



**Maharashtra State Electricity Distribution  
Company Limited**

**MATERIAL SPECIFICATIONS CELL**

TECHNICAL SPECIFICATION

FOR

**TECHNICAL SPECIFICATION OF 10 ,16 AND 20kVA,  
11/0.433 kV & 22/ 0.433 kV LEVEL-2 & LEVEL-3, THREE  
PHASE, SEALED TYPE DISTRIBUTION TRANSFORMERS  
OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE**

TECHNICAL SPECIFICATION NO.  
CE/MMC/MSC-I/3Phase (5-20kVA)/DT/T/2017/01,

Date: 01.06.2017.

(Amended as per guidelines by Ministry of Power)

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**MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY**  
**TECHNICAL SPECIFICATION OF 10 ,16 AND 20kVA, 11/0.433 kV & 22/ 0.433**  
**kV LEVEL-2 & LEVEL-3, THREE PHASE, SEALED TYPE DISTRIBUTION**  
**TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP**  
**FEATURE.**

CE/MMC/MSC-I/3Phase (10-20kVA)/DT/T/2017/01 dt.01.06.2017

**1 Scope:-**

- 1.1 This specification covers design, manufacturing, testing and delivery of **10 ,16 and 20kVA, 11/0.433 kV & 22/ 0.433 kV level-2 & level-3, three phase, sealed type distribution transformers outdoor type oil immersed without CSP feature, Oil natural Air Natural (ONAN)** suitable for 11 kV& 22 kV , 50 Hz, Distribution system.
- 1.2 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.3 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.
- 1.4 The design and constructional aspects of materials shall not withstanding any anomalies, discrepancies, omissions, in-completeness, etc. in these specifications and will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.
- 1.5 The Bidder/supplier shall bind himself to abide by these considerations to the entire satisfaction of the purchaser and will be required to adjust such details at no extra cost to the purchaser over and above the tendered rates and prices.
- 1.6 Tolerances:  
The tolerance of guaranteed performance figures shall be as specified in the (Part-I) table 1 of latest issue of IS 2026 **except losses** or relevant International Standard except wherever specified otherwise in this specification.

**2 System Particulars:-**

The transformers shall be suitable for outdoor installation with following system particulars and they should be suitable for service under fluctuations in supply voltage as permissible under Indian Electricity Rules.

- |     |                                      |   |                   |
|-----|--------------------------------------|---|-------------------|
| 2.1 | Nominal System Voltage               | : | 11 kV or 22 kV    |
| 2.2 | Corresponding Highest System Voltage | : | 12kV or 24 kV     |
|     | Rated Basic Insulation Level         | : | 75 KVp or 125 KVp |

- 2.3 Neutral earthing : Solidly earthed  
2.4 Frequency : 50 Hz with  $\pm 3$  % tolerance  
2.5 Number of Phases : 3

### 3 SERVICE CONDITIONS:

3.1 Equipment supplied against the specification shall be suitable for satisfactory operation under the following tropical conditions:-

- |      |  |   |   |
|------|--|---|---|
| i    | Max. ambient air temperature                       | : | 50 Deg. C   |
| ii   | Max. relative humidity                             | : | 100 %   |
| iii  | Max. annual rainfall                               | : | 1450 mm   |
| iv   | Max. wind pressure                                 | : | 150 kg/sq.m.  |
| v    | Max. altitude above mean sea level                 | : | 1000 mtrs.  |
| vi   | Isoceraunic level                                  | : | 50  |
| vii  | Seismic level (Horizontal acceleration)            | : | 0.3 g.  |
| viii |  |   | Climatic Condition<br>Moderately hot and<br>humid tropical climate<br>conducive to rust and<br>fungus growth. |
| ix   | Reference Ambient Temperature for temperature rise | : | 50 Deg C  |

- 3.2 The climatic conditions are prone to wide variations in ambient conditions and hence the Distribution Transformer shall be of suitable design to work satisfactorily under these conditions.
- 3.3 The Distribution Transformer shall be for use in moderately hot and humid tropical climate conducive to rust and fungus growth.
- 3.4 The Distribution Transformer shall be mark with standard mark governed by BIS as per clause 13.4 of IS 1180(Part 1):2014].
- 3.5 The Distribution Transformer shall bear star 1 or 2 rating label approved by BEE (Bureau of Energy Efficiency).
- 3.6 The Distribution Transformer shall bear level 2 (star 1 of BEE) or 3 (star 2 of BEE) ratings label approved by BIS (Bureau of Indian Standard) as per IS 1180 ( Part1): 2014 (Amendment-1 August 2016).
- 3.7 The Bidder/ Manufacturer shall possess the BIS license for offered product.
- 3.8 The Bidder/ Manufacturer shall possess the BEE certification for offered product.

**4 APPLICABLE STANDARDS:-**

- 4.1 The design, manufacture and performance of the Distribution Transformer shall comply with all currently applicable statutes, regulations and safety codes. Nothing in this specification shall be construed to relieve the bidder off his responsibilities.
- 4.2 The Distribution Transformers shall conform to IS: 1180 (Part 1) : 2014 amended up to date or other International Standards for equal or better performance. Unless otherwise modified in this specification the Distribution Transformers shall comply with the Indian Standard Specification IS 1180 latest.
- 4.3 Unless otherwise specified, the Distribution Transformer offered shall conform to amended up to date Indian, IEC, British or U.S.A. Standards and in particular, to the following:-
- 4.4 The applicable standards are as follows :

Sr.No.	IS number	IS name
1.	IS:1180(Part-1) : 2014 with (Amendment-1 August 2016)	Outdoor type oil immersed distribution transformers up to and including 2500 kVA, 33kV.
2.	IS:2026(Part I to IV)	Specification for power transformer
3.	IS:335/1993	New insulating oil- Specification (fourth revision)
4.	IS:2099/1986, IS: 7421-1988, IS:3347 (Part-I /Sec-2)-1979, IS:3347 (Part-I /Sec-1)-1982 amended up to date	Bushing
5.	IS 5	Colours for ready mixed paints and Enamels.
6.	IS 13730 (Part-27)1996	Specification for particular types of winding wires.
7.	IS: 3073/1974, IS: 3070( Part-II)	Specifications for L.A's
8.	CEA Guidelines August -2008	Manual on transformers
9.	Gazette notification by Ministry of Power dated 16.12.2016	Revised losses of distribution transformer

- 4.5 In case of conflict arising out due to variations between the applicable standard and the standards specified herein the provisions of this specification should prevail.

**5 Specific Technical requirement:**

**5.1 Standard kVA Ratings:-**

The standard ratings for three phase transformer shall be 10,16 and 20 kVA as per IS 1180 (Part-I):2014

**5.2 Nominal voltage ratings**

- i Primary voltage : 11 kV/ 22 kV
- ii Secondary voltage : 0.433 kV

5.2.1 Winding connections:-

- i. H.V. Winding : Delta ( $\Delta$ )
- ii. L.V. Winding : Star (Y)

so as to produce a positive phase displacement of 30 degrees from the primary to the secondary vectors of the same phase. The neutral of the L.V. winding shall be brought out to a separate insulated terminal. The voltage group shall be Dyn-11 (IS 2026 Part I).

5.3 Temperature Rise:

- i The temperature rise for top oil over an ambient temperature of 50° C should be 35°C maximum [measured by thermometer in accordance with IS 1180 (Part 1) & IS 2026 (Part 2)]
- ii Temperature rise for winding over an ambient temperature of 50° C should be 40° C maximum [measured by resistance method in accordance with IS 1180 (Part 1) IS 2026 (Part 2)]

5.4 No load voltage ratio:-

The no load voltage ratio shall be 11000/433 Volts & 22000/433 Volts.

## 6 Design & construction

- a. The spring washers must be used for fixing core with tie rod.
- b. Core base & bottom Yoke shall be supported with 75 mm X 40 mm X6 mm MS Channel with proper bolting. The core assembly shall be fixed by four locking bolts.
- c. 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 with rated voltage and frequency does not exceed 1.9 Tesla. Flux density should not be more than 1.55 Tesla at rated voltage and frequency.
- d. Limit of no load current shall be 3% of full load current of respective winding at rated voltage.

### 6.1 Core

- i The core shall be stacked/ wound type.
  - a) **For Stack core :-** The core shall be of high grade cold rolled grain oriented (C.R.G.O) annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together to the frames firmly to prevent vibration or noise. All core clamping bolts shall be effectively insulated. The complete design of core must ensure permanency of the core losses with continuous working of the transformers.

