

**TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE
PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL
IMMERSED WITHOUT CSP FEATURE**

Maharashtra State Electricity Distribution Company Limited

MATERIAL SPECIFICATIONS CELL

TECHNICAL SPECIFICATION

FOR

**TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/ 0.433 kV LEVEL-2 THREE
PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL
IMMERSED WITHOUT CSP FEATURE**

TECHNICAL SPECIFICATION NO.

CE/MMC/MSC-I/3-Phase (10 kVA)/DT/T/2018/03,

Date: 09.04.2018 (Revised on dtd. **18.02.2019**).

(Amended as per guidelines by Ministry of Power)

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1.0 Scope:

- 1.1 This specification covers design, manufacturing, testing and delivery of **10 KVA, 11/0.433 kV & 22/ 0.433 kV level-2 three phase, sealed/non sealed type, Amorphous / CRGO core 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.

2.0 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.

Nominal System Voltage	11 kV or 22 kV
Corresponding Highest System Voltage	12kV or 24 kV
Rated Basic Insulation Level	75 KVp or 125 KVp
Neutral earthing	Solidly earthed
Frequency	50 Hz with ± 3 % tolerance

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Number of Phases	3
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3.0 SERVICE CONDITIONS

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

Max. ambient air temperature	50 Deg. C
Max. relative humidity	100 %
Max. annual rainfall	1450 mm
Max. wind pressure	150 kg/m ²
Max. altitude above mean sea level	1000 mtrs.
Isoceraunic level	50
Seismic level (Horizontal acceleration)	0.3 g.
Climatic Condition	Moderately hot and humid tropical climate conducive to rust & fungal growth.
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 marked with standard mark governed by BIS as per clause 13.4 of IS 1180(Part 1):2014].

3.4 The Distribution Transformer shall bear star 1 or 2 rating label approved by BEE(Bureau of Energy Efficiency).

3.5 The Distribution Transformer shall bear level2 (star 1of BEE)ratings label approved by BIS (Bureau of Indian Standard) as per IS 1180 (Part1):2014 (Amendment-1 August 2016).

3.6 The Bidder/ Manufacturer shall possess the BIS license for offered product.

3.7 The Bidder/ Manufacturer shall possess the BEE certification for offered product.

4.0 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.

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- 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) amended up date.	Outdoor type oil immersed distribution transformers up to and including 2500kVA, 33kV
2	IS:2026(Part I to VII)	Specification for power transformer
3	IS:335/2018	New insulating oil- Specification (Fifth revision)
4	IS 16585: 2016	Magnetic Material – Specification for for Individual material – Fe-based Amorphous Strip delivered in the Semi- Processed State
5	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
6	IS 5	Colours for ready mixed paints and Enamels.
7	IS 13730 (Part-27)1996	Specification for particular types of winding wires
8	IS: 3073/1974, IS: 3070(Part-II)	Specifications for L.A's
9	CEA Guidelines August -2008	Manual on transformers
10	Gazette notification by Ministry of Power dated 16.12.2016	Revised losses of distribution transformers
11	IS 1180 (Part 1): 2014	Draft amendment No. 3 November 2017
12	IS 1180 (Part 1): 2014	Amendment No. 3 January 2019

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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.

5.0 Specific Technical requirement:

5.1 Standard kVA Ratings:

The standard ratings for three phase transformer shall be 10 KVA as per IS 1180 (Part-I):2014

5.2 Nominal voltage ratings

(i) Primary voltage: 11 kV or 22 kV

(ii) Secondary voltage: 0.433 kV

5.3 Winding connections:-

(i) H.V. Winding: Delta (Δ)

(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).

5.4 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)]

5.5 No load voltage ratio:

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

6.0 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 X 5 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 1.69 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

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(i) The **Amorphous** /CRGO core material shall be used for 10KVA transformers. 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 or D type construction of **Amorphous core** or 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. Core clamping for Amorphous/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 for CRGO/ Amorphous

(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

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frequency variation with rated voltage and frequency does not exceed 1.9 Tesla. Flux density at rated voltage and frequency should not be more than 1.69 Tesla for CRGO core/ 1.38 Tesla for Amorphous core.

- (vi) The no-load current at rated voltage shall not exceed the percentage as given below. The no load current of 10kVA transformers 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% of rated voltage shall not increase the no-load current by 6% of full load current. (As per IS 1180 (Part1):2014).
- (vii) Number of steps of CRGO stacked core shall be minimum 5 steps. However, for amorphous core transformers, only one step is required being wound core.

6.2 Winding:

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

- (i) Super enameled of thermal grade of 220 degree C Aluminum conductor shall be used for HV/LV winding for 10 KVA Distribution Transformers for both 11 kV& 22 kV.
- (ii) Current Density: Current density for HV and LV winding should not be more than 1.3 A/sq. mm (including tolerance) for Aluminum.
- (iii) L.V. Neutral formation shall be at top.
- (iv) No of HV coil per phase shall be as below

- (a) For CRGO stack core – for 11 kV - 2 /4 coils per phase.
for 22 kV – 4 /6 coils per phase.

- (b) For Amorphous/CRGO wound core– Single coil per phase.

6.3 Losses:

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

Rating (KVA)	% Impedance	Max. total losses in watts for 11 kV Class Level-2 (Star-1)	
		At 50%Load	At 100% Load
11 KV, 10 KVA (CRGO)/ Amorphous	4.5	84	240

Note:

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:

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No positive tolerance shall be allowed on the maximum total 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 values guaranteed in GTP 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 30 mm and 40 mm for 11 kV and 22 kV class respectively.
- (iii) Radial clearances of LV coil (bare conductor) to core shall be minimum 3.5 mm.
- (iv) Radial clearance between HV & LV winding shall be minimum 11mm for 11kV & 14mm for 22kV.
- (v) Phase to Phase clearance between HV conductor shall be minimum 10mm for 11kV & 15mm for 22kV.
- (vi) Minimum End insulation to Earth shall be 11kV - 25mm, 22 kV – 40mm.
- (vii) Minimum external clearances of bushing terminals.

