

MATERIAL SPECIFICATIONS CELL

TECHNICAL SPECIFICATION

25 KVA 11 & 22 KV SINGLE PHASE
OUTDOOR TYPE DISTRIBUTION TRANSFORMER
WITH CSP FEATURE.



TECHNICAL SPECIFICATION NO.

CE/MMC/MSC-I/SP/DT/T/2017/04,

Date: 15/04/2017

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**TECHNICAL SPECIFICATION OF 25 KVA 11 & 22 KV SINGLE PHASE OUTDOOR TYPE
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1.00 Scope

- 1.01 This specification covers design, manufacturing, testing and delivery of the Oil Natural Air Natural (ONAN) with Completely Self Protected feature, outdoor type, level 1, level 2, level 3, Single phase, 25 kVA, $11/\sqrt{3}/0.25\text{kV}$ & $22/\sqrt{3}/0.25\text{ kV}$, 50 Hz, Distribution Transformers.
- 1.02 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.
- 1.03 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.
- 1.04 The design and constructional aspects of materials shall not withstanding any anomalies, discrepancies, omissions, incompleteness, 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, Electricity Act 2003 and other statutory provisions.
- 1.05 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.
- 1.06 Tolerances:
Tolerances on all the dimensions shall be in accordance with provisions made in the relevant Indian/International standards and in these specifications. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

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2.00 Service conditions:

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

Max. ambient air temperature	:	50Deg. C
Max. relative humidity	:	100 %
Max. annual rainfall	:	1450 mm
Max. wind pressure	:	150 kg/sq.m
Max. altitude above mean sea level	:	1000 mtrs.
Isoceraunic level (days /year)	:	50
Seismic level (Horizontal acceleration	:	0.3 g.

Reference Ambient Temperature for temperature rise : 50 Deg C

Climatic Condition Moderately hot and humid tropical climate conducive to rust and fungus growth.

2.02 The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

2.03 The equipment shall be for use in moderately hot and humid tropical climate conducive to rust and fungus growth.

2.04 The Distribution Transformer shall be marked with the Standard Mark (ISI mark) [clause no. 13.4 of IS 1180(Part 1):2014] .

2.05 The Single Phase Distribution Transformer shall bear level 1, level 2, level 3, rating label approved by BIS.

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

3.00 Applicable standards:-

3.01 The design, manufacture and performance of the equipment 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.

3.02 The Distribution Transformers shall conform to IS: 1180 (Part 1) : 2014 amended up to date as 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.

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3.03 Unless otherwise specified, the equipment offered shall conform to amended up to date Indian, IEC, British or U.S.A. Standards and in particular, to the following:-

3.04 The applicable standards are as follows :

Sr.No.	IS number	IS name
1.	IS:1180(Part-1) : 2014	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: 8623/1993 amended upto date	Specification for Low -Voltage Switchgear and control gear assemblies.
8.	IS: 3073/1974, IS: 3070(Part-II)	Specifications for L.A's
9.	CBIP Publication No.295:2006	Manual on transformers
10.	I.S. 13947/I/1993	Specification for low voltage switchgear & control gear
11.	IS 2026,Part-7	Guide for loading of oil immersed transformer.

3.05 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.

4.00 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

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- | | | |
|------|--|---|
| 4.01 | Nominal System Voltage (HV) | : 11 KV or 22 KV |
| 4.02 | Rated Voltage (HV) | : 11 / $\sqrt{3}$ kV or 22 / $\sqrt{3}$ kV |
| 4.03 | Rated Voltage (LV) | : 250 V |
| 4.04 | Rated Current (HV) | : 3.94 Amp (for 11 KV)
: 1.97 Amp (for 22 KV) |
| 4.05 | Corresponding Highest System Voltage | : 12/ $\sqrt{3}$ kV or 24/ $\sqrt{3}$ kV |
| 4.06 | Neutral earthing | : Solidly earthed at both
HV & LV |
| 4.07 | Frequency | : 50 Hz with ± 3 % tolerance |
| 4.08 | Number of Phase | : 1 |
| 4.09 | Type of cooling | : ONAN. |
| 4.10 | 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 I):2014. | |
| 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 I):2014. | |

Bids not conforming to the above limits of temperature rise will be treated as non-responsive.

4.11 No load voltage ratio:-

The no load voltage ratio shall be 11 / $\sqrt{3}$ KV / 250 Volts or 22 / $\sqrt{3}$ KV / 250 Volts.

4.12 Flux density:-

Flux density should not be more than 1.55 Tesla at the rated voltage and frequency. The value of the flux density allowed in the design shall be clearly stated in the offer along with graph.

Transformer core should be designed in such a way that it will not get saturated for any value of V/f (Voltage/frequency) ratio to the extent of 112.5% of rated value of V/f ratio (i.e. 11000/ $\sqrt{3}$ /50 & 22000/ $\sqrt{3}$ /50) (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions. Actual core design along with calculations in support of it should be enclosed with the offer.

- i) The no load current 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 percent maximum of full load current.

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25kVARating	At Rated Voltage	At 112.5 % Rated Voltage
	3 % of the full load current in LT winding	6 % of the full load current

Number of steps of core shall be minimum of

	Stack core	Wound core CRGO
For 25 kVA	5 standard steps	One step

Only those bidders who directly imported CRGO either from the manufacturer or through their accredited marketing organization of repute (and not through any agent) shall be considered. In support of this requirement the bidder should give an undertaking in the form of affidavit on Rs.100 stamp paper, duly notarized, in the specified format.

Test reports for specific loss, chemical analysis, surface insulation resistance have to be submitted during stage inspection.