#### b) For Wound core :-

The core shall be 'C' type construction of high grade cold rolled grain oriented (C.R.G.O.) annealed steel lamination having low loss and good grain properties, coated hot oil proof insulation. The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The core material shall not be brittle in case of CRGO material.

Core clamping for C.R.G.O. Wound core type transformers shall be as follows:

1. Core clamping shall be with top and bottom U- shaped core clamps made of sheet steel clamped.
  2. M.S. core clamps shall be painted with oil-resistant paint.
  3. Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to arrest movement of the active part.
  4. Core shall be clamped by minimum 12 mm diameter MS Tie rods.
  5. Compliance of CRGO Electrical steel as per IS 3024 [as mentioned in Cl.No.9.1(a)of IS 1180(Part1):2014] shall be ensured through test certificate of the supplier.
- ii The grade of core laminations shall be M4 or better.
- iii The successful bidder, shall be required to submit the manufacturer's test report showing the Watt Loss per kg and the thickness of the core lamination, to ascertain the quality of Core materials.  
The purchaser reserves the right to get sample of the core material tested at any Government recognized laboratory.
- iv The transformer core shall not be saturated for any value of V/f ratio to the extent of 112.5% of the rated value of V/f ratio (i.e. 11000/50 or 22000/50) (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and will not get saturated. The bidder shall furnish necessary design data in support of this situation.
- v Flux density:-  
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 with rated voltage and frequency does not exceed 1.9 Tesla. Flux density should not be more than 1.55 Tesla at rated voltage and frequency.
- vi The No load current at rated voltage shall not exceed the percentage as given below.  
The no load current of 10 kVA ,16kVA and 20 kVA transformer shall not exceed 3% the full load current and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5 percent of rated voltage shall not increase the no load current by 6% of full load current.( As per IS 1180 (Part1):2014).



Number of steps of core shall be minimum of

Sr. No.	Rating (kVA)	Number of steps
1	10	Min. 5 standard steps
2	16	Min. 5 standard steps
3	20	Min. 5 standard steps

## 6.2 Winding:-

The material for winding shall be Aluminum for both 11kV & 22kV class.

- i Double paper covered Aluminum conductor shall be used for HV and LV winding for both 11 kV & 22 kV.
- ii Current Density:- Current density for HV and LV winding should not be more than 1.6 A/sq. mm for Aluminum.
- iii L.V. Neutral formation shall be at top.

## 6.3 Losses :

The total losses (no-load + load losses at 75 deg. Centigrade) at 50% of rated load & total losses at 100% of rated load shall not exceed the maximum total loss values indicated as below:- for 11kV class transformers. *The indicated losses in the table are for CRGO core only.*

Max. total losses in watts up to 11 kV Class					
		Level-2		Level-3	
Rating (kVA)	Impedance (Percent)	50% Load	100% Load	50% Load	100% Load
10	4.50	65	240	58	215
16	4.50	135	440	120	400
20	4.50	160	525	145	485

Note:- 1) For Transformer having voltage class above 11 kV and up to and including 22 kV , the permissible total loss values shall not exceed by 5 percent of the maximum total loss values mentioned in above table.( Ref Clause 6.8.1.2 of IS 1180: Part- I/2014)

## Tolerances:

No positive tolerance shall be allowed on the maximum losses given in the above table for both 50 % & 100 % loading values. In case the actual loss values exceed the above guaranteed values, the transformers shall be rejected at the risk, cost

and responsibility of the supplier. The bidder should guarantee individual No load losses.

The values guaranteed in G.T.P. for flux density, no load current at rated voltage, no load current at 100 % & 112.5% of rated voltage and no load loss at rated voltage shall be individually met.

The tolerance on electrical performance excluding total losses at 50% of rated load & total losses at 100% of rated load shall be as given in IS 2026(Part 1).

**6.4 Insulation material & clearances:**

- i** Materials - Makes of Electrical grade insulating Kraft paper, Press Board, Perma wood/ Haldi wood insulation shall be declared in GTP by the bidder. The test reports for all properties as per relevant IS amended up to date shall be submitted during inspection .Compliance to Kraft paper IS 9335 [Cl.No.9.1(d) of IS 1180 (Part 1):2014] and for press board IS 1576 [Cl.No.9.1(e) of IS 1180 (Part 1):2014] and gasket shall be ensured through test certificate of the supplier.
- ii** The electrical clearance between the winding and body of the tank (between inside surface of the tank and outside edge of the windings) should not be less than 25 mm and 30 mm for 11 kV and 22 kV class respectively.
- iii** Minimum external clearances of bushing terminals

		<u>11 kV</u>	<u>22 kV</u>
H V	Ph to Ph	255 mm	330 mm
	Ph to E	140 mm	230 mm
L V	Ph-to-Ph	75 mm.	75 mm
	Ph to E	40 mm.	40 mm

**6.5 Impedance Value -**

The percentage impedance at 75 ° C. for different ratings shall be as per clause no 6.3 table above.

**6.6 Tank**

6.6.1 The transformer tank shall be made up of prime quality M.S. sheets of rectangular shape. No other shape will be accepted. The transformer tank shall be of robust construction. All joints of tank and fittings should be oil tight and no bulging shall occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plates shall be of such strength that the complete transformer when filled with oil may be lifted bodily by means of the lifting lugs provided. Tank inside shall be painted by varnish or oil resistant paint. Top cover plate shall be slightly sloping; approximately 5 to 10 deg. Opposite to LV bushing and edges of cover plate should be bent downwards so as to avoid entry of water through the cover plate gasket. The width of bend plate shall be 25 mm min. The top cover shall have no cut at point of lifting lug. The rectangular tank shall be fabricated by welding at corners.

6.6.2 The transformer tank of corrugation is also acceptable, however shape of tank shall be rectangular only. The corrugation sheets thickness shall be of minimum 1.6mm. 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 detailed calculation sheet alongwith offer. The safe guard angle frame 25X25X5 mm shall be welded for corrugated side to the tank.

6.6.3 In rectangular shape tanks, horizontal or vertical joints in tank side walls and its bottom or top cover will be not allowed. In addition the cover of the main tank shall be provided with an air release plug to enable air trapped within to be released.

Side wall thickness : 2 mm. (min.)

Top and bottom plate thickness : 2.5 mm. (min)

a) The permanent deflection of flat plates after pressure / vacuum has been released shall not exceed the values given below.

(All figures in mm)

Horizontal length of flat Plate	Permanent deflection
Up to and including 750 mm	5.0 mm
751 to 1250 mm	6.5 mm

6.6.4 Reinforced by welded angle 25X25X5 MM on all the outside walls on the edge of tank to form two equal compartments.

6.6.5 When transformer tank without oil is subject to air pressure of 80 KPa above atmospheric pressure for 30 min as per IS 1180 (Part 1):2014. Pressure test shall be performed carefully as per IS 1180 (Part 1):2014 Clause no.21.5.1 at the time of 1<sup>st</sup> stage inspection only to confirm the adequacy of reinforcement angle and gauge of the tank and certified by E.E. (IW).

6.6.6 All welding operations to be carried out by MIG process.( Metal Inert Gas Welding)

6.6.7 Lifting lugs: 2 nos. welded heavy duty lifting lugs of MS plate of 5 mm (minimum) thickness suitably reinforced by vertical supporting flat of same thickness as of lug welded edgewise below the top cover on the side wall. They shall be so extended that cutting of bend plate is not required. 2 nos. of welded heavy duty lifting lugs of MS plate of 5 mm thickness should be on the top plate of transformers.

6.6.8 All bolts / nuts / washers exposed to atmosphere shall be as follows:[Clause no.15.3 of IS 1180 (Part 1):2014]

a) Size 6 mm—stainless steel.

b) Above 6 mm--- steel with suitable finish like electro galvanized with passivation or hot dip galvanized.

6.6.10 Top cover fixing bolts: GI nut bolts of 1/2” diameter (min) with one plain washer shall be used for top cover fixing, spaced at 4” apart. 6 mm neoprene bonded cork

oil resistance gaskets conforming to type B/C IS 4253 Part-II amended up to date will be placed between tank and cover plate.

- 6.6.11 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.
- 6.6.12 The transformer tank shall be of adequate mechanical strength to withstand positive and negative pressures built up inside the tank while the transformer is in operation.
- 6.6.13 The tank design shall be such that the core and windings can be lifted freely.
- 6.6.14 Plain tank shall be capable of withstanding a pressure of 80kPa for 30 minutes and a vacuum of 250 mm of mercury for 30 minutes (Type Test). The permanent deflection of flat plates shall not exceed the values given in IS 1180(Part 1): 2014 clause no. 21.5.1.1.
- 6.6.15 Thermometer pocket must be located at centre of top cover or high side of tank height for true value of max top oil temperature
- 6.6.16 The construction of the tank should be sealed and oil insulated.