	Details	11 kV	22 kV
HV	Ph to Ph	255 mm	330 mm
	Ph to E	140 mm	230 mm
LV	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:

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- 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 along with 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.
- Side wall thickness : 3.15 mm. (min.)
- Top and bottom plate thickness : 5 mm. (min.)
- 6.6.4 The permanent deflection of flat plates after pressure / vacuum have 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

- 6.6.5 Reinforced by welded angle 25x25x5 MM on all the outside walls on the edge of tank to form two equal compartments.
- 6.6.6 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 stage inspection only to confirm the adequacy of reinforcement angle and gauge of the tank and certified by MSEDCL Inspecting Officer.
- 6.6.7 All welding operations to be carried out by MIG process.(Metal Inert Gas Welding)
- 6.6.8 Lifting lugs:
- 2 nos. welded heavy duty lifting lugs of MS plate of 8 mm (minimum) thickness suitably reinforced by vertical supporting flat of same thickness as of lug welded edgewise below

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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 8 mm thickness should be on the top plate of transformers.

6.6.9 Pulling lugs:

2 nos. of welded heavy duty pulling lugs of MS plate of 8mm thickness shall be provided to pull the transformer horizontally.

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

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

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

6.6.12 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.

6.6.13 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.

6.6.14 The tank design shall be such that the core and windings can be lifted freely.

6.6.15 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.

6.6.16 Thermometer pocket must be located at centre of top cover or high side of tank height for true valve of max top oil temperature

6.6.17 The construction of the tank should be sealed / non-sealed.

The space on the top of the oil shall be filled with dry air or nitrogen for sealed transformers. 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 fix on side wall of the tank.

6.6.18 QR code laminated P touch labels shall be fixed on transformer tank body below the name plate depicting various technical details such as Name of manufacturer, rating, Serial no, date of manufacturing, A/T No. etc.

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6.7 Off Load Taps:

No taps are 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) Heat Dissipation by tank walls excluding top and bottom plates should be 500 Watts/Sq. meter.
- b) Heat dissipation calculation should be based on maximum measured total loss i.e(No load at rated excitation + load loss at 100% Loading converted to 75 deg' C reference temperature) shall be supplied during temperature rise test.
- c) The heat dissipation by tank wall should be increased 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.

KVA rating	Oil in liters(exclusive of oil absorbed in core & coil assembly)	
	11/0.433 kV	22/0.433 kV
10	45	60

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& Transformer shall be supplied complete with first filling of oil up to the mark indicator level of conservator(for non-sealed type transformer). Detailed calculation of absorption should be submitted.

10.0 Conservator:

- a. The total volume of conservator shall be such as to contain 10% of total quantity of oil. Normally 3% quantity of the total oil will be contained in the conservator. Dimension of the conservator shall be indicated on the General Arrangement Drawing. The capacity of the conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to the temperature variations.

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- b. Oil level indicator shall be provided on the side which will be with fully covered detachable flange with single gasket and tightened with MS nut-bolt. Level indication by color shall not be accepted.
- c. The inside diameter of the pipe connecting the conservator to the main tank should be 25 to 50 mm and it should be project into the conservator in such way 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 deg.) should be above the sump level. [Refer Cl.no.16.3 of IS 1180 (Part1):2014]
- d. There shall be minimum -5deg, normal 30deg and maximum 98deg marking on the oil gauge indicator of the conservator.

11.0 Breather:

- a) The material used for breather shall be only of Poly propylene.
- b) The dehydrating agent shall be silica gel. The volume of breather shall be with 250 gm.silica gel conforming to IS: 3401.

12.0 Terminals:

- a) On H.V. side, the bimetallic connector to be provided.
- b) The rating of brass rod for H.V. & L.V. shall be as per relevant IS for different capacity of Transformer. [Following (c) is indicative and shall be conformed with relevant IS].
- c) Brass rods of 12 mm. diameter for HT & LT with necessary nuts, check-nuts and plain thick tinned washer.

13.0 Bushings & Connections:

- 13.1 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. The dimensions shall conform to IS 1180(Part 1): 2014 clause no. 10.1.5.
- 13.2 The LV 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 for non-sealed type transformers. For sealed type transformers, LV bushing inside the tank shall remain dipped in oil. [Refer Cl.no.10.1.3 of IS 1180 (Part1):2014]
- 13.3 Gaskets shall be made of synthetic rubber or synthetic rubberized cork resistant to hot transformer oil or **Nitrile Rubber**. [Refer Cl.no.10.1.4 of IS 1180 (Part1):2014]
- 13.4 The dimensions of the bushings of voltage classes shall confirm to Cl. no 10.1.5 of IS 1180 (Part1):2014.

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- 13.5 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.
- 13.6 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.
- 13.7 The minimum creepage distance for both HV & LV Bushings shall not be less than 25 mm per kV.
- 13.8 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.
- 13.9 Supporting clamp for cable should be provided to avoid weight of cable on the bushing/bushing rod.

14.0 Internal connections:

14.1 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.

14.2 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.

15.0 Tank base channel / Mounting Arrangement:

The under-base of the transformer shall be provided with two 75x40 mm channel of suitable length as per clause 14.1 of IS 1180 (Part1):2014 for fixing to a platform or plinth.