4.13 Losses:

The total losses at 50% & 100% loading for level 1, level 2, level 3, single phase, 25 kVA, $11/\sqrt{3}$ /0.250 kV and $22/\sqrt{3}$ / 0.250 kV transformers at rated voltage, frequency and at 75°C shall not exceed the values indicated as below:

TABLE - 1

Maximum total losses of Single Phase Transformer in watts up to 11 kV Class							
Rating (kVA)	Impedance (Percent)	Level 1		Level 2		Level 3	
		50 % Load	100 % Load	50 % Load	100 % Load	50 % Load	100 % Load
25	4.0	125	340	110	300	95	260
Maximum total losses of Single Phase Transformer in watts up to 22 kV Class							
25	4.0	134	365	118	322	102	279

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

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

4.14 Insulation material & clearances:

- i) **Materials** – Makes of Electrical grade insulating craft 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 I.S. amended up to date shall be submitted during inspection.
- 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 be minimum 25 mm for 11/ $\sqrt{3}$ kV class and 30 mm for 22/ $\sqrt{3}$ kV class transformers.

Minimum external clearances of bushing terminals

		<u>11 kV</u>	<u>22 kV</u>
HV	Ph to E	140 mm	230 mm
LV	Ph to E	40 mm.	40 mm

4.15 Impedance Value-

The percentage impedance at 75 ° C. shall be 4% for 11/ $\sqrt{3}$ kV class and 22/ $\sqrt{3}$ kV class (Tolerance of $\pm 10\%$ is applicable as per IS 2026, Part -I).

Bids not conforming to the limits indicated above will be treated as non-responsive.

5.00 Design & construction:

5.01 Core

i) **For Stack Core:**

The core shall be stacked core type construction using new and high grade cold rolled grain oriented (CRGO) annealed steel metal core with heat resistant insulating coating, 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. The core shall be properly stress relieved by annealing in

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inert atmosphere. The core material shall not be brittle in case of CRGO material but shall be made of prime grade (M-4 or better) .

ii) **For Wound core :-**

The core shall be 'C' type construction of high grade cold rolled grain oriented (CRGO) annealed steel lamination having low loss and good grain properties, coated hot oil proof insulation material. 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 but shall be made of prime grade (M-4 or better).

5.02 Core clamping for CRGO Wound core type transformers shall be as follows:

- a) Core clamping shall be with top and bottom U- shaped core clamps made of sheet steel clamped
- b) M.S. core clamps shall be painted with varnish or oil-resistant paint.
- c) Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to arrest movement of the active part.

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.

5.03 **Winding.**

HV and LV windings shall be wound from Aluminum/Copper conductors with DPC / Polyesterimide enamel (Class F) for strip conductors as per Part-16 of IS 13730 and modified polyester enamel (Class B) for round conductors as per Part- 45 of IS 13730 insulation. The windings shall be progressively wound in LV, HV coil design for better voltage regulation and mechanical strength. The inner layer insulation shall be of Epoxy dotted paper. The type of winding shall be indicated in the tender whether windings are of conventional type or foil wound. Winding must be done in cleanest possible atmosphere to prevent possible accumulation of dust particles. The coil shall be further processed for dimensional control, improved bonding and for improving short circuit withstand capability.

The current density of the winding shall not be more than 1.2 A/mm² for Aluminum and 2.8 A/mm² for Copper. Test reports for material characteristics like density, tensile strength, and elongation moisture content, ash content, dielectric strength, thickness of resin etc. for epoxy dotted paper shall be submitted during stage inspection.

5.04 **Winding connection & terminal arrangements:**

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For HV live end should be brought out through 12 kV bushing and the other end of HV, which is intended to be earth, shall be brought out in 1kV bushing (HV neutral bushing) provision shall be made for connecting the neutral HV terminal to local earth. The secondary (LV) winding shall be connected to LV bushings. The HV bushing (live) shall be provided on top cover and the LV bushing shall be provided on the sidewall of the tank and below top cover.

5.05 Bushing terminals:

HV terminal connector shall be designed to directly receive ACSR conductor upto 7/2.59 mm (without requiring the use of lug) and the LV terminal connectors shall be suitable for directly receiving LT cables (Aluminum) ranging from 50 Sq.mm to 70 Sq.mm both in vertical and horizontal position and the arrangements should be such as to avoid bimetallic corrosion. Terminal connectors must have type tested as per IS:5561.

- i) Brass rods 12 mm. dia. for HT with necessary nuts, check-nuts and plain thick tinned washer.
- ii) Brass Rods of 12 mm diameter for LT extension with suitable cable lugs, necessary nuts, check-nuts and plain thick tinned washer.

5.06 Bushings & Connections:

- i) For HV 11/ $\sqrt{3}$ kV, class 12 kV bushing and for 22/ $\sqrt{3}$ kV, class 24 kV bushing shall be used; for earth / neutral of HV winding and for LV 1 kV class bushing shall be used. Neutral end of HV winding shall be brought out to Neutral through 1KV bushing. Neutral terminal shall be connected to tank by a tinned copper strip of adequate size. Bushings with plain shade shall be as per relevant IS 1180 Part 1: 2014 amended up to date.
- ii) HV bushings shall be fixed to the top cover of the transformer tank & LV bushings of 1KV class shall be fixed to the side of the transformer tank.
- iii) Bushings having type tested, as per relevant IS (IS 3347) amended up to date shall only be acceptable.
- iv) The minimum Creepage distance for all the bushings shall not be less than 25 mm per kV.
- v) The HV bushings shall have Bird guard (Porcelain or other insulating material).
- vi) The terminal arrangement shall not require a separate oil chamber.

5.07 Tank.

The transformer tank shall be of robust construction cylindrical in shape and shall be built up of tested CRCA/MS sheet of the following thickness.

- i) Side wall thickness : 2.0 mm(min.)