The space on the top of the oil shall be filled with dry air or nitrogen. The dry air or nitrogen plus oil volume inside the tank shall be such that even under extreme operating conditions, the pressure generated inside the tank does not exceed 0.4kg/sq.cm positive or negative. The nitrogen shall conform to commercial grade of the relevant standard. Oil level indicator with only minimum position corresponding to the operating temperature of 30°C (for sealed type transformers) shall fixed on side wall of the tank.

## **6.7 Off Load Taps:**

- 6.7.1 No taps are normally required to be provided up to 100 kVA rating.

## **7.0 Efficiency:**

The efficiency is the ratio of output in KW to the input in KW.

$$\text{Efficiency} = \frac{(\text{Input in KW} - \text{Total Losses in KW})}{\text{Input in KW}}$$

## **8.0 Heat Dissipation:**

- a) Minimum total loss ( No load + load loss at 75 deg' C reference temperature) at 100 %loading shall be supplied during temperature rise test.
- b) The heat dissipation by tank wall should be increase to appropriate value considering the climatic temperature rise.

## **9.0 Total Minimum Oil Volume :**

The firm should maintain the minimum oil volume in all supplied transformers as mentioned below or oil up to mark indicator level whichever is more.

Sr.No.	KVA rating	Oil in liters (exclusive of oil absorbed in core & coil assembly)	
		Voltage rating 11/0.433 kV	Voltage rating 22/0.433 kV
1	10	45	60
2	16	50	70
3	20	65	85

Note: Transformer shall be supplied complete with first filling of oil up to minimum position corresponding to the operating temperature of 30°C (for sealed type transformers) on oil indicator fixed on side wall of the tank. Detailed calculation of absorption should be submitted.

**10.0 Terminals:**

- a. The Palm type terminal connector of adequate capacity shall be connected to L.V side suitable to connect it to the Bus extension.
- b. On H.V. side the bimetallic connector to be provided with bimetallic lug of suitable rating.
- c. The rating of brass rod for H.V. & L.V. shall be as per relevant IS for different capacity of Transformer. [Following (d) and (e) are indicative and shall be confirmed with relevant IS]
- d. Brass rods 12 mm. diameter for HT with necessary nuts, check-nuts and plain thick tinned washer.
- e. LT extension with suitable cable lugs, necessary nuts, check-nuts and plain thick tinned washer.

**11.0. Bushings & Connections:**

- 11.1 The transformers shall be fitted on high voltage and low voltage sides with outdoor type bushings of appropriate voltage and current ratings. The high voltage bushings (3nos.) shall be provided with R-Y-B colour coding marking & shall conform to IS 2099. The low voltage bushings (4 nos.) shall conform to IS 7421. Alternatively, the low voltage side may be made suitable for adoption of PVC/XLPE cables of suitable size. The dimensions shall conform to IS 1180(Part 1): 2014 clause no. 10.1.5.
- 11.2 The bushing shall be made in two parts. The outer bushing shall be of porcelain. The dimensions of the outer bushing shall confirm to the relevant Part/Section of IS 3347 depending on the voltage class. The internal bushing shall be of either porcelain or tough insulating material, like epoxy and shall have embedded stem. Metal portion of the internal HV and LV bushing inside the tank shall remain dipped in oil in all operating conditions. [Refer Cl.no.10.1.3 of IS 1180 (Part1):2014]
- 11.3 Gaskets shall be made of synthetic rubber or synthetic rubberized cork resistant to hot transformer oil. [Refer Cl.no.10.1.4 of IS 1180 (Part1):2014]

- 11.4 The dimensions of the bushings of voltage classes shall confirm to Cl. no 10.1.5 of IS 1180 (Part1):2014.
- 11.5 For 11 kV class 12 kV bushing & for 22 kV class 24 kV bushing shall be used and for 433 volts 1.0 kV bushing shall be used. Bushings of the same voltage class shall be interchangeable. Bushings with plain shed shall be as per relevant IS:3347 amended up to date. HV bushings shall be mounted on the top of the transformer tank & LV bushings shall be mounted on side of the transformer tank.
- 11.6 HV bushings shall be mounted on curvature shaped embossed plate and not on welded M.S ring. Supporting clamps for LT cable should be provided to avoid the weight of cable on the Bushing.
- 11.7 The minimum creepage distance for both HV & LV Bushings shall not be less than 25 mm per kV.
- 11.8 Compliance of bushing as per IS 2099 / IS 7421 and relevant part of IS 3347 shall be ensured through test certificate from the supplier of transformer manufacturer firm getting the same tested from BIS recognized / group 2 category of laboratory.
- 11.9 Supporting clamp for cable should be provided to avoid weight of cable on the bushing/bushing rod

#### **12.0 Internal connections:**

##### **12.1 H.V. Winding :**

- i .In case of H.V. winding all jumpers from winding to bushing shall have cross section larger than winding conductor.
- ii. Inter coil connection shall be by crimping and brazing.
- iii. In case of Aluminum Winding Delta joints shall be with crimping and Brazing only.
- iv. Lead from delta joint shall be connected to bushing rod by brazing only.

##### **12.2 L.V. Winding :**

- i. For Aluminum windings inter coil connections crimping & silver brazing shall be used.
- ii. L.T. Star point shall be formed of Aluminum flat of sufficient length. Lead from winding shall be connected to the flat by crimping and brazing.
- iii. Firm connections of L.T. winding to bushing shall be made of adequate size of 'L' shaped flat. Connection of L.T. Coil lead to 'L' shape flat shall be by crimping and brazing. Alternatively 'L' shape lug of adequate capacity effectively crimped shall be acceptable.
- iv. 'L' shape flat/lug shall be clamped to L.V. Bushing metal part by using nut, lock-nut and washers.

#### **13.0 Tank base channel / Mounting Arrangement:**

The under-base of the transformer shall be provided as per clause 14.1 of IS 1180(Part1):2014

#### 14.0 Terminal Marking Plates and Rating Plates :

- a) All Transformer HV terminals shall be provided terminal marking plated to Tank. Each terminal, including with neutral, shall be distinctly marked on both primary & secondary in accordance with the connection diagram fixed upon the transformer which shall conformed to latest IS-2026 (part- IV).
- b) Each Transformer shall be provided with rating plate having marking as per IS 1180 (part-1):2014 clause no 13 clearly indicating max. total losses at 50% rated load in watts and maximum total losses at 100% rated load in watts
- c) Rating & terminal marking plates shall be combined into one plate and shall be mark with standard mark Govern by the provisions of the BIS act 1986.
- d) Terminals shall be provided with terminal marking plates. The transformer shall be provided with riveted rating plate of minimum 18 SWG aluminum anodized material sheet in a visible position. The entries of the rating plate shall be in indelibly marked (i.e. by etching, engraving or stamping).
- e) Marking as `M.S.E.D.C.L'S and `Sr. No.' of transformer shall be engraved on transformer main tank below L.T. bushings.
- f) The name of the company, order No., capacity, month and year of manufacturing shall be engraved on separate plate which shall be firmly welded to main tank and shall form integral part of the tank.
- g) The distribution transformer shall be marked with the Standard Mark. The use of Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules Regulations made thereunder.
- h) In addition to the BIS certification mark license No. (a seven digit number) represented as CM/L xxxxxxx shall be clearly & indelibly marked on the rating plate as per the norms of BIS. The width to height ratio of ISI symbol shall be 4:3.
- i) The copy of valid ISI licence shall be submitted in support with the bidding document.

Each transformer shall be provided with rating plate having marking as per Cl.no.13 of IS 1180(Part 1): 2014 clearly indicating maximum total losses at 50% rated load in watts and maximum total losses at 100% rated load in watts.

Following details shall also be given on the rating plate as per Fig.1 of Cl.no.13.1 of IS 1180(Part 1): 2014 and terminal marking plate with diagram shall be in accordance with Cl.no.13.2 of IS 1180(Part 1): 2014.

- (i) ISI Mark.
- (ii) Energy Efficiency level as approved by BIS
- (iii) Order No. – Month & year.
- (iv) Sr.No. of transformer.
- (v) Date of manufacturing – Month & year.
- (vi) Date of expiry of guarantee period – month & year.
- (vii) Maximum guaranteed 50% load loss & 100 % load loss figures.
- (viii) Name and full address of the manufacturer.
- (ix) Capacity.