16.0 Terminal Marking Plates and Rating Plates:

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- (a) All Transformer 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 conform to latest IS-2026 (part- IV).
- (b) Each Transformer shall be provided with rating plate made of 18 SWG anodized aluminium material securely fixed on the outer body, easily accessible showing the information 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. The entries on the rating plate shall be engraved.
- (c) Rating & terminal marking plates shall be combined into one plate and shall be marked with standard mark governed by the provisions of the BIS act 1986.
- (d) 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.
- (e) 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.
- (f) 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 there under.
- (g) 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.
- (h) The copy of valid ISI license shall be submitted in support with the bidding document.
- (i) 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.
 - (a) ISI Mark.
 - (b) Energy Efficiency level as approved by BIS
 - (c) Order No. – Month & year.
 - (d) Sr.No. of transformer.
 - (e) Date of manufacturing – Month & year.
 - (f) Date of expiry of guarantee period – month & year.
 - (g) Maximum guaranteed 50% load loss & 100 % load loss figures.
 - (h) Name and full address of the manufacturer.
 - (i) Capacity.
 - (j) Rating.

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

- (j) Further the QR code as per the technical details as per Annexure - P shall be provided on transformer tank below name plate.

17.0 Fittings:

- (a) 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	Pulling lugs	2 nos.
5	Drain valve - 32mm for all T/Fs (It shall be covered with metallic box spot welded to tank) IS 554	1 No.
6	Silica gel breather 250gms	1No.
7	Oil filling hole with cap (On Conservator)	1No.
8	Conservator with drain plug	1No.
9	The pipe connecting the conservator to the main tank	1No.
10	Thermometer pocket with cap	1No.
11	Oil filling hole with cap on top cover	1No.
12	Pressure release device	1No.
13	On transformer side tank wall Oil level gauge indicating oil level at minimum, 30°C and maximum operating temperature; or on conservator with 3 position Minimum (-) 5 deg.C. Normal 30 deg.C, Maximum 98 deg.C.	1No.

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14	HT & LT bushing and terminal connectors	3 nos. of HT bushing and 4 nos. of LT bushing shall be provided with brass terminal rods with 3 nos. of brass nuts and 2 plain brass washers.
15	Lightening Arrestors for HT bushings	3 Nos.
16	2 year guarantee plate	1 No.
17	Anti-theft stainless steel fasteners with breakaway nut at top cover	4Nos.

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

(b) 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.

18.0 Lightning Arrestors:

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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 & 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.

19.0 Transformer Oil

The unused mineral insulating oil (type II) for transformers as per IS 335/2018 (fifth revision) amended upto date to be used in all Distribution transformers. The Type test certificates of oil being used shall be produced to inspecting officer at the time of Final inspection at factory premises.

20.0 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.

20.1 Routine Tests

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

20.2 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)].

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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 5)].

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.

20.3 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.

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

20.5 Special Tests

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.

20.6 Pressure and Oil leakage Test

20.6.1 Pressure Test (Type Test)

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

20.6.2 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.

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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.

20.6.3 Oil leakage Test (routine Test):

The assembled transformer for sealed / non- 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.

21.0 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 conformed. No positive tolerances in losses are permitted. If the product is not conformed the manufacturer would pay the challenge fee and challenger would get the fee refunded. However as a redressal system the challenger would be allow 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 conform 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 be allowed to compete in tenders of the MSEDCL for the period of three years and heavy penalty would be imposed.

22.0 Offer Qualification for Type Test:-

22.1 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

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- 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.*

22.2 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.

23.0 Drawings & Calculation sheet:

23.1 Following drawings shall be uploaded by the bidder duly sealed & signed if bidder does not agree to supply the transformers as per MSEDCL standard drawing as given in standard GTP attached with this specification:

- 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 drawing of HV& LV Bushing
- vii. Silica gel breather drawings
- viii. BEE certification
- ix. Calculation sheet for flux density and total losses at 50% and 100% loading
- x. Heat dissipation calculations
- x. Oil absorption calculations

23.2 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.

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

23.4 The successful Bidders shall submit complete set of legible and clear drawings (as listed in Cl.No.23.1) of the transformer before offering factory inspection of the transformers.

24.0 Rejection:

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24.1 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 losses 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.

25.0 Cleaning and Painting.

- (i) The external surface of transformers shall be painted with one coat of Epoxy primer (30 micron) and two coats of Polyurethane (finish coat) Liquid paint (each 25 micron) and inside surface of the tank hot oil resistant paint/ varnish with one coat (35/10 micron) 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 two places one at conservator and other at sum conspicuous place on the transformer which shall be clearly visible from the ground.

26.0 Standard Guaranteed & Technical Particulars:

The specific requirement of MSEDCL is given in GTP attached with this specification, the bidder if agrees to all technical parameters given as listed in GTP the statement such as “as per MSEDCL’s requirement” shall be considered and if he wants to offer deviations to specific requirement they can offer their technical parameters in column given in GTP. The GTP should be filled otherwise offer shall be liable for rejection.

27.0 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.

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28.0 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 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.

29.0 Modified Inspection and Testing procedure for HVDS Transformers:

The supplier shall normally offer at a time, the entire quantity required to be delivered every month as per the delivery schedule of purchase order for the purpose of inspection by the Purchaser.

However, MSEDCL may permit the bidders from Maharashtra to offer the material in part quantity for inspection against the monthly committed lot. Daily visit of all Maharashtra manufacturers shall be carried out by the Executive Engineer (O&M) Dn. / Executive Engineer, Testing Division / Executive Engineer (Adm.) of O&M Circle office for the manufacturers in their jurisdiction & inform the same to this office on email eehohvds@gmail.com to confirm the readiness of material for inspection. The successful bidders shall grant free access to purchaser's representative at a reasonable time when the work is in progress. It is also the responsibility of the supplier to inform the daily progress of manufacture / material made ready on eehohvds@gmail.com. After receipt of confirmation as well as the intimation from the supplier in the prescribed proforma on eehohvds@gmail.com indicating quantity ready for inspection, the material may be inspected immediately by the Executive Engineer or the representative authorized by the Purchaser before dispatch as per the inspection procedure mentioned in technical specifications.

