

**TECHINICAL SPECIFICATION FOR BIS CERTIFIED OUTDOOR THREE PHASE DISTRIBUTION TRANSFORMERS OF 25, 63, 100, 200 KVA (ALUMINIUM WOUND) AND 315 KVA & 500 KVA (COPPER WOUND) OF ENERGY EFFICIENCY LEVEL '1' AS PER AMENDMENT NO. 4 MARCH 2021 OF IS:1180 (PART 1) : 2014**

**1. SCOPE :**

i) This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed, naturally cooled 3-phase 11 kV/433 V distribution transformers for outdoor use.

ii) The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

iii) The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

iv) All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

**2. STANDARD RATINGS:**

The standard ratings shall be 25, 63, 100, 200, 315 & 500 kVA for 11 kV distribution transformers.

**3. STANDARDS:**

**3.1** The major materials used in the transformer shall conform in all respects to the relevant/specified Indian Standards and international Standards with latest amendments thereof as on bid opening date, unless otherwise specified herein. Some of the applicable Indian Standards are listed as hereunder:

<b>Indian Standards</b>	<b>Title</b>	<b>International Standards</b>
IS -2026	Specification for Power Transformers	IEC 76
IS 1180 (Part-I): 2014 (with latest amendment no. 4 march 2021)	Outdoor Type Oil Immersed Distribution Transformers upto and including 2500kVA, 33kV-Specification	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS-335 :2018	Specification for Transformer/Mineral Oil	IEC Pub 296
IS-5	Specification for colors for ready mixed paints	
IS -104	Ready mixed paint, brushing zinc chromate, priming	
IS-2099	Specification for high voltage porcelain	

	bushing	
IS-649	Testing for steel sheets and strips and magnetic circuits	
IS- 3024	Cold rolled grain oriented electrical sheets and strips	
S - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS - 6600	Guide for loading of oil Immersed Transformers	IEC 76
IS - 2362	Determination of water content in oil for porcelain bushing of transformer	
IS - 6162	Paper covered Aluminium conductor	
IS - 6160	Rectangular Electrical conductor for electrical machines	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical insulating liquids	
IS - 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS - 6792	Determination of electrical strength of insulating oil	
IS - 10028	Installation and maintenance of transformers.	

#### 4 SERVICE CONDITIONS:

**4.1** The Distribution Transformers to be supplied against this Specification shall be suitable for satisfactory continuous operation under the following climatic conditions as per IS 2026 (Part - I).

- i) Location : At various locations in the country
- ii) Maximum ambient air temperature (°C) : 50
- iii) Minimum ambient air temperature (°C) : -5
- iv) Maximum average daily ambient air temperature (°C) : 40
- v) Maximum yearly weighted average ambient temperature(°C) : 32
- vi) Maximum altitude above sea level (Meters) : as per Clause 33 of Ann-B

#### Note:

1. The climatic conditions specified above are indicative and can be changed by the user as per requirements.

2. The equipment shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

## 5. PRINCIPAL PARAMETERS:

5.1 The transformers shall be suitable for outdoor installation with three phase, 50 Hz, 11 kV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage upto plus 12.5% to minus 12.5%.

(i) The transformers shall conform to the following specific parameters :

Sl.N	Item	11 kV Distribution Transformers
1	System voltage (Max.)	12 kV
2	Rated Voltage (HV)	11 kV
3	Rated Voltage (LV)	433 V
4	Frequency	50 Hz +/- 5%*
5	No. of Phases	Three
6	Connection HV	Delta
7	Connection LV	Star (Neutral brought out)
8	Vector group	Dyn-11
9	Type of cooling	ONAN

Audible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers shall be as below (NEMA Standards):

kVA rating	Audible sound levels (decibels)
0-50	48
51-100	51
101-300	55
301-500	56

## 6. TECHNICAL REQUIREMENTS:

### 6.1.1 CORE MATERIAL

6.1.2.1 The core shall be stack / wound type of high grade Cold Rolled Grain Oriented or Amorphous Core annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers.

**The maximum flux density in any part of the core and yoke at rated voltage and frequency shall be such that the flux density with +12.5% combined voltage and frequency variation from rated voltage and frequency does not exceed 1.9 Tesla.**

The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

6.1.2.2 The company reserved the rights to inspect the core during manufacturing stage.

6.1.2.3 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. The bidder shall furnish necessary design data in support of this situation.