- (x) Rating.  
(All details on the rating and diagram plate shall be indelibly marked i.e. by engraving or stamping or etching).

**15.1 Fittings:**

The following standard fittings shall be provided.		
1	Rating and terminal marking plate	1 no.
2	Earthing terminals with lugs.	2 nos.
3	Lifting lugs	4 nos. ( 2 nos for tank and 2 nos for top plate of the transformer )
4	Thermometer pocket with cap	1 no
5	Air release device. Oil/Nitrogen/Air filling hole having (1¼" nominal size thread) with cover (for sealed type transformers without conservator);	1 no
6	On transformer side tank wall	1no
7	Oil level gauge indicating oil level at minimum, 30°C and maximum operating temperature;  Normal 30 deg.C Maximum 98 deg.C.	
8	HT & LT bushing and terminal connectors	3 nos. of HT bushing and 4 nos. of LT bushing shall be provided with 3 nos. of brass nuts and 2 plain brass washers.
9	Lightening Arrestors for HT bushings	3 nos
10	Anti-theft stainless steel fastners with 4 nos. breakaway nut at top cover	

Any other fitting necessary for satisfactory performance. The fittings shall be provided in accordance with Cl no. 20.1 (a to v) & Cl no. 20.2 Optional fittings of IS 1180 (Part1):2014 ( if required)

**15.2 Fasteners.**

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



3. All nuts and pins shall be adequately locked.
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.
5. All ferrous bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion by hot dip galvanizing except high tensile steel bolts and spring washers, which shall be Electro, galvanized. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar materials.
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 are provided at inaccessible places for ordinary spanners, special spanners shall be provided.
7. The length of screwed portion of the bolts shall be such that no screw thread may form part of a sheer plane between members.
8. Taper washers may be provided where necessary. Protective washers of suitable material shall be provided front and back of the securing screws.
9. LT side should be of Pad type terminal.

#### **16.0 Lightning Arrestors:**

The Lightning Arrestors (Disconnecter type) of high surge capacity of 9 kV ( Vrms), 5 kA( 8/20 micro wave shape) for 11 kV class transformers and 18 kV ( Vrms), 5 kA ( 8/20 micro wave shape) for 22 kV class transformers & 30 kV, 10 kA ( 8/20 micro wave shape) for 33 kV , conforming to IS: 3070/1993 shall be mounted on the HV bushings of transformer, clamped securely to the tank, to protect the transformer and associated line equipment from the occasional high voltage surges resulting from lighting or switching operations. The earthing terminal of the lightning arresters shall be grounded separately.

Random sample of LA shall be destructively tested by breaking the LA to confirm availability of inside component only.

#### **17.0 Transformer Oil**

Transformer oil to be used in all the Distribution transformers shall comply with the requirements of latest IS 335/1983 amended up to date thereof. In addition the oil should conform to 'Ageing Characteristics' specified below for New Oil and Oil in Transformers. Type test certificates of oil being used shall be produced to EE (IW) at the time of stage inspection.

New oil - Ageing characteristics after accelerated ageing test 96 hrs at 115° C (open beaker method with copper catalyst):

- i. Specific Resistance (Resistivity)
  - a) at 20 ° C :-  $2.5 \times 10^{12}$  Ohm-Cm (Min)
  - b) at 90 ° C :-  $0.2 \times 10^{12}$  Ohm-Cm (Min)
- ii. Dielectric dissipation factor - 0.20 (Max .tan delta) at 90 ° C.
- iv. Total sludge value (%) by weight - 0.05 (Max.)
- v. The method of testing these aging characteristics is given in Appendix - C of IS 335 amended up to date.
- vi. The Density of oil shall be maximum 0.89 g /cm<sup>3</sup> at 29.5 °C as per IS 1448.
- vii. Total acidity mg/KOH/gm-0.05(Max.)

viii The important characteristics of the transformer oil after it is filled in the transformer (within 3 months of filling) shall be as follows: -

Sr.No.	Characteristics	Specifications
1.	Electric Strength (Breakdown voltage)	30 kV (Min)
2.	Dielectric dissipation factor (Tan Delta) at 90 deg.C.)	0.01 (Max)
3.	Specific Resistance (Resistivity) at 27 deg. C (ohm-cm)	$10 \times 10^{12}$
4.	Flash Point, P.M. (closed)	140 ° C (Min)
5.	Inter facial tension at 27 ° C.	0.04N/M (Min)
6.	Neutralization value (total acidity)	0.03Mg.KOH/gm (Max.)
7	Water content PPM	40 (Max)

## 18.0 Test and Inspection:-

All routine, type and special tests as described in Clause 21.2 to 21.4 of IS 1180 (Part 1):2014 shall be performed as per relevant parts of IS 2026. Pressure and oil leakage test shall be conducted as per Clause 21.5 of IS 1180 (Part1):2014.

### 18.1 Routine Tests (to be conducted on all units):-

The following shall constitute the routine tests:

- a) Measurement of winding resistance [ IS 2026 (Part 1)].
- b) Measurement of voltage ratio and check of phase displacement[IS 2026(Part1)].
- c) Measurement of short circuit impedance and load loss at 50 percent and 100 percent load [ IS 2026 (Part 1)].
- d) Measurement of no load loss and current [ IS 2026 (Part 1)].
- e) Measurement of insulation resistance [ IS 2026 (Part 1)].
- f) Induced over-voltage withstand test [ IS 2026 (Part 3)].
- g) Separate-source voltage withstand test [ IS 2026 (Part 3)].
- h) Pressure test
- i) Oil leakage test

### 18.2 Type Tests (to be conducted on one unit):-

The following shall constitute the type tests:

- a) Lightning impulse test [ IS 2026 (Part 3)].
- b) Temperature-rise test [ IS 2026 (Part 2)].  
**Note** – Minimum total loss ( No load + load loss at 75 deg' C reference temperature) at 100 % loading shall be supplied during temperature rise test.
- c) Short-circuit withstand test (IS 2026 (Part 1)

d) Pressure test.

In addition to that the successful bidder shall submit the type test report of transformer Oil & HV/LV bushings as per relevant IS with offer.

**18.3** The Type Tests as per Clause 20.2 above shall be successfully carried out at laboratories accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with IS 1180(Part 1):2014 as amended from time to time and technical specifications, within the last 5 (five) years prior to the date of offer.

**18.4** The type test reports should be submitted and got approved from the Chief Engineer (MMC) before commencement of supply.

**18.5 Special Tests (to be conducted on one unit):-**

The following shall constitute the special tests.

- a) Determination of sound levels [ IS 2026 (Part 10)].
- b) No load current 112.5 percent voltage [refer clause 7.9.2 of IS 1180(Part 1): 2014].
- c) Paint adhesion tests: The test is performed as per ASTM D 3359 ( Standard Test Methods for measuring adhesion by Tape Test).
- d) BDV and moisture content of oil in the transformer ( IS 335).

Note:Tests at (c) and (d) may be carried out on more than one unit.

**18.6 Pressure and Oil leakage Test :-**

**18.6.1 Pressure Test ( Type Test ) :** For sealed type transformers, the transformer tank subjected to air pressure of 80 kPa for 30 min and vacuum of 250 mm of mercury for 30 min. The permanent deflection of flat plate, after pressure/vacuum has been released, shall not exceed the values given below.

Length of Plate	Deflection
Up to 750 mm	5.0 mm
751 mm to 1250 mm	6.5 mm

**18.6.2. Pressure Test ( Routine Test ) :**

**a) Plain tanks :** The transformer tank with welded / bolted cover shall be tested at a pressure of 35 kPa above atmospheric pressure maintained inside the tank for 10 min. There should be no leakage at any point .

**b) Corrugated tanks :** The corrugated transformer tank shall be tested for air pressure of 15 kPa above atmospheric pressure maintained inside the tank for 10 min. There should be no leakage at any point .

**18.6.3 Oil leakage Test (routine Test) :** The assembled transformer for sealed type with all fittings including bushing in position shall be tested at a pressure equivalent to twice the normal head measured at the base of the tank for 8 h. There should be no leakage at any point. Tank with corrugations shall be tested for oil leakage test a pressure of 15 kPa measured at the top of the tank for 6 h. There should be no leakage at any point.

## **19.0 Challenge Testing:**

The manufacturer can also request challenge testing for any test based on specification and losses. The challenger would request for testing with testing fees. The challenge test fees are proposed at least three times the cost of testing. This is likely to deter unnecessary challenges. The challenger would have the opportunity to select the sample from the store and any such challenge should be made within the guarantee period. The party challenged, challenger and the utility could witness the challenge testing.