The supplier outside Maharashtra may offer 50% of the monthly lot quantity for inspection.

The payment of part quantity inspected & supplied shall be made irrespective of the monthly lot.

If in any month supplier could not supply 100% quantity committed for the month, he must supply minimum 50% of the committed quantity in the particular month & balance 50% quantity in the next immediate month along with 100% quantity committed in the next month. This facility shall not exceed two times in the entire contractual delivery period.

Materials shall be inspected by the Purchaser's Executive Engineer / or the representative authorized by the Purchaser before dispatch. Intimation in the prescribed proforma about the date on which materials shall be ready for inspection, indicating quantity, shall have to be given in advance, failing which, the supplier shall be responsible for delay in delivery on account of inspection.

On receipt of such intimation, the materials shall be inspected immediately within 2 working days as per the procedure given below.

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Procedure for Inspection:

(A) Stage Inspection: Cancelled.

(B) Inspection at Factory Premises

- (i) The manufacturer will give inspection call for a lot / part of lot for inspection in prescribed proforma along with the serial numbers of distribution transformers.
- (ii) The Executive Director (Infra) will depute one Inspecting Officer for inspection of offered lot / part of lot.
- (iii) The MM Cell shall also communicate the inspection call to the Inspecting Officer through ERP.
- (iv) All offered lot / part of lot shall be tested for total losses at 50% & 100% loading.
- (v) If any of the transformers exceed the limits of total losses at 50% & 100% loading, then the transformers exceeding the limits of total losses from the lot / part of lot offered will be rejected & the remaining transformers will be considered for further tests.
- (vi) 10% of the transformers passed in total losses at 50% & 100% loading will be considered & tested for routine tests, viz.
 - (a) Measurement of winding resistance,
 - (b) Measurement of voltage ratio and check of phase displacement
 - (c) Measurement of short circuit impedance
 - (d) Measurement of no load loss & current
 - (e) Measurement of insulation resistance
 - (f) Induced over-voltage withstand test
 - (g) Separate source voltage withstand test
 - (h) Pressure test
 - (i) Oil Leakage test
- (vii) In case the selected transformers fail in any of the routing tests, complete lot / part of lot offered for inspection will be rejected & the supplier shall reoffer the lot / part of lot for inspection.
- (viii) If the transformers pass in routine tests, the Random Sample Testing (RST) will be carried out by opening one transformer selected by the Inspector from the balance 90% quantity passed in total losses at 50% & 100% loading. All design technical parameters shall be checked as per GTP, approved drawings and technical specifications.
- (ix) In case the selected transformer fails in Random Sample Testing (RST), complete lot / part of lot offered for inspection will be rejected & the supplier shall reoffer the lot / part of lot for inspection.

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(x) If the selected transformer passes in Random Sample Testing (RST), the Inspector will seal all the transformers and give clearance for dispatch to consignee stores as per delivery instructions issued by MM Cell.

(xi) The inspection report shall be fed online through ERP by the Inspector from factory premises only.

(xii) This inspection procedure shall also be applicable for the transformers earlier procured for HVDS vide various tenders.

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.

The materials shall be dispatched after inspection and approval of the same by the Inspector. The inspection approval letter shall be valid for a period of 30 days from the date of issue of letter to enable the supplier pack the material and arrange transportation thereof so that material should be reached at the respective consignee stores within scheduled delivery period.

After the period of 30 days, the validity of this inspection approval letter will lapse. If the material is not reached within scheduled delivery period to respective consignees, the approval of purchaser is to be sought by the supplier for revalidation of inspection approval letter at the sole discretion of MSEDCL.

30.0 Inspection & Testing of Transformer Oil:

The tenderer shall make arrangements for testing of transformer oil as per IS 335/2018 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.

31.0 Quality Assurance

31.1 The bidder shall invariably furnish following information along with the offer failing to which the offer will be rejected.

31.2 Certificates of following materials shall be submitted as per relevant standards indicated in Clause No.9.1 of IS 1180(Part1):2014.

- i. Aluminum conductor
- ii. Transformer oil
- iii. CRGO Core / Amorphous core
- iv. Insulating / Kraft paper.
- v. Porcelain Bushings
- vi. Steel Plate used for Tank, press board.

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- 31.3 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.
- 31.4 Information and copies of test certificate as in (cl.no.33) above respect of bought out accessories including terminal connectors.
- 31.5 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.
- 31.6 Level of automation achieved and list of areas where manual processing still exists.
- 31.7 List of areas in manufacturing process where stage inspection are normally carried out for quality control and details of such tests and inspections.
- 31.8 Special features provided in the equipments to make it maintenance free
- 31.9 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.
- 31.10 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, aluminium for conductors, insulating materials, Core materials, Bushing at the time of routine Testing of the fully assembled transformer.

32.0 Performance Guarantee:

All transformers supplied against this specification shall be guaranteed for a period of 24 months from the date of receipt of material at concern stores / consignee. 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.

33.0 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.

10 KVA, 11 KV / 22 KV				
Particulars	Unit	Rate	Qty.	Amount (Rs.)
CRGO core (M4 or better)/Amorphous core	Kg			
Aluminium with super enameled of thermal	Kg			

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grade of 220 degree C for HV winding				
Aluminium with DPC for LV winding	Kg			
Insulation paper	Meter			
Oil	Litre			
Tank	No.			
Channels	Kg			
Insulators/Bushings	No.			
Others	Lumpsum			
Wastage @ %				

34.0 Schedules:

34.1 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.