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- ii) Top cover : 2.5 mm(min.)
- iii) Bottom Cover : 2.5 mm(min.)
- i) The construction of the tank should be sealed and oil insulated.
- ii) 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.
- iii) Only one vertical joint will be allowed in round shape tank. In addition the cover of the main tank shall be provided with an air release plug.
- iv) The tank without oil is subjected to an air pressure of 100Kpa above atmosphere for 30 minutes and 760mm of mercury for 30 min in vacuum as per **IS1180 part1:2014**. Permanent deflection should not be more than the limits specified in **IS 1180 part 1:2014**. Pressure test shall be performed carefully at the time of 1st stage inspection only to confirm the adequacy of the tank strength and to be certified by E.E. (IW).
 - The long seam joint and other welds shall be oil tight and no deflection /bulging should occur during service.
 - Manufacturer should carry out the all welding operations as per the relevant ASME standards and submit a copy of the welding procedure qualifications and welder performance qualification certificates to the purchaser.
 - The bottom of the tank should be 25 mm above the transformer bottom and welded with channel.
 - Tank shall have permanent 2 Nos. lugs of 5 mm thickness for lifting the transformer bodily and there shall be facilities for lifting the core coil assembly separately.
 - The transformer tank and the top cover shall be designed in such a manner as to leave no external pockets in which water can lodge.
 - The transformer shall be provided with two mounting lugs suitable for fixing the transformer to a single pole by means of 2 bolts of 20 mm diameter as per IS 1180 Part 1 : 2014
 - Both mounting lugs are made with steel of min. 5 mm thickness.
 - Minimum oil level mark shall be embossed inside the tank.
 - Jump proof lips shall be provided for upper mounting lug.
 - Mounting lugs faces shall be in one plane.
 - The top cover shall be fixed to the tank by proper arrangement to avoid ingress of moisture.
 - Design of top cover shall be such that no water can lodge on the topside.

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- HV bushing pocket shall be embossed to topside of the top cover so as to eliminate ingress of moisture and water.
- The edges of the top cover shall be formed, so as to cover the top end of the tank and gasket.
- Nitrile / neoprene rubber gaskets conforming to latest Type III as per IS 11149 / Type C as per IS 4253 part-II shall be provided between tank and top cover.

- v) The oil volume inside the tank shall be such that even under the extreme operating conditions, the pressure generated inside the tank does not exceed 0.4kg/Sq.cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion.

The tank cover shall have plasticized surface at the top to guard against bird-faults. Alternatively, suitable insulating shrouds shall be provided on the bushing terminals.

- vi) **Tank sealing:**

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.

- vii) All welding operations to be carried out by MIG process.

6.00 Heat Dissipation:

The manufacturer will have to design the tank such that heat is dissipated without radiators. Transformers with radiators will not be accepted. Heat Dissipation calculations shall have to be submitted along with the offer.

Heat Dissipation Calculation covers that the heat dissipation by tank walls excluding top & bottom should be 500 Watts/ Sq.Meter.

7.00 Efficiency:

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

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

The minimum Percentage Efficiency of distribution transformer shall be 98.25 %

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8.00 Total Minimum Oil Volume:

The insulating oil shall comply with the requirements of IS335/1993. Oil shall be filled under vacuum only.

KVA rating	Oil in liters (exclusive of oil absorbed in core & coil assembly)	
	11KV	22kV
25 KVA	50 Litres minimum	60 Litres minimum

9.00 Surface protection.

The transformer tanks should be powder coated, with Pale cream colour paint (shade: 352 As per IS 5). Steel surface of the tank shall be prepared by sand / shot blast or chemical cleaning including phosphating as per IS 3618. Heat resistance paint (Hot oilproof) shall be provided to the tank. On external surface one coat of thermosetting powder paint or one coat of epoxy primer followed by two coats of polyurethane base paint shall be used. Paint scheme shall be as per clause 15.5 and Table 12 of IS 1180 (Part 1):2014.

10.00 Cleaning and Painting.

10.01 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 60 micron as per IS 1180(Part 1): 2014. The powder coating shall be of Pale cream colour (shade No. 352 as per IS 5) 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. Inside of tank shall be painted with varnish or oil resistant paint.

10.02 The month and year of supply shall be painted in Red Bold Marathi language at one places, at some conspicuous place on the transformer, which shall be clearly visible from the ground.

11.00 Terminal Marking Plates and Rating Plates:

Each transformer shall be provided with non-detachable name, rating and terminal marking plate fitted in a visible position. All details shall be given on one plate. Material of the plate shall be anodized aluminum / stainless steel only. Thickness shall be 0.9 mm (with a tolerance of +/- 0.1 mm). The plate shall be made absolutely undetectable – either through riveting or through any other approved method. There shall be a rating plate on the transformer containing the information given in the

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relevant Indian Standard (IS 1180(Part 1):2014). The HV winding terminals shall be marked 1.1. The corresponding secondary terminal shall be marked as 2.1 and 2.2(n).

Besides other particulars, following details shall also be given on the name plate.

- ISI Mark.
- Order No. – Month & year.
- Sr. No. of transformer.
- Date of manufacturing – Month & year.
- Date of expiry of guarantee period – month & year.
- Maximum guaranteed total loss at 50% load & total loss at 100 % load .
- Name and full address of the manufacturer.
- Capacity.
- Rating.

ALL DETAILS ON THE RATING AND DIAGRAM PLATE SHALL BE INDELIGIBLY MARKED BY ENGRAVING.

12.00 Tank base channel :

The tank base channel for 25 kVA transformers – 75 mm x 40 mm.

13.00 Pressure release device:

The transformer shall be equipped with a self-sealing pressure release device design to operate at a minimum pressure of 8-PSI (0.564 kg/cm²).

14.00 Protection:

The transformer shall have the following additional fittings as its integral part:

The transformers shall have the following CSP features:

14.01 a) Internal HV Fuses on the HT side of transformers:

Specification for HT Fuses:

Expulsion /any other suitable fuse placed in series with primary winding. This fuse is mounted normally inside of the primary bushing and is disconnected to high voltage winding through a terminal block. This has to protect that part of electrical distribution system, which is ahead of the distribution transformers from faults, which occurs inside the distribution transformers i.e.