The challenge testing would cover following tests:

1. Measurement of magnetizing current.
2. No load losses test.
3. Load losses test (at 50 % loading or as per routine test).
4. Temperature rise test.

The challenge test could be conducted at NABL Laboratory, like ERDA and CPRI. If the values are within the limits the products gets confirmed else not confirmed. No positive tolerances in losses is permitted. If the product is not confirmed the manufacturer would pay the challenge fee and challenger would get the fee refunded. However as a redressal system the challenger would be allowed to ask for fresh testing of two or more samples from the store and the same be tested in NABL Laboratory in presence of party challenge, challenger and the utility.

If any one of the above sample does not confirm the test, then the product is said to have failed the test. In such cases the manufacturer will be declared as unsuccessful manufacturer for the said product with wide publicity and would not allow to compete in tenders of the MSEDCL for the period of three years and heavy penalty would be imposed.

## **20.0 Offer Qualification for Type Test:-**

### **20.1 In case of any of the following, the offer may be considered for evaluation only.**

- i) If above tests are carried out beyond 5 years
- ii) Impulse Voltage Withstand test ,Dynamic Short Circuit test, Temperature rise Test & Pressure Test carried out not from NABL approved Laboratory.
- iii) If there is any change in the design/ type of old type tested transformers to be offered against this specification.

**Note:** *However, In that case successful bidders have to carry out the type tests at the laboratories accredited by NABL before commencement of supply at their own expense on the sample drawn by the purchaser from the lot offered for first Stage Inspection.*

**20.2** In respect of the successful bidder, the purchaser reserves the right to demand repetition of some or all the type tests in presence of the purchaser's representative.

In case the unit fails in the type tests, the complete supply shall be rejected. The bidders are therefore requested to quote unit rates for carrying out each type test, which however, will not be considered for evaluation of the offer.

## **21.0 Drawings & Calculation sheet:-**

21.1 A set of following drawings with all dimensions shall be submitted by the Bidder along with the offer:

- i. Rating & Diagram Plate Drawing.(As per Cl.no.13.1 Fig.1 of IS 1180(Part1):2014
- ii.General Dimensional drawing.
- iii.Internal Construction Drawing
- iv.Core Assembly drawing
- v.HV& LV Bushings Assembly drawing
- vi.Creepage distances distance drawing of HV& LV Bushing
- vii.Calculation sheet for flux density viii.Heat dissipation

ix.Oil absorption

21.2 The drawings shall be of A-3 (420 x 297 mm) size only. The bidder should also supply along with his offer the pamphlets/literatures etc. for fittings / accessories.

21.3 The bidder should not change design once offered as per A/T, Approved drawings and Type Test Reports.

22.4 The successful Bidders shall submit complete set of Drawings (as listed in Cl.No.23.1) of transformer in triplicate indicating dimensions to CE (MMC) for approval and get approved it before offering Ist stage inspection.

## **22.0 Rejection :-**

22.1 Apart from rejection due to failure of the transformer to meet the specified test requirements the transformer shall be liable for rejection on any one of the following reasons.

- i. **Maximum total losses at 50 % load & 100% Load loss** exceeds the specified values mentioned in Cl. No.6.3 above.
- ii. Impedance voltage value exceeds the Guaranteed value plus tolerances as mentioned at Cl.No.6.5 above.
- iii Type test are not carried out as per clause no. 20.2 & 20.3 of the specification.
- iv. Drawings are not submitted as per clause no. 23.0 of the specification.
- v. GTP not submitted as per clause no. 26.0 of the specification.
- vi Heat dissipation calculation sheet are not submitted as per clause no.8.0 of the specification.

## **23.0 Cleaning and Painting.**

- i. The external surfaces shall be painted with one coat of thermo setting paint or one coat of epoxy primer followed by two coats of polyurethane( finish coat) for (outside) and hot oil resistant paint/ varnish with one coat (inside) with dry film thickness as mentioned in Table 12 , Cl.no.15.5 of IS 1180( Part 1):2014 .

- ii. The test of measurement of paint thickness shall be carried out cross hatch test, chemical test and other as per IS 13871:1993
- iii. The surface of the tank shall be properly pre-treated / phosphated in a seven tank process and shall be applied with a powder coating of 40 micron thickness. The powder coating shall be of **Aircraft Blue** colour ( shade No. 108) for transformers. Powder coating shall be suitable for outdoor use. The seven tank process facility shall be enhance to ensure proper quality for outdoor application.
- iv. The month and year of supply shall be painted in red bold **Marathi** lettering at sum conspicuous place on the transformer which shall be clearly visible from the ground.

#### **24.0 Guaranteed & Technical Particulars:**

The bidder should fill up all the details in GTP parameter list, the statement such as “as per drawings enclosed”, “as per MSEDCL’s requirement” “as per IS” etc. shall be considered as details are not furnished and such offers shall liable for rejection.

#### **25.0 Testing facility**

The bidder should have adequate testing facility for all routine and acceptance tests and also arrangement for measurement of losses, resistance, etc. details of which will be enumerated in the tender.

#### **26.0 Submission Routine Test Certificate**

- a. The successful bidder shall submit the routine test certificate along with documentary evidence for having paid the Excise Duty for the following raw materials viz. Oil, Aluminum, copper for conductors, insulating materials, core materials, bushings at the time of routine testing of the fully assembled transformer
- b. Instruction and operation Manual The successful bidder shall be required to submit 5 copies of instruction and Operation manual for each lot of 100 Transformers (or part thereof) supplied. This instruction manual should give complete details about the pre-commissioning tests/checks and the details of preventive maintenance etc.

#### **27.0 Stage Inspection :-**

- 27.1 Supplier shall give 15 days’ advance intimation to the Chief Engineer (MMC) to organize stage inspection in which assembly of core, windings and other core materials etc. would be inspected. In respect of raw materials such as core stamping, winding conductor, oil etc. successful bidder shall use these materials manufactured/supplied by the standard manufacturers and furnish the manufacturer’s test certificates, as well as, proof of purchase from those manufacturers documentary evidence for having paid the excise duty for the information of the department.
- 27.2 Chief Engineer (MM Cell) will depute representatives from testing and inspection wing at the time of Stage inspection.

- 27.3 The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representatives at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications and shall not prevent subsequent rejection if the equipment is found to be defective.
- 27.4 In addition to the above, the purchaser may pick up any transformer and decide to get it type tested from any laboratory accredited by NABL at purchaser's cost. The Bidder will have to organize packing of the transformer at company's Stores for which they will be paid necessary charges. If the transformer fails to meet the requirement of type tests, the quantity of transformers ordered on them will be forthwith rejected and the purchaser may purchase these transformers at the risk and cost of the supplier.

### **28.0 Final Inspection**

- a) 10 % of the transformers offered will be tested for all tests without opening the transformer. Heat Run Test/ Temperature-rise test IS 2026(Part-II) as per IS 1180(Part-I):2014 Clause no.21.3 b will have to be carried out on one unit. Minimum total loss ( No load + load loss at 75 deg' C reference temperature) at 100 %loading shall be supplied during temperature rise test. Chief Engineer (MM Cell) will depute his representatives from testing and inspection wing at the time of final inspection. Out of balance 90% distribution transformer, one transformer shall be opened and all design technical parameters shall be checked as per E-GTP, approved drawings and technical specifications. If any technical parameters are found deviating from E-GTP, approved drawings & Technical specifications, the final inspection of the whole lot shall be reoffered for final inspection after rectification.
- 28.1 Leakage test on sample transformer shall be carried out during final inspection as per relevant IS.

### **29.0 Testing of all Distribution Transformers for losses at 50% load and 100% load:**

After inspection of new transformers at factory for acceptance of the lot, all distribution transformers from the lot will be tested for 50% load and 100% load at all stores. Tenderer has liberty to be present at the time of testing.

### **30.0 Random Sample Testing (RST)**

The tenderer should intimate to C.E. (MM Cell ), M.S.E.D.C.L of completion of dispatches of whole lot of Distribution Transformers to stores against tender. C.E. (MM Cell), M.S.E.D.C.L will select the stores for Random Sample Testing (RST) and depute E.E. (Testing) to carry out RST of the lot.

E.E. (Testing) will select a transformer from the lot of transformers already tested for 50 % load and 100 % load.15 days advance intimation will be given to tenderer for joint inspection. The date of RST will not be altered to the convenience or request of supplier. If supplier's representative fails to attend on the date fixed for RST, the RST will be carried out in his absence and results of RST will be binding

on supplier. In case the selected transformer fails in any of the tests, complete lot of transformers will be rejected.