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- 34.2 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.
- 34.3 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.

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Schedule `A`

STANDARD GUARANTEED TECHNICAL PARTICULARS

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

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

NAME OF FIRM _____

NAME & SIGNATURE OF TENDERER _____

DESIGNATION _____

DATE _____

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

Annexure I

Air Pressure Test

Name of Supplier:

Order No.:

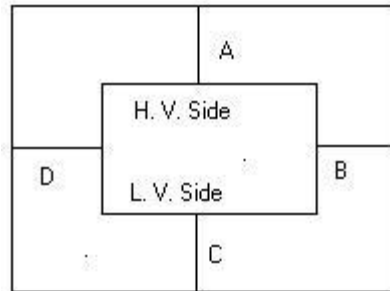
Capacity & Voltage Ratio of Distribution Transformer: ____ kVA, ____/0.433 kV
Vector Group Dyn11

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 ² 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

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

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

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

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

$\frac{\text{Hot Resistance} \times (225 + \text{Cold Ambient Temperature})}{\text{Cold Resistance}} - (225 + \text{Hot Ambient Temperature})$

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/cm² and maintained for 8 hours. No leakage should occur.

Test witnessed by _____

Tested by _____

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE

Standard GTP

10 KVA, 11/0.433 KV Distribution Transformers (Level-2) - Sealed/Non sealed Type

Sr. No.	Guaranteed Technical Particular	MSEDCL Requirement	Whether agree with specific requirement of MSEDCL (Yes/No)	If No, please specify value
1	Name of Manufacturer			
2	Reference Standard	IS : 1180 (Part -1) 2014 Updated		
3	Whether transformer is Oil Natural Air Natural cooled type (Yes/No)	Yes		
4	Whether transformer is suitable for Indoor /Outdoor installation	Outdoor		
5	Rating of Transformers in KVA	10		
6	Primary Voltage in KV	11		
7	Secondary Voltage in KV	0.433		
8	Whether neutral is solidly earthed (Yes/No)	Yes		
9	Colour of transformer	Aircraft Blue (Shade No. 108)		
10	Vector Group	Dyn11		
11	Approximate overall length of transformer in mm	915		
12	Approximate overall breadth of transformer in mm	585		
13	Approximate overall height of transformer in mm	1075		
14	Approximate length of transformer tank in mm	715		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE

15	Approximate breadth of transformer tank in mm	275		
16	Approximate height of transformer tank in mm	695		
17	Thickness of the side of transformer Tank plate in mm	3.15		
18	Thickness of the bottom of transformer tank plate in mm	5.0		
19	Thickness of the top of transformer tank plate in mm	5.0		
20	Weight of Tank & fittings in kgs	78		
21	Total Weight of Transformer in kgs	252		
22	Type of Tank (corrugated/conventional)	Conventional		
23	Degree of slope to the top plate of transformer	5 ° to 10 ° towards HV Side		
24	In case of Corrugated tank, Thickness of corrugated sheet (in mm)	N.A.		
25	Name plate details are as per the requirement specified in tender. (Yes/No)	Yes		
26	Total radiating Surface of Tank & radiators in Sq. Mtrs.	Radiator - NA & Tank -1.376		
27	Core material used & its grade	CRGO, M4 / Amorphous		
28	Type of core	Stacked / Wound		
29	Weight of Core in kgs	53.0		
30	No. of steps of core for CRGO core	6		
	No. of steps of core for Amorphous			

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

	core			
31	Diameter of core in mm	68.5		
32	Effective core area.(sq.cm)	32.33		
33	Flux density in Tesla for CRGO core	1.69 Tesla Maximum		
	Flux density in Tesla for Amorphous core	1.38 Tesla Maximum		
34	Thickness of CRGO core lamination in mm	0.27		
	Thickness of Amorphous core lamination in mm			
35	The temperature shall in no case reach a value that will damage the core itself, other parts or adjacent materials (Yes/No)	Yes		
36	Type of connection for H.V. Winding (Delta) (Yes/No)	Delta		
37	Type of connection for L.V. Winding (Star) (Yes/No)	Star		
38	Material of H.V winding	Aluminium		
39	Material of L.V.Winding	Aluminium		
40	Insulation provided to H.V winding.	DPC		
41	Insulation provided to L.V. winding.	DPC		
42	Current density of H.V. winding (in Ampere/ sq.mm)	1.3 A/sq. mm (MAX)		
43	No. of LV Winding Turns	248		
44	No. of HV Winding Turns	10912		
45	Resistance of LV winding per phase at 20°C in Ohms	0.11		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

46	Resistance of HV winding per phase at 20°C in Ohms	312		
47	Current density of L.V. winding (in Ampere/ sq.mm)	1.3 A/sq. mm (MAX)		
48	Clearance between Core & L.V. winding in mm	3.5		
49	Clearances between L.V. & H.V. winding in mm	11.0		
50	Clearances between HV Phase to Phase in mm	10.0		
51	Clearances between end insulation to Earth in mm	25.0		
52	Clearances between winding to tank in mm (min 30 mm)(Yes/No)	Yes-30 mm		
53	Weight of Aluminium in kg.	40		
54	Inter layer insulation provided in H.V winding to design for Top & bottom layer	Electrical grade insulating Kraft paper, Thk-2 Mill		
55	Inter layer insulation provided in L.V winding to design for Top & bottom layer	Electrical grade insulating Kraft paper, Thk-2 Mill		
56	Inter layer insulation provided in between all layer in H.V winding	Electrical grade insulating Kraft paper, Thk-2 Mill		
57	Inter layer insulation provided in between all layer in L.V winding	Electrical grade insulating Kraft paper, Thk-2 Mill		
58	Details of end insulation	Press Board Blocks & Sheet		
59	Whether wedges are Provided at 50% turns of the Coil (Yes/No)	No		
60	Insulation materials provided for	Hot Oil Proof		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