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either the winding or some other part of the transformer. It shall be ensured that this fuse does not blow for faults on the secondary side (LT side) of the transformer i.e. the blowing characteristics of the fuse and LT beaker shall be coordinated that the fuse shall not blow for any faults on the secondary side of the transformer and these faults shall be cleared by the LT breaker only. The time current characteristics and co-ordination with HV fuses shall be submitted alongwith the offer.

b) Internally mounted oil immersed LT Breaker on the LV side of the transformer:

14.01.1 LT Circuit Breaker:

The LT Circuit breaker shall clear all LT faults. As such, it shall be designed for perfect coordination with the HT fuse link. The supplier shall furnish the time /current characteristics of LT Circuit breaker and $11/\sqrt{3}$ kV fuses for various current multiples. The two characteristics shall be drawn on the same sheet to indicate coordination between the circuit breaker and fuse. This shall be based on the type test carried out on one of the transformers. In addition, the supplier shall carry out coordination test as indicated above, and this forms one of the testes for acceptance.

The breaker is to be mounted on the secondary side of the transformer under oil to minimize premature operations from primary surges. Two single pole elements is preferred. The Breaker shall be coordinated thermally with the transformer rating to follow closely the variations of coil temperature due to fluctuations in loads and ambient temperature.

This is to be accomplished by connecting the breaker in series between the secondary winding and load. The breaker shall be located in the same oil as the core and coil assembly so that the bimetal strips are sensitive to the temperature of oil as well as the load current.

The circuit breaker may be an electro-mechanical device with three elements viz. (a) temperature sensing (b) latching and tripping and (c) current interrupting. The temperature sensing function might be accomplished through the use of bimetallic strips which would be built into breaker, such that load current of the transformer flows through them. In addition to this, a magnetic tripping device is to be provided for increasing the opening speed of the breaker under high fault conditions. The circuit breaker shall be mounted inside of the

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transformer so that these bimetallic strips are within the top oil layer of the transformer. The latching and tripping functions of the circuit breaker may be carried out within assembly similar to those used in industrial type air circuit breaker. The circuit breaker shall also be closed and opened manually standing on ground and with a magnetic trip device also. The current interruption element shall consist of copper current carrying parts plus a set of copper tungsten current interrupting contacts the magnetic element increase the opening speed of the circuit breaker under high fault current conditions. The response of circuit breaker to the activity shall remain unchanged by the addition of the magnetic trip element. The specification to which the breakers conform shall be indicated.

The Type tests shall be carried out on Circuit breaker as per IS: 13947 (Part-2)/1993 amended up to date at any NABL Laboratory and shall be submitted along with the offer.

Note: Mechanical operation test on LV Circuit Breaker shall be carried out in OIL medium as per IS: 13947 (Part-2)/1993 amended up to date.

14.01.2 Load Management Signal Light :

A signal light, controlled by a metal in the breaker shall switch on when the transformer load reaches a predetermined level indicating that the transformer has been over-loaded. The load management signal light shall perform two functions. It shall show visually when the particulars transformers has been operating in an overload condition and shall provided knowledge that for good system management, the economical change out point for the transformer is fast approaching. The signal light need not indicate temporary overloads and shall turn on only when the overload condition has existed at a given level for a certain length of time.

The LT circuit breaker shall be have a set of auxiliary contacts built-in for signal light operation. These, normally open contacts, shall form part of the signal light circuit. The signal light circuit shall consist of an auxiliary transformer winding (one or two turns) which generates about 4V, for the signal light contact set within the circuit breaker, and the signal light is mounted on the transformer tank. The signal light contact set is mechanically connected to the main circuit breaker latching and bimetal system. The signal light mechanism is adjusted so that the signal light contacts will close at a pre-set thermal condition, which occurs before the main latching system opens the main contact. The net result is a visual external indication that a pre-set load conditions has reached by the

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transformer. The signal light mechanism does not reset itself when the load drops off, the signal light remains lighted once the signal light contact closes and can only be turned off by manually operating the external circuit breaker handle.

14.02 ALTERNATIVE FOR 14.01 (b)

b) Externally mounted MCCB for LV side:

Single pole MCCB is to be provided on LV side with thermal trip release within inverse time current characteristics for overload protection and magnetic trip release for instantaneous tripping in the wake of short circuits.

Application	Outdoor (enclosed)
Utilization category	A (IS 13947)
Type	Thermal and magnetic trip free mechanism
Number of poles	One
reference ambient temperature	50 Deg.C
Rated insulation level	600V
Impulse withstand	8 kV peak
Rated operational voltage	250V
Continuous current rating	100 A for 25 kVA
Breaking capacity	10 kA at 250V
Terminal capacity	2x25 Sq.mm Aluminum cable
Applicable standard	IS 13947 Part-2 latest.
Time current characteristics	To co-ordinate with HV fuse

The time current characteristics and co-ordination with HV fuse shall be submitted along with the offer.

MCCB is to be fixed in an enclosure (IP 55) in ready to be used condition and to be mounted on the transformer before installation on the pole. The enclosure shall be made with sheet steel of thickness not less than 1.6 mm. It shall be painted both inside and outside with powder coating. Enclosure shall have providing for pad locking arrangement. Detachable gland plate shall be provided for taking connections from MCCB and transformer bushing terminal.

Signal light (LED Indicating lamp):

The MCCB enclosure shall be provided with LED indicating lamp to indicate tripping of MCCB. An auxiliary relay with changeover contacts can be used to connect LED indicating lamp to the transformer secondary terminals if MCCB is not having auxiliary contacts. In case the MCCB trips or switched OFF, the relay contacts are closed which turns ON the LED indicating lamp. When the MCB is reset and switched ON, the indicating lamp switches OFF. Signal light shall be arranged to avoid damages while handling the MCCB enclosure at site.

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15 Lightning Arrestors:

High surge capacity of 9 kV(Vrms), 5 kA(8/20 micro wave shape) Lightning Arrestor for 11/ $\sqrt{3}$ kV and 18 kV(Vrms), 5 kA (8/20 micro wave shape) Lightning arrestor (Disconnecter type) for 22/ $\sqrt{3}$ kV transformers conforming to IS: 3070/1974 shall be mounted on the transformers, 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 connected solidly to the transformer tank earthing terminal.

16 Fittings

The following standard fittings shall be provided.