### **31.0 Inspection & Testing of Transformer Oil:**

The tenderer shall make arrangements for testing of transformer oil to be used in the transformers and testing will be done in presence of purchaser's representative.

To ascertain the quality of transformer oil, original manufacturer's test report should be furnished to EE (Testing) at the time of factory inspection for acceptance of the lot.

### **32.0 Quality Assurance**

- 32.1 The bidder shall invariably furnish following information along with the offer failing to which the offer will be rejected.
- 32.2 Certificates of following materials shall be submitted as per relevant standards indicated in Clause No.9.1 of IS 1180( Part1):2014.
  - i. Copper / Aluminum conductor
  - ii. Transformer oil
  - iii. C.R.G.O.Core
  - iv. Insulating / Kraft paper.
  - v. Porcelain Bushings
  - vi Steel Plate used for Tank, press board.
- 32.3 Names of the supplier for the raw material, list of standard accordingly to which the raw materials are tested, list of test normally carried out on raw materials in presence of bidder's representatives, copies of type test certificates to be furnished.
- 32.4 Information and copies of test certificate as in (32.3) above respect of bought out accessories including terminal connectors.
- 32.5 List of manufacturing facilities available, in this list the bidder shall specifically mention whether lapping machine, vacuum drying plant, air conditioned dust free room with positive air pressure for provision of insulation and winding etc are available with him.
- 32.6 Level of automation achieved and list of areas where manual processing still exists.
- 32.7 List of areas in manufacturing process where stage inspection are normally carried out for quality control and details of such tests and inspections.
- 32.8 Special features provided in the equipments to make it maintenance free
- 32.9 List of testing equipment available with the bidder for final testing of transformers and test plant limitation, if any, vis-à-vis the type, special acceptance and routine tests specified in the relevant standards and the present specification. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.
- 32.10 The successful bidder shall submit the Routine Test Certificate along with documentary evidence having paid for the excise duty for the following raw materials viz Oil, Copper for conductors, insulating materials, Core materials, Bushing at the time of routine Testing of the fully assembled transformer.

### **33.0 Qualifying Requirement: As per Tender**



### 34.0 Performance Guarantee:

All transformers supplied against this specification shall be guaranteed for a period of 66 months from the date of receipt at the consignee's Stores Center or 60 months from the date of commissioning, whichever is earlier. However, any engineering error, omission, wrong provisions, etc. which do not have any effect on the time period, shall be attended to as and when observed/ pointed out without any price implication.

### 35.0 COST DATA SHEET:-

The bidders shall submit the cost data sheets indicating the break up prices and quantity of each raw material and components along with the unit rates required for manufacture the offered transformers along with the offer. The cost data sheet format is enclosed herewith.. If the rates quoted are not justified with the cost data sheets, the offer shall not be considered for evaluation and placement of the order.

The cost data sheets shall be scrutinized by MM Cell section.

FORMAT FOR COST DATA					
ITEM ----- KVA , ----- KV DISTRIBUTION TRANSFORMER					
Sr. No	PARTICULARS	UNIT	UNIT RATES Rs.	QTY	AMT (Rs.)
1	CORE (M4 or better )	KG			
2	ALUMINIUM/COPPER WITH DPC FOR HV WINDING	KG			
3	ALUMINIUM/COPPER WITH DPC FOR LV WINDING	KG			
3	INSULATION PAPER	Meter			
4	OIL	LTRS			
5	TANK	NO			
6	CHANNELS	KG			
7	INSULATORS/BUSHINGS	KG			
8.	OTHERS	LUMPSUM			
				TOTAL	
	WASTAGE @ %				

### 36.0 Schedules

37.1 The bidder shall fill in the following schedules which form part of the tender specification and offer. If the schedules are not submitted duly filled in with the offer, the offer shall be rejected.

Schedule `A' -Guaranteed Technical Particulars

Schedule `B' -Schedule of Tenderer's Experience.

- 37.2 The discrepancies between the specification and the catalogs, Literatures and indicative drawings which are subject to change, submitted as part of the offer, shall not be considered and representation in this regard will not be entertained.
- 37.3 The Bidder shall submit the list of orders for similar type of equipments, executed or under execution during the last three years, with full details in the schedule of Tenderer's experience (Schedule `B') to enable the purchaser to evaluate the tender.

**TECHNICAL SPECIFICATION OF 10 ,16 AND 20kVA, 11/0.433 kV & 22/ 0.433 kV  
LEVEL-2 & LEVEL-3, THREE PHASE, SEALED TYPE DISTRIBUTION TRANSFORMERS  
OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE.**

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Technical Specification No. CE/MMC/MS-C-I/3Phase (10-20kVA)/DT/T/2017/01,Date: 01.06.2017. Page 26

## Schedule `A'

### *GUARANTEED TECHNICAL PARTICULARS*

*As indicated in E-Tendering GTP Parameter*

SCHEDULE – ‘B’

SCHEDULE OF TENDERER'S EXPERIENCE

Tenderer shall furnish here a list of similar orders executed/under execution by him to whom a reference may be made by Purchaser in case he considers such a reference necessary.

---

Sr. No.	Name of client & Description.	Value Of Order (along with cap. of T/F)	Period of supply & commissioning	Name & Address to whom reference may be made.
1	2	3	4	5

---

NAME OF FIRM \_\_\_\_\_

NAME & SIGNATURE OF TENDERER \_\_\_\_\_

DESIGNATION \_\_\_\_\_

DATE \_\_\_\_\_

**Annexure I**

Air Pressure Test

Name of Supplier:

Order No.:

Capacity & Voltage Ratio of Distribution Transformer : \_\_\_\_\_ kVA, \_\_\_\_/0.433 kV

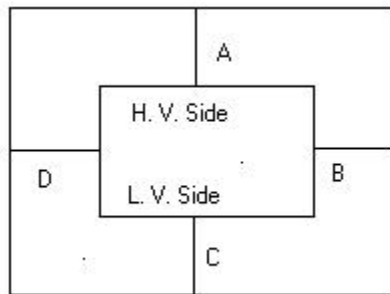
Vector Group Dyn11

Sr. No. of equipment Tested:

Date of Testing:

Reference Standard

All the opening of the transformer tank were closed with suitable gasket, bushing, valves and plugs. The compressor pipe connected at oil filling hole on conservator and a pressure guage was fitted at air vent plug. The parallel string were places around the tank, the distance between string and tank as shown in following diagram were recorded before applying the pressure and after releasing pressure.



Tank Thickness: Side \_\_\_\_\_ mm. Top & Bottom \_\_\_\_\_ mm

Test Pressure : \_\_\_\_\_ kg/cm<sup>2</sup> applied for 30 Minutes.

Test Point	Distance before Test In mm	Distance after release of Pressure in mm	Deflection In mm
A			
B			
C			
D			

Permanent Deflection : \_\_\_\_\_ mm

Permissible Limit of Permanent Deflection as per Specification : \_\_\_\_\_ mm

Test witnessed by

Tested by

**Annexure II**

Temperature Rise Test

Name of Supplier:

Order No.:

Capacity & Voltage Ratio of Distribution Transformer : \_\_\_\_\_ kVA, \_\_\_\_/0.433 kV

Vector Group Dyn11

Sr. No. of equipment Tested:

Date of Testing:

Reference Standard

	H. V. Winding	L. V. Winding
Rated Line Current in Amp		

Guaranteed No Load Losses \_\_\_\_\_ watt

Load Losses \_\_\_\_\_ watt

Total Losses \_\_\_\_\_ watt

P. T. Ratio : \_\_\_\_\_/\_\_\_\_\_ =

C. T. Ratio : \_\_\_\_\_/\_\_\_\_\_ =

Wattmeter Constant \_\_\_\_\_ =

Total Multiplying Factor (MF) \_\_\_\_\_ =

TIME	Ambient Temp.				Top Oil Temp. °C	Rise in Top Oil Temp. °C	Line Voltage in Volts	Line Current in Amps	W1 watts	W2 watts	W3 watts	W1+W2+W3 watt	Multiplying Factor (MF)	Total Watt
	T1 °C	T2 °C	T3 °C	Average °C										
Reduced to Rated Current _____ amps														

Calculation of Temperature Rise in Winding

LV Winding : Since the resistance of LV winding is less than 0.005 ohm, Temperature Rise in LV Winding is taken as temperature rise of oil as per clause no. 4.3 of IS:2026 (Part II)/1977

Temperature Rise in LV Winding = \_\_\_\_\_ °C

HV Winding Resistance across 1U1V at \_\_\_\_\_°C = \_\_\_\_\_ ohm

Measurement of Hot Resistance of HV Winding after Shut Down.

