M)					
1	6CPA2A	1438.36	102.46	215.20	1756.02
2	6CPB3A	693.66	62.72	94.08	850.46
3	6BA3A	500.80	48.70	0	549.50

VHF MAST (FOR 220 KV, 132 KV, 66 KV SUB STATION)

SR.N O.	STRUCTURE	STEEL	B/N	A/B	TOTAL KG
1	MAST	1438.29	45.77	0.0	1484.10
2	STUB	85.37	0.45	0.0	85.82
3	STUB TEMPLATE	148.2	3.27	0.0	151.47

11 KV OUTDOOR STRUCTURE

SR. NO.	STRUCTURE	STEEL	B/N	A/B	TOTAL KG
1	11 KV DP STRUCTURE - GETCO (FOR OUT GOING FEEDER) -A1	352.4	5.9	10.7	368.9
2	11KV SIDE CONNE.ARRA.FOR 66-11KV TRANSFOR.-A2	245.2	4.8	10.7	260.7
3	STRUCTURE FOR 11KV/415KV DISTRIBUTION TRANSFORMER-A3	379.8	7.8	10.7	398.3
4	11KV DP STRUCTURE - DISCOM (FOR CROSS BOUNDARY PROTECTION)- A4	352.4	5.9	10.7	368.9

4.0 SUBMISSION OF DRAWINGS AND DOCUMENTS

The GETCO will provide one set of available drawings of respective structure, to the successful Bidder on award of contract.

Proto-Model (if required) shall be prepared and got inspected for the approval along with fabrication sketches, structural drawings and bills of

material at no extra cost to the GETCO. Soft copy of shop sketches of Structure in Auto CAD format must be submitted to Engineering Cell, Corporate Office, GETCO-Vadodara.

The approved copies of structural drawings and bills of materials shall be distributed as under:

- i) CE (Projects), GETCO , Corp Off, Vadodara - 2 sets
- ii) Supdt. Engineer (Trans), GETCO, Circle Office in-charge of work
- 1 set
- iii) Each consignee - 3 sets

The approved copies of fabrication sketches shall be submitted in duplicate only to the CE (Engg), GETCO, Vadodara.

5.0 Matching of Base Plan

Supply of equipment structures shall be strictly in accordance to the standard base plan attached (Ann-I) with this Technical Specifications. No deviation in this regard will be acceptable.