	core	Insulation Carlite		
61	Length of coil used for HV winding in meter.	5873		
62	Cross Section area of coil used in HV winding in sq mm	0.515 (0.81 dia. mm)		
63	Length of coil used for LV winding in meter.	71.5		
64	Size of strip used for LV winding in mm	5.5 x 3.5		
65	No. of conductors in parallel for LV winding	one		
66	Total cross section area of LV conductor in sq. mm	18.39		
67	No. of H.V coils /phase	4		
68	Thickness of locking spacers between H.V. coils (in mm)	6		
69	Weight of Oil in kgs	62		
70	Volume of Oil in Ltrs (A)	75		
71	Quantity of total oil absorption (in liters) in first filling (indicate oil absorption quantity only (B)	2.3		
72	Total oil volume including Total Oil absorption in Ltrs(A+B)	77		
73	Grade of Oil used.	Mineral oil confirming to IS - 335 amended upto date		
74	Name of Oil manufactures to be supplied.			
75	Breakdown Values of Oil at the time of first filling (kV/mm) considering 2.5 mm gap	60 kV for Filtered & 30 kV for Unfiltered Oil		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE

76	Oil level indicator showing three levels on tank	Yes, minimum -5deg, normal 30deg and maximum 98deg		
77	Drain Valve (32 mm) provided to the transformer tank (Yes/No)	32		
78	Earthing terminals with lugs is provided (Yes/No)	Yes		
79	Lifting lugs provided (Yes/No)	Yes, 8mm Thick 02 Nos.		
80	Thermometer pocket is provided (Yes/No)	Yes		
81	Material of HV and LV Bushings and makes thereof	Porcelain, Make -		
82	Reference standard of Bushings	IS : 3347 Updated		
83	Rating of LV Bushing	1 kV / 250 Amp.		
84	Minimum Creepage Distance of HV Bushing in mm (min.25 mm per kV)	305 mm		
85	Minimum Creepage Distance of LV Bushing in mm (min.25 mm per kV)	65 mm		
86	Rating of H.V. Bushings (in kV, Amp)	12 kV / 250 Amp.		
87	Rating of L.V. Bushing (in kV, Amp)	1.0 kV / 250 Amp.		
88	Min. External clearances of H.V. bushing terminals between ph. to ph (255 mm)	255		
89	Min. External clearances of H.V. bushing terminals between ph. to earth (140 mm)	140		
90	Min. External clearances of L.V. bushing terminals between ph. to ph (75 mm)	75		
91	Min. External clearances of L.V.	40		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

	bushing terminals between ph. to earth (40 mm)			
92	Rating of Lightning Arrestor and make thereof	9 kVrms, 5kA , Make -		
93	Reference standard of Lightning Arrestor	IS : 3070 / 1974 Updated		
94	Maximum winding temperature rise in °C over an Ambient temp. of 50°C by Resistance Method	40 Degree C		
95	Maximum temperature rise of Oil in °C over an Ambient temp. of 50°C by thermometer.	35 Degree C		
96	Magnetizing current (No load) in Amps and its % of full load current at rated voltage referred to LV Side	3% of Full Load Current, 0.40 Amps		
97	Magnetizing current (No load) in Amps and its % of full load current at maximum voltage (112.5% of rated voltage)referred to LV side	6% of Full Load Current, 0.80 Amps		
98	Maximum Core Loss at rated voltage & rated frequency	38		
99	Maximum Total Losses (No Load + Load Losses at 75°C) at 50% loading (Watts)	84		
100	Maximum Total Losses (No Load + Load Losses at 75°C) at 100% loading (Watts)	240		
101	Efficiency at 75 °C at unity P.F. at 125% load	97.17		
102	Efficiency at 75 °C at unity P.F. at 100% load	97.60		
103	Efficiency at 75 °C at unity P.F. at 75 % load	97.98		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

104	Efficiency at 75 °C at unity P.F. at 50% load	98.32		
105	Efficiency at 75 °C at unity P.F. at 25% load	97.98		
106	Efficiency at 75 °C at 0.8 P.F. lag at 125% load	96.46		
107	Efficiency at 75 °C at 0.8 P.F. lag at 100 % load	97.00		
108	Efficiency at 75 °C at 0.8 P.F. lag at 75 % load	97.47		
109	Efficiency at 75 °C at 0.8 P.F. lag at 50 % load	97.90		
110	Efficiency at 75 °C at 0.8 P.F. lag at 25% load	97.47		
111	Efficiency at 75 °C at 0.8 P.F. leading at 125% load	96.46		
112	Efficiency at 75 °C at 0.8 P.F. leading at 100% load	97.00		
113	Efficiency at 75 °C at 0.8 P.F. leading at 75% load	97.47		
114	Efficiency at 75 °C at 0.8 P.F. leading at 50%load	97.90		
115	Efficiency at 75°C at 0.8 P.F. leading at 25 % load	97.47		
116	Regulation at Unity P.F (in %)	0.303		
117	Regulation at 0.8 P.F. lag. (in %)	2.9193		
118	Regulation at 0.8 P.F. leading. (in %)	2.9193		
119	% Impedance value at 75°C	4.5% Tolerance +/- 10%		
120	Separate source power frequency	28 kVrms		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

	withstand test for HV for 1 minute in kv(min)			
121	Separate source power frequency withstand test for LV for 1 minute in kv(min)	3 kVrms		
122	Induced over voltage withstand test for 1 min. specify voltage frequency, time for test.	866 Volt, 100 Hz. For one minute		
123	Impulse test value (in kVp) .	75 kVp, 1.2/50 micro-second		
124	Test certificate of Aluminium conductor, Core, Insulating paper porcelain bushing, steel plate used for enclosure of offer transformer is enclosed along with the offer in soft copy (Yes/No)	Yes		
125	All type test report type test carried out on transformer at NABL laboratory shall be submitted along with the offer in soft copy (Yes/No)	Yes		
126	Air pressure test and temperature rise test shall be conducted as per format enclosed with the technical specification along the offer (Yes/No)	Yes		
127	All Drawings shall be furnished with each offered item separately along with the offer(Yes/No)	Yes		
128	Oil absorption Calculation sheet shall be furnished with for each offered item separately along with the offer(Yes/No)	Yes		
129	Heat Dissipation Calculation sheet shall be furnished with for each offered item separately along with the offer(Yes/No)	Yes		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

130	Flux Density calculation sheet shall be furnished with for each offered item separately along with the offer(Yes/No)	Yes		
131	Calculation sheet for 112.5% of rated v/f ratio (Over fluxing calculation sheet) offered shall be furnished with for each item separately along with the offer(Yes/No)	Yes		
132	Required documents, plant & machinery list of order executed/ under execution sheet shall be furnished for each offered item separately along with the offer(Yes/No)	Yes		
133	The information required under quality assurance shall be submitted with the offer in physical format & soft copy (Yes/No)	Yes		
134	The cost data in the prescribed format shall be submitted with the offer in physical format & soft copy (Yes/No)	Yes		
135	The performance guarantee of the transformers in years	24 Months from the Date of Receipt of Material		
136	Power frequency withstand voltage dry & wet in KV (rms) for HV Bushing	28 kVrms for one minute		
137	Dry lightning impulse withstand voltage in KV(peak) stating the waveform adopted for hv bushing	75 kVP, 1.2/50 micro-second		

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE

Standard GTP

10 KVA, 22/0.433 KV Distribution Transformers (Level-2) - Sealed/Non sealed Type

Sr. No.	Guaranteed Technical Particular	Offered Parameters
1	Name of Manufacturer	
2	Reference Standard	
3	Whether transformer is Oil Natural Air Natural cooled type (Yes/No)	
4	Whether transformer is suitable for Indoor /Outdoor installation	
5	Rating of Transformers in KVA	
6	Primary Voltage in KV	
7	Secondary Voltage in KV	
8	Whether neutral is solidly earthed (Yes/No)	
9	Colour of transformer	
10	Vector Group	
11	Approximate overall length of transformer in mm	
12	Approximate overall breadth of transformer in mm	
13	Approximate overall height of transformer in mm	
14	Approximate length of transformer tank in mm	
15	Approximate breadth of transformer tank in mm	
16	Approximate height of transformer tank in mm	
17	Thickness of the side of transformer Tank plate in mm	
18	Thickness of the bottom of transformer tank plate in mm	
19	Thickness of the top of transformer tank plate in mm	

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE

20	Weight of Tank & fittings in kgs	
21	Total Weight of Transformer in kgs	
22	Type of Tank (corrugated/conventional)	
23	Degree of slope to the top plate of transformer	
24	In case of Corrugated tank, Thickness of corrugated sheet (in mm)	
25	Name plate details are as per the requirement specified in tender. (Yes/No)	
26	Total radiating Surface of Tank & radiators in Sq.Mtrs.	
27	Core material used & its grade	
28	Type of core	
29	Weight of Core in kgs	
30	No. of steps of core for CRGO core	
	No. of steps of core for Amorphous core	
31	Diameter of core in mm	
32	Effective core area.(sq.cm)	
33	Flux density in Tesla	
34	Thickness of core lamination in mm	
35	The temperature shall in no case reach a value that will damage the core itself, other parts or adjacent materials (Yes/No)	
36	Type of connection for H.V. Winding (Delta) (Yes/No)	
37	Type of connection for L.V. Winding (Star) (Yes/No)	
38	Material of H.V winding	
39	Material of L.V.Winding	

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

40	Insulation provided to H.V winding.	
41	Insulation provided to L.V. winding.	
42	Current density of H.V. winding (in Ampere/ sq.mm)	
43	No. of LV Winding Turns	
44	No. of HV Winding Turns	
45	Resistance of LV winding per phase at 20°C in Ohms	
46	Resistance of HV winding per phase at 20°C in Ohms	
47	Current density of L.V. winding (in Ampere/ sq.mm)	
48	Clearance between Core & L.V. winding in mm	
49	Clearances between L.V. & H.V. winding in mm	
50	Clearances between HV Phase to Phase in mm	
51	Clearances between end insulation to Earth in mm	
52	Clearances between winding to tank in mm (min 30 mm)(Yes/No)	
53	Weight of Aluminium in kg.	
54	Inter layer insulation provided in H.V winding to design for Top & bottom layer	
55	Inter layer insulation provided in L.V winding to design for Top & bottom layer	
56	Inter layer insulation provided in between all layer in H.V winding	
57	Inter layer insulation provided in between all layer in L.V winding	
58	Details of end insulation	
59	Whether wedges are Provided at 50% turns of the Coil (Yes/No)	

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE

60	Insulation materials provided for core	
61	Length of coil used for HV winding in meter.	
62	Cross Section area of coil used in HV winding in sq mm	
63	Length of coil used for LV winding in meter.	
64	Size of strip used for LV winding in mm	
65	No. of conductors in parallel for LV winding	
66	Total cross section area of LV conductor in sq. mm	
67	No. of H.V coils /phase	
68	Thickness of locking spacers between H.V. coils (in mm)	
69	Weight of Oil in kgs	
70	Volume of Oil in Ltrs (A)	
71	Quantity of total oil absorption (in liters) in first filling (indicate oil absorption quantity only (B)	
72	Total oil volume including Total Oil absorption in Ltrs.(A+B)	
73	Grade of Oil used.	
74	Name of Oil manufactures to be supplied.	
75	Breakdown Values of Oil at the time of first filling (kV/mm) considering 2.5 mm gap	
76	Oil level indicator showing three levels on tank	
77	Drain Valve (32 mm) provided to the transformer tank (Yes/No)	
78	Earthing terminals with lugs is provided (Yes/No)	
79	Lifting lugs provided (Yes/No)	
80	Thermometer pocket is provided (Yes/No)	

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

81	Material of HV and LV Bushings and makes thereof	
82	Reference standard of Bushings	
83	Rating of LV Bushing	
84	Minimum Creepage Distance of HV Bushing in mm (min.25 mm per kV)	
85	Minimum Creepage Distance of LV Bushing in mm (min.25 mm per kV)	
86	Rating of H.V. Bushings (in kV, Amp)	
87	Rating of L.V. Bushing (in kV, Amp)	
88	Min. External clearances of H.V. bushing terminals between ph. to ph (255 mm)	
89	Min. External clearances of H.V. bushing terminals between ph. to earth (140 mm)	
90	Min. External clearances of L.V. bushing terminals between ph. to ph (75 mm)	
91	Min. External clearances of L.V. bushing terminals between ph. to earth (40 mm)	
92	Rating of Lightning Arrestor and make thereof	
93	Reference standard of Lightning Arrestor	
94	Maximum winding temperature rise in °C over an Ambient temp. of 50°C by Resistance Method	
95	Maximum temperature rise of Oil in °C over an Ambient temp. of 50°C by thermometer.	
96	Magnetizing current (No load) in Amps and its % of full load current at rated voltage referred to LV Side	
97	Magnetizing current (No load) in Amps and its % of full load current at maximum voltage (112.5% of rated voltage)referred to LV side.	
98	Maximum Core Loss at rated voltage & rated frequency	

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

99	Maximum Total Losses (No Load + Load Losses at 75°C) at 50% loading (Watts)	
100	Maximum Total Losses (No Load + Load Losses at 75°C) at 100% loading (Watts)	
101	Efficiency at 75 °C at unity P.F. at 125% load	
102	Efficiency at 75 °C at unity P.F. at 100% load	
103	Efficiency at 75 °C at unity P.F. at 75 % load	
104	Efficiency at 75 °C at unity P.F. at 50% load	
105	Efficiency at 75 °C at unity P.F. at 25% load	
106	Efficiency at 75 °C at 0.8 P.F. lag at 125% load	
107	Efficiency at 75 °C at 0.8 P.F. lag at 100 % load	
108	Efficiency at 75 °C at 0.8 P.F. lag at 75 % load	
109	Efficiency at 75 °C at 0.8 P.F. lag at 50 % load	
110	Efficiency at 75 °C at 0.8 P.F. lag at 25% load	
111	Efficiency at 75 °C at 0.8 P.F. leading at 125% load	
112	Efficiency at 75 °C at 0.8 P.F. leading at 100% load	
113	Efficiency at 75 °C at 0.8 P.F. leading at 75% load	
114	Efficiency at 75 °C at 0.8 P.F. leading at 50%load	
115	Efficiency at 75°C at 0.8 P.F. leading at 25 % load	
116	Regulation at Unity P.F (in %)	
117	Regulation at 0.8 P.F. lag. (in %)	
118	Regulation at 0.8 P.F. leading. (in %)	
119	% Impedance value at 75°C	

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSED WITHOUT CSP FEATURE

120	Separate source power frequency withstand test for HV for 1 minute in kv(min)	
121	Separate source power frequency withstand test for LV for 1 minute in kv(min)	
122	Induced over voltage withstand test for 1 min. specify voltage frequency, time for test.	
123	Impulse test value (in kVp) .	
124	Test certificate of Aluminium conductor, Core, Insulating paper porcelain bushing, steel plate used for enclosure of offer transformer is enclosed along with the offer in soft copy (Yes/No)	
125	All type test report type test carried out on transformer at NABL laboratory shall be submitted along with the offer in soft copy (Yes/No)	
126	Air pressure test and temperature rise test shall be conducted as per format enclosed with the technical specification along the offer (Yes/No)	
127	All Drawings shall be furnished with each offered item separately along with the offer(Yes/No)	
128	Oil absorption Calculation sheet shall be furnished with for each offered item separately along with the offer(Yes/No)	
129	Heat Dissipation Calculation sheet shall be furnished with for each offered item separately along with the offer(Yes/No)	
130	Flux Density calculation sheet shall be furnished with for each offered item separately along with the offer(Yes/No)	
131	Calculation sheet for 112.5% of rated v/f ratio (Over fluxing calculation sheet) offered shall be furnished with for each item separately along with the offer(Yes/No)	

TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE OIL IMMERSSED WITHOUT CSP FEATURE

132	Required documents, plant & machinery list of order executed/ under execution sheet shall be furnished for each offered item separately along with the offer(Yes/No)	
133	The information required under quality assurance shall be submitted with the offer in physical format & soft copy (Yes/No)	
134	The cost data in the prescribed format shall be submitted with the offer in physical format & soft copy (Yes/No)	
135	The performance guarantee of the transformers in years	
136	Power frequency withstand voltage dry & wet in KV (rms) for HV Bushing	
137	Dry lightning impulse withstand voltage in KV(peak) stating the waveform adopted for hv bushing	

**TECHNICAL SPECIFICATION OF 10 KVA, 11/0.433 kV & 22/0.433 kV LEVEL-2 THREE
PHASE, SEALED/NON SEALED TYPE DISTRIBUTION TRANSFORMERS OUTDOOR TYPE
OIL IMMERSSED WITHOUT CSP FEATURE**

Drawing - D-1