Time	Resistance

Hot winding Resistance at Ambient Temperature \_\_\_\_\_ °C (from graph) = \_\_\_\_\_ Ohm

Temperature Rise in H. V. Winding is

$$= \frac{\text{Hot Resistance} \times (235 + \text{Cold Ambient Temperature})}{\text{Cold Resistance}} - (235 + \text{Hot Ambient Temperature})$$

=

=

Results :

- 1) Temperature Rise in Oil = \_\_\_\_\_ °C
- 2) Temperature Rise in LV Winding = \_\_\_\_\_ °C
- 3) Temperature Rise in HV Winding = \_\_\_\_\_ °C

4) Oil leakage test:

The oil leakage test shall be conducted on one unit selected from the offered lot of each rating. Transformer complete in all respects shall be subjected to the pressure of 0.4 kg/cm<sup>2</sup> and maintained for 8 hours . No leakage should occur.

Test witnessed by \_\_\_\_\_

Tested by \_\_\_\_\_



## Schedule `A'

### GUARANTEED TECHNICAL PARTICULARS

Three phase, 10, 16 & 20 kVA, 11/0.433 kV & 22/0.433 kV Distribution Transformer level 2 and level 3 without CSP feature		
Sr. No.	GTP Parameter	
1	Name of Manufacturer .	T
2	Reference Standard	T
3	Whether transformer is Oil Natural Air Natural cooled type (Yes/ No)	B
4	Whether transformer is suitable for Indoor /Outdoor installation	T
5	Rating of transformer in KVA	N
6	Primary Voltage in kV	N
7	Secondary Voltage in kV	T
8	Whether neutral is solidly earthed (Yes/ No)	B
9	Colour of transformer	T
10	Vector Group	T
11	Approximate overall length of transformer in mm	N
12	Approximate overall breadth of transformer in mm	N
13	Approximate overall height of transformer in mm	N
14	Approximate length of transformer tank in mm	N
15	Approximate breadth of transformer tank in mm	N
16	Approximate height of transformer tank in mm	N
17	Thickness of the side of transformer Tank plate in mm	N
18	Thickness of the bottom of transformer tank plate in mm	N
19	Thickness of the top of transformer tank plate in mm	N
20	Weight of Tank & fittings in kgs	N
21	Total Weight of Transformer in kgs	N
22	Type of Tank (corrugated/conventional)	T
23	Degree of slope to the top plate of Transformer.	T
24	In case of Corrugated tank, Thickness of corrugated sheet ( in mm)	T
32	Name plate details are as per the requirement specified in tender. (Yes/ No)	B
36	Total radiating surface of transformer tank in Sq. mtrs.	N
37	Core material used & its grade	T
38	Type of core	T
39	Weight of Core in kgs	N
40	No. of steps of core for CRGO core	N
41	Diameter of core in mm	N
42	Effective core area.(sq.cm)	N
43	Flux density in Tesla	N
44	Thickness of core lamination in mm	N
45	The temperature shall in no case reach a value that will damage the core itself, other parts or adjacent materials ( Yes/No)	B
46	Type of connection for H.V. Winding (Delta) (Yes/ No)	B
47	Type of connection for L.V. Winding (Star) (Yes/ No)	B
48	Material of H.V. winding	T
49	Material of L.V.Winding	T
50	Insulation provided to H.V winding.	T
51	Insulation provided to L.V. winding.	T
52	Current density of H.V. winding (in Ampere/ sq.mm)	N
53	No of LV winding turns	N
54	No of HV winding turns	N
55	Resistance of LV winding per phase at 20 deg C in ohms	T
56	Resistance of HV winding per phase at 20 deg C in ohms	T

**TECHNICAL SPECIFICATION OF 10 ,16 AND 20kVA, 11/0.433 kV & 22/ 0.433 kV  
LEVEL-2 & LEVEL-3, THREE PHASE, SEALED TYPE DISTRIBUTION TRANSFORMERS  
OUTDOOR TYPE OIL IMMersed WITHOUT CSP FEATURE.**

57	Current density of L.V. winding (in Ampere/sq. mm.)	N
58	Clearance between Core & L.V. winding in mm	N
59	Clearances between L.V. & H.V. winding in mm	N
60	Clearances between HV Phase to Phase in mm	N
61	Clearances between end insulation to Earth in mm	N
62	Clearances between winding to tank in mm (min 30 mm)Yes/No	B
63	Weight of Aluminum/Copper in kgs	N
64	Inter layer insulation provided in H.V winding to design for Top & bottom layer	T
65	Inter layer insulation provided in L.V winding to design for Top & bottom layer	T
66	Inter layer insulation provided in between all layer in H.V winding	T
67	Inter layer insulation provided in between all layer in L.V winding	T
68	Details of end insulation	T
69	Whether wedges are Provided at 50% turns of the Coil (Yes/ No)	B
70	Insulation materials provided for core	T
71	Length of coil used for HV winding in meter.	N
72	Cross section area of the coil used for HV winding ( sq.mm)	T
73	Length of coil used for LV winding in meter.	N
74	Size of strip used for LV winding in mm	T
75	No. of conductors in parallel for LV winding	N
76	Total cross section area of LV conductor in sq. mm	N
77	No. of H.V coils /phase	N
78	Thickness of locking spacers between H.V. coils ( in mm)	N
79	Weight of Oil in kgs	N
80	Volume of Oil in Ltrs	N
81	Quantity of total oil absorption ( in liters) in first filling	N
82	Total oil Volume including Total Oil absorption in liters	N
83	Grade of Oil used.	T
84	Name of Oil manufacturers to be supplied.	T
85	Breakdown Values of Oil at the time of first filling (kV/mm) considering 2.5 mm gap	T
86	Oil level indicator (showing three levels) on tank ( Yes/ No)	B
87	Drain Valve (20 mm) provided to the transformer tank ( Yes/No)	B
88	Earthing terminals with lugs is provided ( Yes/No)	B
89	Lifting lugs provided (Yes/No)	B
91	Thermometer pocket is provided (Yes/No)	B
93	Material of HV and LV Bushings and makes thereof	T
94	Reference standard of Bushings	T
95	Rating of L.V. Bushing	T
96	Minimum Creepage Distance of HV Bushing in mm (min.25 mm per kV)	N
97	Minimum Creepage Distance of LV Bushing in mm (min.25 mm per kV)	N
98	Rating of H.V. Bushings ( in kV)	N
99	Rating of L.V. Bushing (in kV, kA )	T
100	Min. External clearances of H.V. bushing terminals between ph. to ph (255 mm)	B
101	Min. External clearances of H.V. bushing terminals between ph. to earth (140 mm)	B
102	Min. External clearances of L.V. bushing terminals between ph. to ph (75 mm)	B
103	Min. External clearances of L.V. bushing terminals between ph. to earth (40 mm)	B
104	Rating of Lightning Arrestors and Make thereof	T
105	Reference Standard of Lightning Arrestors.	T
106	Maximum winding temperature rise in °C over an Ambient temp. of 50°C by Resistance Method	N
107	Maximum temperature rise of Oil in °C over an Ambient temp. of 50°C by thermometer.	N
108	Magnetizing current (No load) in Amps and its % of full load current at rated voltage referred to L.V. side.	T
109	Magnetizing current (No load) in Amps and its % of full load current at maximum voltage (112.5% of rated voltage) referred to L.V. side.	T
110	Max. core (No load) losses at rated voltage and rated frequency (Watts) .	N

**TECHNICAL SPECIFICATION OF 10 ,16 AND 20kVA, 11/0.433 kV & 22/ 0.433 kV  
LEVEL-2 & LEVEL-3, THREE PHASE, SEALED TYPE DISTRIBUTION TRANSFORMERS  
OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE.**