- Two earthing terminals with earthing symbol.
- Oil level gauge indicating oil level at minimum, 30 deg. Celsius and maximum operating temperature. - 1 No.
- Air release device. - 1 No
- Rating and terminal marking plates. - 1 No.
- Thermometer pocket with cap - 1No.
- Oil filling holes having 1 ^{1/4}" nominal size thread) with cover. 1 No.
- An extended pipe connection on upper end with welded cover. The pipe should be suitably threaded over a sufficient length to enable use of a refilling / siphon connection after removing the welded cover or any other similar arrangement capable of reuse; - 1 No.
- Two lifting lugs for the complete transformer as well as for core and winding assembly. - 2 No.
- Nitrogen / air filling device / pipe with welded cover capable of reuse. 1 No.
- LV earthing arrangement
- Metal oxide lightning surge arrester with Dis-connector. 1 No.
- HV bushings - 1 No.
- LV bushings.- 2 No.
- HV & LV terminal connectors
- Top cover- fixing clamps - 4 No.
- Mounting lugs – 2
- Protection cover (Plasticized cover on live parts)
- Circuit breaker, Operating mechanism. - 1 No.
- Signal light - 1 No.
- Five year guarantee plate - 1 No.
- HV fuse - 1 No.
- Drain Valve of 20 MM size - 1 No.
- Any other fitting necessary for satisfactory performance.

17 Fasteners.

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- 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.
- Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.
- All nuts and pins shall be adequately locked.
- 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.
- 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.
- 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.
- The length of screwed portion of the bolts shall be such that no screw thread may form part of a sheer plane between members.
- Taper washers may be provided where necessary. Protective washers of suitable material shall be provided front and back of the securing screws.

18 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 :- 2.5×10^{12} Ohm-Cm (Min)
 - b) at 90 ° C :- 0.2×10^{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.

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- vi. The Density of oil shall be maximum 0.89 g / cm³ at 29.5 ° C as per IS 1448 (P:16):1990.
- vii. 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 x 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/g m (Max.)
7	Water content PPM	40 (Max)

19 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 10 minutes. No leakage should occur.

20 Test and Inspection:-

20.01 Routine Tests:-

- i) All transformers shall be subjected to the following routine tests at the manufacturer's works. The tests are to be carried out in accordance with the details specified in IS 2026(Part I and III) or as agreed upon between the purchaser and the manufacturer.
 - 1. Measurement of winding resistance.
 - 2. Measurement of Voltage Ratio.
 - 3. Measurement of Short- circuit Impedance.
 - 4. Load losses at 50% & 100 % loading.
 - 5. No-load losses and No-load current.
 - 6. Insulation resistance.

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7. Induced over voltage withstand.
 8. Separate source voltages withstand.
 9. Pressure test as per clause 21.5 of IS 1180 (Part I):2014
 10. Oil leakage test as per clause 21.5 of IS 1180 (Part I):2014
- All the routine tests shall be conducted in the suppliers' laboratory at their cost.
- ii) Heat run test shall be arranged free of cost on the unit selected from the 1st lot by Executive Engineer/Authorized Representative.
 - iii) The calculations to confirm the thermal ability as per Clause no. 9.1 of latest IS: 2026 Part-I or equivalent International Standard shall be submitted to Executive Engineer (IW).

20.02 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 acceptance 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 system of redress 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 complete in tenders of the MSEDCL for the period of three years and heavy penalty would be imposed.

20.03 Type Tests:-

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In addition to routine test as above the Tests as under 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. The bidder shall furnish the following type tests reports (along with General arrangement drawing, Rating and Diagram Plate and Internal Constructional drawing) along with the offer.

- i) Impulse Voltage with stand Test shall be carried out as per Clause No. 14 of IS 2026 (Part-III) on HV phase chopped on tail.
- ii) Dynamic Short circuit Test (IS 2026 (Part 5) (Routine tests before and after short circuit test shall be conducted as per IS 1180 (Part I): 2014.
- iii) Temperature – rise Test [IS 2026(Part 2)]
- iv) Pressure Test [IS 1180 (Part 1):2014 clause 21.5]

In addition to that the successful bidder shall submit the type test report of Circuit breaker/MCCB (Sequence-1,2,3), HT Fuse, Transformer oil & HV/LV Bushings as per relevant Indian Standards shall submit along with offer.

20.04 In case of any of the following, the offer may be considered for evaluation only.

20.04.1 If above tests are carried out beyond 5 years

20.04.2 Impulse Voltage Withstand test and Dynamic Short Circuit test carried out not from NABL approved Laboratory.

20.04.3 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.*

20.05 The following balance type test should be carried at the manufacturer's works invariably in the presence of M.S.E.D.C.L's representative at the time of inspection from the first lot.

20.05.1 Temperature Rise Test

20.05.2 Air pressure test as per clause no. 21.5 of IS:1180 (Part I)/2014

20.06 The type test reports should be submitted and got approved from the Chief Engineer (MMC) before offering Ist stage inspection.

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20.07 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 Drawings :-

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

- i. Rating & Diagram Plate Drawing.
- ii. General Dimensional drawing.
- iii. Core Assembly drawing.
- iv. Internal Construction Drawing
- v. HV Bushings Assembly and Creepage distances.
- vi. LV Bushings Assembly and Creepage distances.
- vii. Internally mounted oil immersed LT Breaker OR Externally mounted MCCB for LV side.
- viii. Internal HV Fuses on the HT side.
- ix. Time current characteristics for LT breaker / MCCB and HV fuse to indicate co-ordination between LT breaker / MCCB and HV fuse.

21.01 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.

21.02 The successful Bidders shall submit complete set of Drawings (as listed in Cl.No.20.1) of transformer in triplicate indicating dimensions to CE (MM Cell) for approval and get approved it before offering 1st stage inspection.

21.03 The successful bidder shall invariably submit the Heat Dissipation Calculation along with offer.

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

22 Rejection :-

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

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- 22.01 Total losses at 50 % & 100 % loading exceeds the values mentioned above in the specification.
- 22.02 Impedance voltage value exceeds the Guaranteed value plus tolerances as mentioned above in the specification.
- 22.03 Type test are not carried out as mentioned in above specification.
- 22.04 Drawings are not submitted as given in the specification.
- 22.05 GTP not submitted as per schedule "A" given in the specification.
- 22.06 Heat dissipation calculation sheet are not submitted as per the specification.

23 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 be liable for rejection.

24 Testing facility

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

25 Submission Routine Test Certificate

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, copper/aluminum for conductors, insulating materials, core materials, bushings at the time of routine testing of the fully assembled transformer.

26 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 Stage Inspection :-

- 27.01 Supplier shall give 15 days advance intimation to the Chief Engineer (MM Cell.), S.E. (MM Cell)& S.E. (MS Cell) to organize stage inspection in

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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.

- 27.02 Chief Engineer (MM Cell) will depute his representative at the time of stage inspection.
- 27.03 10 % of the transformers from the offered lot will be tested for acceptance tests at factory, in the presence of purchaser's representative before dispatch.
- 27.04 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.
- 27.05 The purchaser may at its option, open a transformer supplied to the Stores, in presence of supplier at site or at Stores. If any of the technical particulars are seen to be in variance than the guaranteed technical particulars, the whole lot of transformer will be rejected without any liability on purchaser.
- 27.06 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.
- 27.07 Testing of all Distribution Transformers for no load and full load losses.
- 27.08 After inspection of new transformers at factory for acceptance of the lot, all distribution transformers from the lot will be tested for no load and full load losses at 50 % & 100 % loading at all stores. Tenderer has liberty to be present at the time of testing.

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28 Final Inspection

10 % of the transformers offered will be tested for all tests without opening the transformer. Heat Run Test will have to be carried out on the transformer having maximum no load and full load losses taken together. Out of balance 90% distribution transformers, one transformer shall be opened and all design technical parameters should be checked as per E-GTP, approved drawings and technical specifications. If any technical parameters are found deviating from the E-GTP, approved drawings & technical specifications, the final inspection of the whole lot shall be reoffered for final inspection after rectification.

C.E. (MM Cell) will depute his representative at the time of final inspection along with “Executive Engineer (Testing)”.

29 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 this tender. S.E. (MSC.), 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 No load & full load losses. 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.

30 Inspection & Testing of Transformer Oil:

To ascertain the quality of the transformer oil, the original manufacturer's test report should be submitted at the time of inspection. Also arrangements should be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative or in an independent laboratory.

31 Loading of transformer:

The transformer shall be suitable for loading as per IS2026, Part-7. The tenderer should state clearly the percentage overload the transformer can take for a continuous period of one hour.

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32 Quality Assurance

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

Certificates of following materials.

- Copper conductor
- Transformer oil
- Core
- Insulating paper.
- Porcelain Bushings
- Steel Plate used for Tank

32.01 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.

32.02 Information and copies of test certificate as in (i) above respect of bought out accessories including terminal connectors.

32.03 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.

32.04 Level of automation achieved and list of areas where manual processing still exists.

32.05 List of areas in manufacturing process where stage inspection are normally carried out for quality control and details of such tests and inspections.

32.06 Special features provided in the equipments to make it maintenance free

32.07 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.

32.08 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.

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33 Qualifying Requirement: As per Tender.

34 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 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 CPA section.

FORMAT FOR COST DATA					
ITEM ----- KVA , ----- KV DISTRIBUTION TRANSFORMER					
Sr.	PARTICULARS	UNIT	UNIT RATE S Rs.	QUANTITY	AMOUNT (Rs.)
1	CORE (M4)	KG			
2	Super enameled Copper (HV Winding)	KG			
3	COPPER WITH DPC (LV Winding)	KG			
4	INSULATION PAPER	METER			
5	OIL	LTRS			
6	TANK	KG			
7	CHANNELS	KG			

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8	INSULATORS/BUSHINGS	NO			
9	OTHERS	LUMPSUM			
				TOTAL	
	WASTAGE @ %				

36 Schedules

36.01 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' - Tender's Experience

36.02 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.

36.03 Authentic documents and clarifications shall support the deviation brought out in the schedule, otherwise the offer may be liable for rejection.

36.04 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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Annexure I

Air Pressure Test

Name of Supplier:

Order No.:

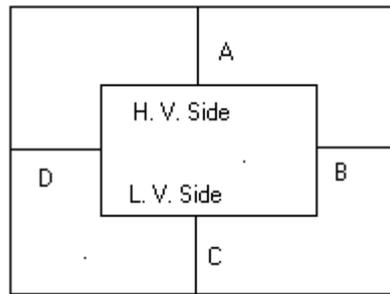
Capacity & Voltage Ratio of Distribution Transformer : 25 kVA, /0.250 kV

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 tank surface and a pressure gauge was fitted at air vent plug. The parallel string were placed around the tank, the distance between string and tank as shown in following diagram (indicative drawing) were recorded before applying the pressure and after releasing pressure.



Tank Thickness: Side mm. Top & Bottom mm

Test Pressure: kg/cm² 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

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Annexure II

Temperature Rise Test

Name of Supplier:

Order No.:

Capacity & Voltage Ratio of Distribution Transformer : 25 kVA, /0.250 kV

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	Multiplying Factor (MF)	Total Watt
	T1 °C	T2 °C	T3 °C	Average °C							
Reduced to Rated Current _____ amps											

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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 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

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

Results :

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

Test witnessed by _____

Tested by _____

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SCHEDULE - "B"

TENDERER'S EXPERIENCE

The Tenderer shall furnish list of similar order executed or under execution of supplying single phase Distribution transformers by him to whom a reference may be made by purchaser in case he consider such a reference necessary.

SR. NO.	NAME OF ORDER NO.	QTY. ORDERED	QTY. SUPPLIED
	CLIENT & DATE		

NAME OF FIRM _____

NAME & SIGNATURE OF TENDERER_____

DESIGNATION _____

DATE _____

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SCHEDULE - "A"

ITEM NAME: OUTDOOR TYPE DISTRIBUTION TRANSFORMER WITH CSP FEATURE		
SR. NO.	GUARANTEED TECHNICAL PARTICULARS	GTP VALUES
1.0	Name of Manufacturer	TEXT
2.0	Reference Standard	TEXT
3.0	Energy efficiency <u>level</u> as per IS 1180 Part-I(2014)	TEXT
4.0	Whether transformer is Oil Natural Air Natural cooled type (Yes/No)	BOOLEAN
5.0	Whether transformer is suitable for Indoor /Outdoor installation	TEXT
6.0	Rating of Transformers in KVA	NUMERIC
7.0	Primary Voltage in KV	NUMERIC
8.0	Secondary Voltage in KV	NUMERIC
9.0	Whether neutral is solidly earthed (Yes/No)	BOOLEAN
10.0	Colour of transformer	TEXT
11.0	Approximate overall breadth of transformer in mm	NUMERIC
12.0	Approximate overall height of transformer in mm	NUMERIC
13.0	Approximate Diameter of transformer tank in mm	NUMERIC
14.0	Approximate height of transformer tank in mm	NUMERIC
15.0	Thickness of the side of transformer Tank plate in mm	NUMERIC
16.0	Thickness of the bottom of transformer tank plate in mm	NUMERIC
17.0	Thickness of the top of transformer tank plate in mm.	NUMERIC
18.0	Total Radiating surface of transformer tank in sq. mtrs	NUMERIC
19.0	Size of base channel provided to tank and no.s	NUMERIC

**TECHNICAL SPECIFICATION OF 25 KVA 11 & 22 KV SINGLE PHASE OUTDOOR TYPE
DISTRIBUTION TRANSFORMER WITH CSP FEATURE.**

20.0	Weight of Tank & fittings in kgs	NUMERIC
21.0	Weight of Core in kgs	NUMERIC
22.0	Weight of winding in kgs	NUMERIC
23.0	Weight of Oil in kgs	NUMERIC
24.0	Volume of Oil in Ltrs	NUMERIC
25.0	Total Weight of Transformer in kgs	NUMERIC
26.0	Core material used & its grade	TEXT
27.0	Type of core	TEXT
28.0	No. of steps of core for CRGO core	NUMERIC
29.0	Diameter of core in mm	NUMERIC
30.0	Effective core area.(sq.cm)	NUMERIC
31.0	Core Window Height in mm	NUMERIC
32.0	Centre to Centre Distance in mm	NUMERIC
33.0	Flux density in Tesla	NUMERIC
34.0	Thickness of core lamination in mm	NUMERIC
35.0	The temperature shall in no case reach a value that will damage the core itself, other parts or adjacent materials ,Max. temperature.	NUMERIC
36.0	Type of connection for H.V. Winding	TEXT
37.0	Type of connection for L.V.Winding	TEXT
38.0	Material of H.V winding	TEXT
39.0	Material of L. V. Winding	TEXT
40.0	Insulation provided to H.V winding.	TEXT
41.0	Insulation provided to L.V. winding.	TEXT
42.0	Current density of H.V. winding (in Ampere/ sq.mm)	NUMERIC
43.0	Current density of L.V. winding (in Ampere/ sq.mm)	NUMERIC

**TECHNICAL SPECIFICATION OF 25 KVA 11 & 22 KV SINGLE PHASE OUTDOOR TYPE
DISTRIBUTION TRANSFORMER WITH CSP FEATURE.**

44.0	No. of LV Winding Turns	NUMERIC
45.0	No. of HV Winding Turns	NUMERIC
46.0	Resistance of LV winding per phase at 20 oC in Ohms	NUMERIC
47.0	Resistance of HV winding per phase at 20 oC in Ohms	NUMERIC
48.0	Clearance between Core & L.V. winding in mm	NUMERIC
49.0	Clearances between L.V. & H.V. winding in mm	NUMERIC
50.0	Clearances between end insulation to Earth in mm	NUMERIC
51.0	Clearances between winding to tank in mm (min 30 mm).	NUMERIC
52.0	Insulation materials provided for core	NUMERIC
53.0	Length of coil used for HV winding in meter.	NUMERIC
54.0	Diameter of conductor used for HV winding (in mm)	NUMERIC
55.0	Cross section area of the coil used for HV winding (sq.mm)	NUMERIC
56.0	Length of coil used for LV winding in meter.	NUMERIC
57.0	Size of strip used for LV winding in mm	NUMERIC
58.0	No. of conductors in parallel for LV winding	NUMERIC
59.0	Total cross section area of LV conductor in sq. mm	NUMERIC
60.0	No. of H.V coils	NUMERIC
61.0	Thickness of locking spacers between H.V. coils (in mm)	NUMERIC
62.0	Quantity of total oil absorption (in liters) in first filling	NUMERIC
63.0	Total oil volume including Total Oil absorption in Ltrs.	NUMERIC
64.0	Grade of Oil used.	TEXT
65.0	Name of Oil manufactures to be supplied.	TEXT
66.0	Breakdown Values of Oil at the time of first filling (kV/mm) considering 2.5 mm gap	NUMERIC
67.0	Drain Valve (20 mm) provided to the transformer tank	TEXT

**TECHNICAL SPECIFICATION OF 25 KVA 11 & 22 KV SINGLE PHASE OUTDOOR TYPE
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68.0	Earthing terminals with lugs is provided	TEXT
69.0	Lifting lugs provided	TEXT
70.0	Thermometer pocket is provided	TEXT
71.0	Rating of H.V. Bushings (in kV, A)	NUMERIC
72.0	Rating of L.V. Bushing (in kV, A)	NUMERIC
73.0	Material of HV Bushings and makes thereof	TEXT
74.0	Material of LV Bushings and makes thereof	TEXT
75.0	Reference standard of Bushings	TEXT
76.0	Minimum Creepage Distance of HV Bushing in mm (min.25 mm per kV)	NUMERIC
77.0	Minimum Creepage Distance of LV Bushing in mm (min.25 mm per kV)	NUMERIC
78.0	Minimum external clearances of bushing terminals: HV Phase to Earth	NUMERIC
79.0	Minimum external clearances of bushing terminals: LV Phase to Earth	NUMERIC
80.0	Power frequency withstand voltage dry & wet in KV (rms) for HV Bushing	NUMERIC
81.0	Dry lightning impulse withstand voltage in KV(peak) stating the waveform adopted for HV bushing	NUMERIC
82.0	Power frequency withstand voltage dry & wet in KV (rms) for LV Bushing	NUMERIC
83.0	Dry lightning impulse withstand voltage in KV(peak) stating the waveform adopted for LV bushing	NUMERIC
84.0	Maximum temperature rise of Oil in °C over an Ambient temp. Of 50°C by thermometer.	NUMERIC
85.0	Maximum temperature rise of winding in °C over an Ambient temp. Of 50°C by thermometer.	NUMERIC
86.0	Magnetizing current (No load) in Amps and its 3% of full load current at rated voltage referred to LV Voltage	NUMERIC
87.0	Magnetizing current (No load) in Amps and its 6 % of full load current at maximum voltage (112.5% of rated voltage)referred to LV side	NUMERIC
88.0	Max. Core Loss at rated voltage and rated frequency (Watts)	NUMERIC
89.0	Max. Total Losses (No load+Load losses at 75 °C) at50% Loading (Watts)	NUMERIC

**TECHNICAL SPECIFICATION OF 25 KVA 11 & 22 KV SINGLE PHASE OUTDOOR TYPE
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90.0	Max. Total Losses (No load+Load losses at 75 °C) at 100% Loading (Watts)	NUMERIC
91.0	Efficiency at 75 °C at unity P.F. at 125% load	NUMERIC
92.0	Efficiency at 75 °C at unity P.F. at 100% load	BOOLEAN
93.0	Efficiency at 75 °C at unity P.F. at 75 % load	BOOLEAN
94.0	Efficiency at 75 °C at unity P.F. at 50% load	BOOLEAN
95.0	Efficiency at 75 °C at unity P.F. at 25% load	BOOLEAN
96.0	Efficiency at 75 °C at 0.8 P.F. lag at 125% load	BOOLEAN
97.0	Efficiency at 75 °C at 0.8 P.F. lag at 100 % load	BOOLEAN
98.0	Efficiency at 75 °C at 0.8 P.F. lag at 75 % load	TEXT
99.0	Efficiency at 75 °C at 0.8 P.F. lag at 50 % load	NUMERIC
100.0	Efficiency at 75 °C at 0.8 P.F. lag at 25% load	NUMERIC
101.0	Efficiency at 75 °C at 0.8 P.F. leading at 125% load	NUMERIC
102.0	Efficiency at 75 °C at 0.8 P.F. leading at 100% load	NUMERIC
103.0	Efficiency at 75 °C at 0.8 P.F. leading at 75% load	NUMERIC
104.0	Efficiency at 75 °C at 0.8 P.F. leading at 50% load	NUMERIC
105.0	Efficiency at 75 °C at 0.8 P.F. leading at 25 % load	NUMERIC
106.0	Regulation at Unity P.F (in %)	NUMERIC
107.0	Regulation at 0.8 P.F. lag. (in %)	NUMERIC
108.0	Regulation at 0.8 P.F. leading. (in %)	NUMERIC
109.0	% Impedance value at 75°C	NUMERIC
110.0	Type of HV fuse used in CSP	TEXT
111.0	Rating of HV fuse in Kv & Amps	NUMERIC
112.0	Make HV fuse	TEXT
113.0	Rating of LT breaker / MCCB used in CSP in volt & amps	TEXT

**TECHNICAL SPECIFICATION OF 25 KVA 11 & 22 KV SINGLE PHASE OUTDOOR TYPE
DISTRIBUTION TRANSFORMER WITH CSP FEATURE.**

114.0	Opening time of LT breaker / MCCB	NUMERIC
115.0	Make of LT breaker / MCCB	TEXT
116.0	Whether Time current characteristics for LT breaker / MCCB and HV fuse to indicate co-ordination between LT breaker / MCCB and HV fuse are uploaded.(Yes/No)	BOOLEAN
117.0	Load management signal provided.(Yes/No)	BOOLEAN
118.0	Separate source power frequency withstand test for HV for 1 minute in kv(min)	NUMERIC
119.0	Separate source power frequency withstand test for LV for 1 minute in kv(min)	NUMERIC
120.0	Induced over voltage withstand test for 1 min. specify voltage frequency, time for test.	TEXT
121.0	Impulse test value (in kVP) .	TEXT
122.0	The test certificate of Aluminium /Copper conductor ,core insulation paper , porcelain bushings ,steel plate used for enclosure of offer transformer is enclosed along with the offer in soft copy .	TEXT
123.0	All type test report type test 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 tenders .	TEXT
124.0	Unbalanced current test, air pressure test and temperature rise test shall be conducted as per format enclosed with the technical specification along the offer .	TEXT
125.0	All drawings shall be furnished with each offered item separately along with the offer.	TEXT
126.0	Oil absorption Calculation sheet shall be furnished with for each offered item separately along with the offer.	TEXT
127.0	Heat Dissipation Calculation sheet shall be furnished with for each offered item separately along with the offer.	TEXT
128.0	Flux Density calculation sheet with no. of Primary & Secondary turns shall be furnished with for each offered item separately along with the offer.	TEXT
129.0	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.	TEXT
130.0	Required documents , plant and machinery , list of order executed /under execution shall be furnished for each offered items separately along with this offer.	TEXT
131.0	The Information required under Quality Assurance shall be submitted with the offer in physical format & soft copy.	TEXT
132.0	The cost data in the prescribed format shall be submitted with the offer in physical format & soft copy .	TEXT
133.0	Firm shall confirm that the distribution transformer complies to the specified requirement of Indian Standard and submit copy of valid ISI licence along with the offer.	TEXT

**TECHNICAL SPECIFICATION OF 25 KVA 11 & 22 KV SINGLE PHASE OUTDOOR TYPE
DISTRIBUTION TRANSFORMER WITH CSP FEATURE.**

134.0	The performance guarantee of transformer in Year	NUMERIC
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