6.1.2.4 (i) No-load current up to 200kVA shall not exceed 3% of full load current and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.

(ii) No-load current above 200kVA and upto 2500kVA shall not exceed 2% of full load current and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% of full load current.

6.1.2.5 The check list for inspection of Prime quality CRGO for Transformer is given in Annexure - A (enclosed). The core material shall be checked accordingly as per procedure given in Ann- A.

## **7. WINDINGS:**

### **(i) Material:**

7.1.1 Double paper covered / Super enamel covered, Aluminium conductor shall be used for HV and LV winding upto 200 KVA & copper conductor for 315 and 500 KVA.

7.1.2 LV winding shall be such that neutral formation will be at top.

7.1.3 The winding construction of single HV coil wound over LV coil is preferable.

7.1.4 Inter layer insulation shall be Nomex /Epoxy dotted Kraft Paper.

7.1.5 Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted.

7.1.6 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars.

7.1.7 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

7.1.8 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

## **8. TAPPING RANGES AND METHODS:**

8.1.1 No tapping shall be provided for distribution transformers up to 100 kVA rating.

8.1.2 (a) For rating of 200 kVA, tappings shall be provided, on the higher voltage winding for variation of HV voltage within range of (+) 2.5 % to (-) 5% in steps of 2.5%.

8.1.2 (b) For ratings above 200 kVA and up to 500 kVA, tappings shall be provided, on the higher voltage winding for variation of HV voltage within range of (+) 5.0 % to (-) 10% in steps of 2.5%.

8.1.3 Tap changing shall be carried out by means of an externally operated self-position switch and when the transformer is in de-energised condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Arrangement for pad locking shall be provided. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

## 9. OIL:

9.1 The insulating oil shall comply with the requirements of IS 335:2018 latest. Use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than 35 X10<sup>12</sup> ohm-cm at 27°C when tested as per IS 6103.

9.2 Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.

9.3 The oil shall be filled under vacuum.

9.4 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

## 10. INSULATION LEVELS:

Sl. No.	Voltage (kV)	Impulse Voltage (kV Peak)	Power Frequency Voltage (kV)
1	0.433	-	3
2	11	75	28
3	33	170	70

## 11. LOSSES :

11.1 The transformer of HV voltage up to 11kV, the total losses (no-load + load losses at 75 °C) at 50% of rated load and total losses at 100% of rated load shall not exceed the maximum total loss values given in Table-1 upto 200kVA & Table-2 for ratings above 200kVA of IS 1180(Part-1):2014 Amendment no. 4 march 2021.

11.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75 °C for 11/0.433 kV transformers can be chosen by the utility as per **Table-1 upto 200kVA** and **Table-2 for ratings above 200kVA** as per **Energy Efficiency Level-1 specified in IS 1180 (Part-1):2014 (latest amendment 4, March'2021)** for all kVA ratings of distribution transformers.

**TABLE – 1**

KVA Rating	Voltage Ratio in kilovolts	Losses at 50% loading (Watts) at 75°C	Losses at 100% loading (Watts) at 75°C
25	11/0.433	190	635
63	11/0.433	340	1140
100	11/0.433	475	1650
200	11/0.433	780	2300

**TABLE – 2**

KVA Rating	Voltage Ratio in kilovolts	Losses at 50% loading (Watts) at 75°C	Losses at 100% loading (Watts) at 75°C
315	11/0.433	1025	3100

500	11/0.433	1510	4300
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11.3 The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above stated values.

## **12. TOLERANCES:**

12.1 No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% and 100% loading values.

## **13. PERCENTAGE IMPEDANCE:**

**13.1** The percentage impedance of transformers 4.5% at 75 °C for 16 KVA to 500 KVA ratings of DTRs as per IS 1180(Part-1):2014 latest.

### **13.2 – Tolerance :-**

The tolerance on electrical performance excluding losses shall be as given in IS 2026 (Part 1).

**14. Temperature rise:** The temperature rise over ambient shall not exceed the limits given below:

**14.1** Upto including 200KVA -

- (a) Top oil temperature rise measured by thermometer : 35 °C
- (b) Winding temperature rise measured by resistance method : 40 °C

**14.2** Higher than 200KVA upto 2500KVA -

- (a) Top oil temperature rise measured by thermometer : 40 °C
- (b) Winding temperature rise measured by resistance method : 45 °C

**14.3** The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

## **15. PENALTY FOR NON PERFORMANCE:**

15.1 During testing at supplier's works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

15.2 Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.

15.3 Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance.

## **16 INSULATION MATERIAL:**

16.1 Electrical grade insulation epoxy dotted Kraft Paper / Nomex and pressboard of standard make or any other superior material subject to approval of the purchaser shall be used.

16.2 All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

**17.1 TANK:**

- Transformer tank construction shall conform in all respect to clause 15 of IS 1180(Part-1):2014.
- The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.
- All joints of tank and fittings shall be oil tight and no bulging should occur during service.
- Inside of tank shall be painted with varnish/hot oil resistant paint.
- The top cover of the tank shall be slightly sloping to drain rain water.
- The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle.
- Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the customer.

**i) PLAIN TANK:**

17.2.1 The transformer tank shall be of robust construction rectangular in shape and shall be built up of electrically tested welded mild steel plates of thickness as below:-

Sl. No.	Ratings (KVA)	Thickness (mm) of MS Sheet	
		For sides	For Top & Bottom
1.	16	3.15	5
2.	25	3.15	5
3.	63	3.15	5
4.	100	3.15	5
5.	200	4	6
6.	315	4	6
7.	500	4	6

17.2.2 In case of rectangular tanks above 100 kVA the corners shall be fully welded at the corners from inside and outside of the tank to withstand a pressure of 0.8 kg/cm<sup>2</sup> for 30 minutes. In case of transformers of 100 kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.

17.2.3 Under operating conditions the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747 for DT below 63 KVA rating. For DT of 63 KVA and above ratings, conservator shall be provided.

- (i) The tank shall be reinforced by welded angle 50x50x5 MM on all the outside walls on the edge of tank to form two equal compartments. Pressure test shall

be performed carefully at the time of stage inspection only to confirm the adequacy of reinforcement angle and gauge of the tank.

- (ii) Permanent deflection: Plain tank shall be capable of withstanding vacuum of 250 mm of mercury for ratings up to 200 kVA. For transformers above 200 kVA plain tank shall be capable of withstanding vacuum of 500 mm of mercury. The permanent deflection, when the tank without oil is subjected to above, shall not be more than the values as given below:

(All figures are in mm)

<b>Horizontal length of flat plate</b>	<b>Permanent deflection</b>
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
Above 1751	9.0

17.2.4 The tank shall further be capable of withstanding a pressure of 0.8kg/sq.cm and a vacuum of 0.7 kg/sq.cm (g) without any deformation.

17.2.5 The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

### **17.3 CORRUGATED TANK:**

17.3.1 The bidder may offer corrugated tanks for transformers of all ratings.

17.3.2 The transformer tank shall be of robust construction corrugated in shape and shall be built up of tested sheets.

17.3.3 Corrugation panel shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

17.3.4 Tanks with corrugation shall be tested for leakage test at a pressure of 0.15 kg/sq.cm measured at the top of the tank.

17.3.5 The transformers with corrugation should be provided with a pallet for transportation, the dimensions of which should be more than the length and width of the transformer tank with corrugations.

**Note :** Minimum thickness at the corrugation shall be 1.0 mm.

17.4 All welding operations to be carried out by MIG process.

17.5 **Lifting lugs:** 2 nos. welded heavy duty lifting of MS plate of **8mm** thickness suitably reinforced by vertical supporting flat of same thickness as of lug welded edgewise below the lug on the side wall, up to reinforcing angle. They shall be so extended that cutting of bend plate is not required.

17.6 **Pulling lugs:** 4 nos. of welded heavy duty pulling lugs of MS plate of **8mm** thickness/ pulling holes in the base channel shall be provided to pull the transformer horizontally on width side up-to 100kVA.

17.7 **Top cover fixing bolts:** GI nuts bolts of 3/8" dia. with one plain & one spring washer shall be used for top cover fixing spaced at 4" apart. 6mm neoprene bonded cork/ nitrile rubber bonded oil resistance gaskets conforming to type B/C IS 4352 Part – II amended up to date will be placed between tank and cover plate.



**17.8 Vertical clearance:** The height of the tank shall be such that minimum vertical clearance up to the top cover plate of 120 mm is achieved from top yoke.

**17.9** Top cover and side walls of transformer should be welded through "U" clamp of adequate size as stiffener of Transformer.

**18. BOX ON HT AND LT SIDE OF TRANSFORMER:-**

Box on HT and LT sides of distribution transformer of capacities 315 KVA and 500 KVA should be provided in some quantity as detailed hereunder :-

S.N.	Ratings	Quantity required with Box on HT as well as LT side (in nos.)	
		Qty. for CG State SSI	Qty. for Regular supplier
1.	315 KVA	40	60
2.	500 KVA	20	30

- a) External boxes on HT and LT sides should cover all Terminals on HT side and on LT side.
- b) The clearances of line HT and LT terminal should be as per ISS.
- c) The top plate has to be bolted type i.e. it will be fixed through bolting arrangement. At least 16 no. bolts should be provided on LT side and sufficient number of bolts on HT side. Sealing arrangements should also be provided both in plate and its bolts (4 nos.).
- d) The Bottom plate of LT side box will also be bolted type with four holes so that cable of suitable size as per the rating of transformer can be inserted. Suitable sealing arrangements should also be provided in bottom plate.
- e) Similarly, the Bottom plate of HT side box will also be bolted type with three holes so that cable of suitable size as per the rating of transformer can be inserted. Suitable sealing arrangements should also be provided in bottom plate.
- f) As the box is provided in distribution transformer therefore terminal clamp arrangement will have to be re-worked. In the absence of suitable terminal clamp, lugs can also be provided.
- g) The box should be sturdy i.e. sheet size should not be less than 4.0 mm (Four millimeter in thickness) on both HT and LT sides and made of the same sheet metal as the transformer tank.
- h) Drawing of HT and LT Terminal Box should be submitted by the bidder for approval.

**19. CONSERVATOR:**

- (i) Transformers of rating 63 kVA and above with plain tank construction, the provision of conservator is mandatory. For corrugated tank and sealed type transformers with or without inert gas cushion, conservator is not required.
- (ii) When a conservator is provided, oil gauge and the plain or dehydrating breathing device shall be fitted to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1¼)] normal size thread with

cover. In addition, the cover of the main tank shall be provided with an air release plug.

- (iii) The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the colour of the silica gel crystals which should be easily visible from a distance. Volume of breather shall be suitable for 500g of silica gel conforming to IS 3401 for transformers upto 200 kVA and 1 kg for transformers above 200 kVA.
- (iv) The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain 10% quantity of the oil. Normally 3% quantity the oil shall be contained in the conservator.
- (v) The cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.
- (vi) The inside diameter of the pipe connecting the conservator to the main tank should be within 20 to 50 mm and it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 °C) should be above the sump level.

## **20. SURFACE PREPARATION AND PAINTING:**

### **(i) GENERAL**

- 20.1.1 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.
- 20.1.2 All primers shall be well marked into the surface, particularly in areas where painting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, where ever airless spray is not possible, conventional spray be used with prior approval of purchaser.

### **20.2 CLEANING AND SURFACE PREPARATION:**

- a) After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.
- b) Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).
- c) Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical. Manufacturer to clearly explain such areas in his technical offer.

### **20.3 PROTECTIVE COATING:**

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

## **20.4 PAINT MATERIAL:**

i) Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site:

Heat resistant paint (Hot oil proof) for inside surface

ii) For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of polyurethane base paint. These paints can be either air drying or stoving.

iii) For highly polluted areas, chemical atmosphere or for places very near to the sea coast, paint as above with one coat of high build Micaceous iron oxide (MIO) as an intermediate coat may be used.

## **20.5 PAINTING PROCEDURE:**

i) All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

ii) Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.

## **20.6 DAMAGED PAINTWORK:**

**20.6.2.1 (i)** Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.

**(ii)** Any damaged paint work shall be made good as follows:

20.6.2.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

20.6.2.2 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

20.6.2.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

## **20.7 DRY FILM THICKNESS:**

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

20.7.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

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

20.7.4 The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

Sl. No.	Paint type	Area to be painted	No. of coats	Total dry film thickness (min.) (microns)
1.	Thermo setting powder paint	inside	01	30
		outside	01	60
<b>2. Liquid paint</b>				
a)	Epoxy (primer)	outside	01	30
b)	P.U. Paint (Finish coat)	outside	02	25 each
c)	Hot oil paint/ Varnish	inside	01	35/10

## 20.8 TESTS FOR PAINTED SURFACE:

20.8.1 The painted surface shall be tested for paint thickness as per Clause 15.5 of IS:1180 (Part 1) : 2014 (latest amendment)

20.8.2 Acceptance tests shall be carried out on all ratings during 'FINAL INSPECTION' to be carried out by CSPDCL's inspecting officer at firm's works.

Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years

## 21. BUSHINGS :

21.1 The bushings shall conform to the relevant standards specified and shall be of outdoor type. The bushing rods and nuts shall be made of Brass / Copper material 12 mm diameter for both HT and LT bushings. The bushings shall be fixed to the transformers on side with straight / tilted pockets and in the same plane or the top cover for transformers above 100 kVA.

For transformers of 100 kVA and below the bushing can be mounted on pipes. The tests as per latest IS 2099 and IS 7421 shall be conducted on the transformer bushings

**Any other provision shall also be acceptable for which 'ISI' marking is available to firm.**

21.2 Bushing can be of either or epoxy type porcelain conforming with relevant standard specified. Polymer insulator bushing conforming with relevant IEC can also be used.

21.3 Dimensions of the bushings of the voltage class shall conform to the Standards specified and dimension of clamping arrangement shall be as per IS 4257

21.4 Minimum external phase to phase and phase to earth clearances of bushing terminals shall be as follows:

Voltage	Clearance	
	Phase to phase	Phase to earth
33 kV	350mm	320mm
11 kV	255mm	140mm
LV	75mm	40mm

The clearances in case of cable box shall be as below:

Voltage	Clearance	
	Phase to phase	Phase to earth
33 kV	350mm	220mm
11 kV	130mm	80mm
LV	25mm	20mm

21.5 Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section – IX.

21.6 The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.

21.7 The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

## **22. TERMINAL CONNECTORS:**

22.1 The LV and HV bushing stems shall be provided with suitable terminal connectors as per IS 5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.

### **23. Explosion vent :**

Explosion vent shall be provided in transformers of above 200KVA rating only.

### **24. Tank base channel:**

Tank base channels to be fitted across the length of the transformer as follows:

- (a) For 16, 25, 63, 100 and 200 KVA Transformer - Two channels of 75x40 mm of length as per Clause 14.1 of IS:1180 (part 1):2014 (latest amendment).
- (b) For 315 KVA and 500 KVA Transformer - As per Clause 14.2 of IS:1180 (part 1):2014 (latest amendment).

## **25. Terminal Marking Plates and Rating Plates:**

### **TERMINAL MARKINGS:**

High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding small letter 2U, 2V, 2W. The neutral point terminal shall be indicated by the letter 2N. Neutral terminal is to be brought out and connected to local grounding terminal by an earthing strip.

The transformers shall be provided with a plate showing the relative physical position of the terminal and their markings engraved on it. The transformers shall be provided with non-detachable rating plate of Aluminium anodized material fitted in a visible position, furnishing the information as specified in IS:2026. The rating plate shall be embossed/ engraved type but not printed type. The relative position of tapping switch and corresponding voltages may also be shown on the rating plate.

Further, MS plate of size 125x125 mm be got welded on width side of the transformer on stiffener angle. On this plate Name of firm, order No. & Date, Rating, serial number and Date of dispatch should be engraved.

The serial number of the transformers shall be engraved on the tank body and the top cover of the transformers also.

## **26 FITTINGS :-**

**26.1** The following standard fittings shall be provided:

- i.** Rating and terminal marking plates, non-detachable - 1 no.
- ii.** Earthing terminals with lugs - 2 Nos.
- iii.** Lifting lugs 8 mm thick MS for main tank and top cover
- iv.** Terminal connectors on the HV/LV bushings (For bare terminations only).
- v.** Thermometer pocket with cap - 1 No.
- vi.** HV bushings - 3 Nos.
- vii.** LV bushings - 4 Nos.
- viii.** Pulling lugs 8 mm thick MS - 4 nos.
- ix.** Stiffener
- x.** Radiators - No. and length may be mentioned (as per heat dissipation calculations)/ corrugations.
- xi.** Arcing horns on HT side - 3 No.
- xii.** Oil level gauge.  
A.-5°C and 90°C marking for non-sealed type Transformers.  
B.(+)30°C marking for sealed type transformers
- xiii.** Air release device (for non sealed type transformers)
- xiv.** One filter valve on upper side of the transformer (For transformers above 200 kVA)
- xv.** Oil filling hole having p. 1- ¼ " thread with plug and drain plug on the conservator.
- xvi.** Silica gel breather (for non-sealed type transformer)
- xvii.** Base channel 75x40 mm for up to 200 kVA having length as per clause 14.1 of IS:1180 (pt 1):2014 (as amended) and for above 200 KVA rating transformer it should be as per clause 14.2 of IS:1180 (pt 1):2014 ( as amended) with holes to make them suitable for fixing on a platform or plinth.
- xviii.** 4 No. rollers for transformers above 200 kVA.
- xix.** Pressure relief device or Explosion vent (above 200 kVA).

**xx.** Conservator shall be provided with one side flanged.

**xxi** HT and LT terminal boxes required to be provided on transformers as per specification as per drawing approved by this office.

## **27. FASTENERS:**

27.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.

27.2 Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.

27.3 All nuts and pins shall be adequately locked.

27.4 Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

27.5 All bolts/nuts/washers exposed to atmosphere should be as follows.

- a) Size 12 mm or below - Stainless steel,
- b) Above 12 mm- steel with suitable finish like electro galvanized with passivation or hot dip galvanized

27.6 Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

27.7 The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.

27.8 Taper washers shall be provided where necessary.

27.9 Protective washers of suitable material shall be provided front and back of the securing screws.

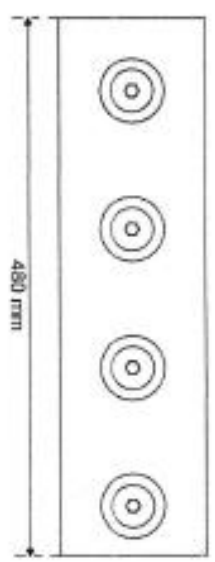
## **28. OVERLOAD CAPACITY:**

28.1 The transformers shall be suitable for loading as per IS 6600.

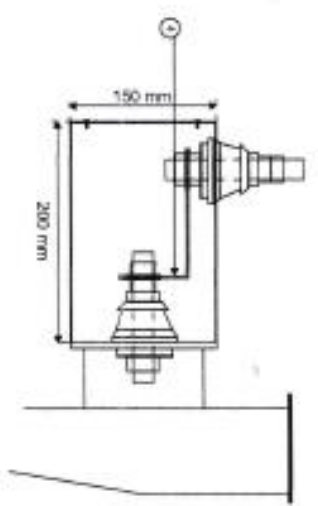
### **Specification of LT auxiliary stud box :-**

LV Cable box with additional studs shall be provided on secondary terminal side for 25,63 & 100 KVA ratings DTRs as per drawing enclosed.

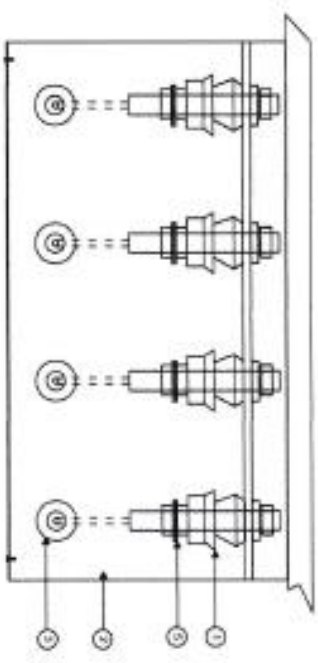
Size of box- L-480 mm,w-200 mm H-150 mm & thickness of sheet 2.0 mm min.



ELEVATION (COVER REMOVED)



SIDE VIEW



PLAN

S.NO	DESCRIPTION	QTY
1	L1 METAL PARTS WITH BUSHING 250 AVG	4
2	CABLE BOX THICKNESS OF MS SHEET 2MM	1
3	L2 METAL PARTS WITH BUSHING 250 AVG	4
4	ALUMINIUM FLAT 6X 50MM	4
5	WATERPROOF WASHER (ONE SIZE SMALLER OTHER SIZE ALUMINIUM)	16

NOTE:- ALL SIDE OF CABLE BOX WELDED EXCEPT FRONT

CABLE BOX DRAWING FOR 25 KVA, 63 KVA & 100 KVA  
110/433 KV TRANSFORMER

CHD	MS	GENERAL DRAWING OF CABLE BOX FOR 25, 63 & 100
APPROVED	MS	KVA, 110/433 HV EL1 ALUMINIUM WOUND
CUSTOMER:-		DISTRIBUTION TRANSFORMER
DRAWING NO.:-		CSPDCL
SCALE - MS		TOLERANCE +/- .25
VT/CB/1		REV NO:- 0

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