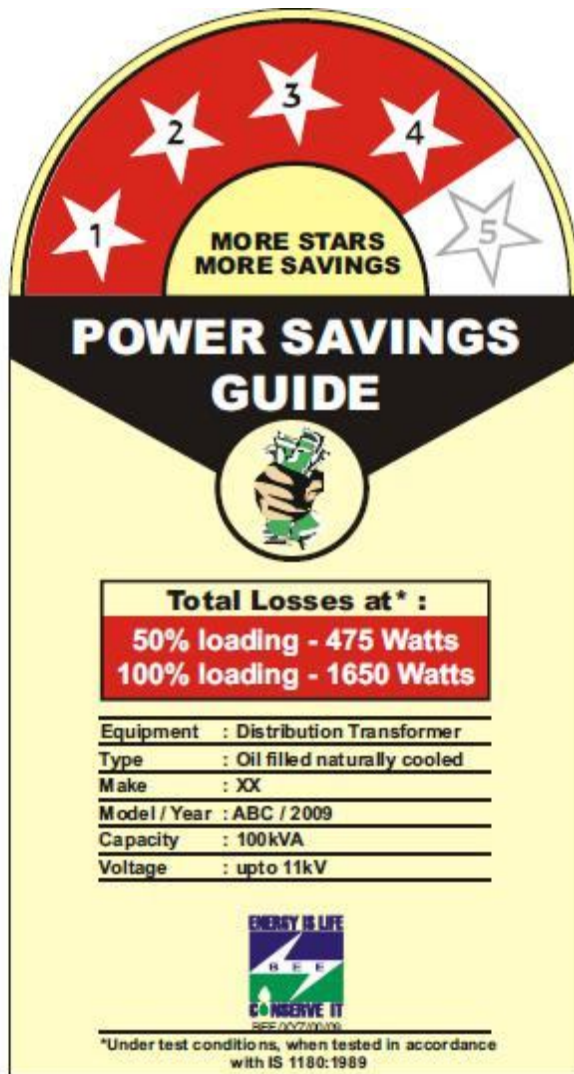
111	Max. Total losses (No Load + Load Losses at 75 °C) at 50% loading in Watts	N
112	Max. Total losses (No Load + Load Losses at 75 °C) at 100% loading in Watts	N
113	Efficiency at 75 °C at unity P.F. at 125% load	N
114	Efficiency at 75 °C at unity P.F. at 100% load	N
115	Efficiency at 75 °C at unity P.F. at 75 % load	N
116	Efficiency at 75 °C at unity P.F. at 50% load	N
117	Efficiency at 75 °C at unity P.F. at 25% load	N
118	Efficiency at 75 °C at 0.8 P.F. lag at 125% load	N
119	Efficiency at 75 °C at 0.8 P.F. lag at 100 % load	N
120	Efficiency at 75 °C at 0.8 P.F. lag at 75 % load	N
121	Efficiency at 75 °C at 0.8 P.F. lag at 50 % load	N
122	Efficiency at 75 °C at 0.8 P.F. .lag at 25% load	N
123	Efficiency at 75 °C at 0.8 P.F. leading at 125% load	N
124	Efficiency at 75 °C at 0.8 P.F. leading at 100% load	N
125	Efficiency at 75 °C at 0.8 P.F. leading at 75% load	N
126	Efficiency at 75 °C at 0.8 P.F. leading at 50%load	N
127	Efficiency at 75°C at 0.8 P.F. leading at 25 % load	N
128	Regulation at Unity P.F (in %)	N
129	Regulation at 0.8 P.F. lag. (in %)	N
130	Regulation at 0.8 P.F. leading. (in %)	N
131	% Impedance value at 75°C	N
132	Separate source power frequency withstand test for HV for 1 minute in kv(min)	T
133	Separate source power frequency withstand test for LV for 1 minute in kv(min)	T
134	Induced over voltage withstand test for 1 min. specify voltage frequency, time for test.	T
135	Impulse test value (in kVp) .	T
137	The test certificates of Aluminium/copper conductor, core , insulating paper, porcelain bushings, steel plate used for enclosure of offer transformer is enclosed along with the offer in soft copy.(Yes/ No)	B
138	All type test report of type tests carried out on transformer at NABL laboratory shall be submitted along with the offer as per cl. XXII (c) of Section (I) i.e. Instructions to tenderers. (Yes/ No)	B
139	Air pressure test and temperature rise test shall be conducted as per format enclosed with the technical specification along with the offer (Yes/ No)	B
140	All drawings shall be furnished for each offered item separately along with this offer (Yes/ No)	B
141	Oil absorption calculation sheet shall be furnished for each offered item separately along with this offer (Yes/ No)	B
142	Heat dissipation calculation shall be furnished for each offered item separately along with this offer (Yes/ No)	B
143	Flux density calculation sheet with no. of Primary & Secondary turns shall be furnished for each offered item separately along with this offer (Yes/ No)	B
144	Calculation sheet for 112.5% of Rated V/f ratio (over fluxing calculation sheet) shall be furnished for each offered item separately along with this offer (Yes/ No)	B
145	Required documents, plant and machinery, list of order executed/under execution shall be furnished for each offered item separately along with this offer (Yes/ No)	B
146	The information required under Quality Assurance shall be submitted with the offer in physical format & soft copy(Yes/ No)	B
147	The cost data in the prescribed format shall be submitted with offer in physical format & soft copy (Yes/ No)	B
148	The performance Guarantee of the transformers in years	N
149	Power frequency withstand voltage dry & wet in kV(rms) for H.V Bushing	T
150	Dry lightning Impulse withstand voltage test in kV (peak) Stating the wave form adopted for H.V. bushing	T

**This is an indicative drawing .Bidder shall submit name plate drawing as per Clause No. 15.1 Fig.1 of IS 1180(Part-1):2014 and as per Clause No.16 of this technical specification.**

**Note:- The drawings given below are indicative drawings, however for providing and affixing label for respective capacity kVA, should be followed as per guidelines of BEE.**

**Label design, manner of display:**

Fig.1. Detailed label specifications (size, colour scheme, font size, security features, if any, etc), content of the label (parameters displayed on the label) is provided below:



**Fig. 2. Manner of display of label:**

The label shall be applied on the front base of the equipment near the name plate, so as to be prominently visible on the equipment.

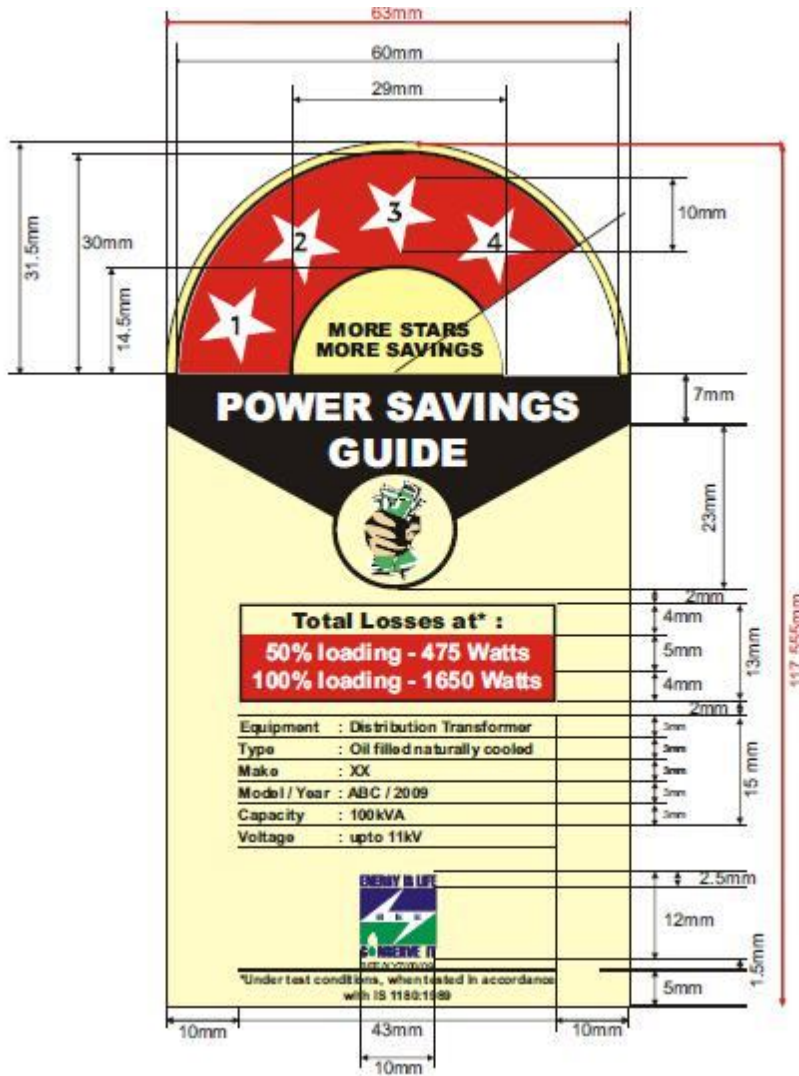


Fig. 3. Colour Scheme: Sample Picture of manner of affixing of Label:



