CONTENTS

1. SCOPE:

This specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing, forwarding, supply and unloading at site/store and performance of oil immersed, non-sealed, naturally cooled, 16KVA Single phase 11 kV/ 0.25 kV, 50 Hz, Aluminium wounded, double wound outdoor type Distribution transformers. The Transformer Primary shall be connected across Two Phase(11KV) & on the secondary winding is Single phase (Phase & Neutral). The equipment covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following Indian, International standards and shall conform to the regulations of the local authorities.

2. APPLICABLE STANDARDS:

The equipment covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following Indian, International standards and shall confirm to the regulations of the local authorities.

Sl.No	IEC/IS	Description
1.	IS 1180- 2014(Part- I)	Outdoor Type Oil Immersed Distribution Transformers Up to and Including 2500KVA
2.	IS- 2026:1977(Part 1 to 5)	Specification of Power Transformers
3.	IS 2099	Specification of high voltage porcelain bushing
4.	IS-104	Ready mixed paint, brushing zinc chromate, priming
5.	IS 649:1997	Testing for steel sheets and strips and magnetic circuits
6.	IS 9335:1997	Specification for Cellulosic Papers for Electrical Purposes
7.	IS 1576: 1992	Solid Pressboard for Electrical Purposes Specification
8.	IS 3347	Specification for Outdoor Bushings

9.	IS 6162	Paper covered aluminum conductor
10.	IS 3024	Grain Oriented Electrical Steel Sheet and Strip
11.	IS-7421: 1988	Specification for Porcelain Bushings for Alternating Voltages including 1000 V
12.	IS-6600:197	Guide for loading of oil immersed Transformers
13.	IS-2362: 1993	Determination of water content in oil by Karl Fischer Method-Test Method
14.	IS-5561: 1970	Specification for Electric Power Connectors
15.	IS-6103:1971	Specification for Testing of specific resistance of electrical insulating liquids
16.	IS-6262:1971	Method for test of Power Factor and dielectric constant of electrical insulating liquids.
17.	IS-6792:1992	Method for Determination of Electric Strength of Insulating Oil
18.	IS-10028:1981	Code of Practice for selection, installation and maintenance of transformers
19.	IS-335:1985	Specification for Transformer Oil
20.	IS-4257	Dimensions for clamping arrangements for bushings
21.	IS-5484	Specification for Aluminum wire rods
22.	IS-6160	Rectangular electrical conductors for electrical machines
23.	IS- 3401	Specification of Silica Gel
24.	IS-5484	Specification for Aluminum wire rods
25.	IS- 3401	Specification of Silica Gel

3. CLIMATIC CONDITIONS:

1	Maximum ambient temperature	50 deg C
2	Max. Daily average ambient temp	35 deg C
3	Min Ambient Temperature	0 deg C
4	Maximum Humidity	95%
5	Average Annual Rainfall	150cm
6	Average No. of rainy days per annum	120
7	Altitude above MSL not exceeding	1000m
8	Wind Pressure	300 Km/hr
9	Earthquakes of an intensity in horizontal direction	equivalent to seismic acceleration of 0.3g
10	Earthquakes of an intensity in vertical direction	equivalent to seismic acceleration of 0.15g (g being acceleration due to gravity)

TPSODL service area has heavy saline conditions along the coast and High cyclonic Intensity winds with speed up to 300 Kmph. The atmosphere is generally laden with mild acid, dust in suspension during the dry months, and is subjected to fog in cold months.

4. GENERAL TECHNICAL REQUIREMENTS:

Sl.No	Description	Requirement
1.	Rated voltage HV (kV)	12
2.	Rated voltage LV (V)	250
3.	Service voltage (KV max.)	11
4.	Rated Line current HV (A)	1.45
5.	Rated Line current LV (A)	66.66
6.	Frequency (Hz)	50
7.	No. of Phases	Single
8.	Energy Efficiency Level as per IS-1180	Level-2

	(Part-1) 2014; As per Amendment No.4 March 2021	
9.	Connection HV	Two phase
10.	Connection LV	Single phase (Phase & Neutral)
11.	Type of cooling	ONAN
12.	Noise level at rated voltage and frequency	48 DB
13.	Winding Material	Aluminium
14.	Insulation Class	A
15.	**Permissible temperature rise over ambient:**	
16.	Of top oil measured by thermometer	35^0 C
17.	Of winding measured by resistance	40^0 C
18.	Maximum current density (A/mm^2)	1.6
19.	OFF Circuit Tap Changer	No Taps required
20.	**Winding Resistance @75 ºC**	
21.	HV Winding (in Ohms)	As Per Bidder's Design
22.	LV Winding (in Ohms)	As Per Bidder's Design
23.	No Load Losses (Watts)	Bidder to mention (Without any positive tolerance)
24.	**100% Voltage @100% Voltage**	
25.	Max. Total Losses at 50% loading at 75°C (watts)	63
26.	Max. Total Losses at 100% loading) at 75°C (Watts)	190
27.	Short circuit **impedance** voltage at 75°C (±10% tolerance)	4%
28.	**Bushing Voltage Grade**	
29.	(a) HV Bushing	17.5 KV
30.	(b) LV Bushing	1.1 KV
31.	(c) Neutral Bushing at LV Side	1.1 KV
32.	Thickness of Lamination	<0.23mm
33.	Normal Flux Density (at rated voltage and frequency)	1.6 T
34.	Maximum flux density (Increase of +12.5% combined voltage and frequency variation from rated voltage and frequency)	1.9 T (Max.)
35.	No Load Current at Rated Voltage	<=3%
36.	No Load Current at 112.5 % Rated Voltage	<=6%
37.	Impulse withstand voltage	75 kVp
38.	Power frequency withstand voltage	28 kV
39.	Voltage fluctuations permissible	(+12.5% to -12.5%)
40.	Neutral terminal	As per Specification

41.	**Minimum clearances in air (mm)**	
42.	HV phase to phase/ phase to earth	255 / 140
43.	LV phase to phase/ phase to earth	75 / 40
44.	**Minimum clearances in Cable Box (mm)**	
45.	HV phase to phase/ phase to earth (Min.)	130 / 80
46.	LV phase to phase/ phase to earth (Min.)	25 / 20
47.	Wheels	NA. These are pole mounted DTs.
48.	**Efficiency at 75 ºC Unity PF**	
49.	125% Load	Bidders to Submit
50.	100% Load	Bidders to Submit
51.	75% Load	Bidders to Submit
52.	50% Load	Bidders to Submit
53.	**Efficiency at 75 ºC 0.8 PF**	
54.	125% Load	Bidders to Submit
55.	100% Load	Bidders to Submit
56.	75% Load	Bidders to Submit
57.	50% Load	Bidders to Submit
58.	**% Voltage Regulation at 75 ºC**	
59.	At Unity PF	Bidders to Submit
60.	At 0.8 PF	Bidders to Submit
61.	**Insulating Material**	
62.	HV winding Insulation	Double Paper Covered with min 25% overlap per layer of Paper
63.	LV winding Insulation	Double Paper Covered with min 25% overlap per layer of Paper
64.	HV-LV Insulation	Epoxy diamond dotted Kraft Paper and compressed Pressboard
65.	**Oil Specification**	
66.	Applicable Standard for Oil	IS 335 2018
67.	Oil Qty	Bidders to Submit
68.	Oil Type	Mineral Oil
69.	Oil Breakdown Voltage	60KV
70.	**Buchholz Relay**	NO
71.	**Tank Thickness**	
72.	Top and Bottom	5 mm (Minimum)
73.	Side	3.15 mm (Minimum)
74.	**Overall Dimensions of Transformer in mm**	
75.	Length	Bidders to Submit

76.	Breadth	Bidders to Submit
77.	Height	Bidders to Submit
78.	**Sealing Arrangement**	Sealing Provision of transformer: To prevent unauthorized access to Transformer Core and Winding , A hole in exposed threaded part of Transformer Top Cover Bolt on opposite corners to be made. Tamper Seals to be put after Acceptance Test.
79.	**Markings**	As per relevant IS 1180 Part-1 (2014) along with Sl No. **Punching** on Top Cover Plate
80.	**Type tests**	
81.	Lightning Impulse Test (IS 2026 Part-3) (CPRI/ERDA)	Mandatory Requirement
82.	Temperature Rise Test (IS 2026 Part-2) (CPRI/ERDA)	Mandatory Requirement
83.	Short Circuit Withstand Test (CPRI/ERDA)	Mandatory Requirement
84.	Pressure Test (CPRI/ERDA)	Mandatory Requirement
85.	Determination of sound levels at No load [IS 2026 (part 10)].	Tests to be conducted at TPSODL Recommended NABL lab. In-house test labs **accepted if in-house lab is NABL accredited fo The test.**
86.	Test to verify IP 55 for cable box. (As per IS 60529 clause 11 to 15)	Tests to be conducted at TPSODL Recommended NABL lab. In-house test labs **accepted if in-house lab is NABL accredited fo The test.**

5. GENERAL CONSTRUCTION:

The transformer shall be double-wound, Aluminium coil, oil immersed, naturally cooled (ONAN) and sealed type with rectangular tank. The transformer shall be suitable for service with fluctuations in supply voltage up to (plus 12.5% to minus 12.5%). The Transformer shall design suitable for service life of 25years.The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment. All outdoor apparatus of the Transformer including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

5.1 Core

The core shall be stack type of high grade cold rolled, non-ageing, grain oriented, annealed silicon steel lamination (CRGO), having low loss & good grain properties, coated with hot oil proof insulation, bolted together to the frames firmly to prevent vibration or noise. Scrap CRGO material shall not be used for transformers. The Core thickness should be 0.23mm less. 23HP85 as per IS 3024 or better with Minimum Polarization in Tesla at a Field Strength of 800 A/m. Only one grade and one thickness of the core shall be accepted & mixing of different is not advisable. The core shall be stress relieved by annealing under inert atmosphere if required. All core-clamping bolts (If any) shall be effectively insulated. It should be coated with hot oil proof insulation, bolted together with frames to prevent vibration & noise. The value of the maximum flux density allowed in design & grade of lamination used shall clearly be stated. The vendor shall submit the calculation in support of it. Only one grade and one thickness of core shall be accepted and no mixing of different grades shall be allowed. The complete sign of the core must ensure permanency of the core losses with continuous working of the transformers. The Transformer shall be suitable for continuous service without damage under over fluxing where the ratio of voltage over frequency exceeds the corresponding ratio at rated voltage & rated frequency up to 12.5% and the core shall not be saturated. Transformer core assembly shall have enclosed hooks for lifting arrangement.

The successful bidder is required to submit the following documents with regard to the procurement of core material:

i. Invoice of supplier
ii. Mill's test certificate
iii. Packing list
iv. Bill of landing
v. Bill of entry certificate by custom
vi. Description of material, electrical analysis, physical inspection certificate for surface defects, thickness and width of material.

The bidder shall offer the core for inspection and approval of TPSODL during manufacturing stage. Heavy penalty or black listing shall be imposed on the bidders using seconds/defective CRGO sheets i.e. in case of nonconformance w.r.t TPSODL Specifications.

The transformer shall be suitable for continuous service without damage under conditions of 'over fluxing' (due to combined effect of voltage and frequency) where the ratio of voltage over frequency exceeds the corresponding ratio at rated voltage and rated frequency up to 12.5% and the core shall not get saturated. The bidder shall furnish necessary design data in support of this situation. No load current shall not exceed 3% of full load current and shall be measured by energising the transformer at

rated voltage & frequency. For increase of rated voltage, 12.5% the no load current shall not increase beyond 6 % of the full load current. The Bidder shall offer stage inspection & approval of TPSODL during manufacturing Stage. Transformer core assembly shall have enclosed hooks for lifting arrangement.

5.2 LOSSES

I. The bidder shall also guarantee the total loss at 50% and 100% load condition (at rated voltage and frequency and these should be within the limits of maximum total losses declared by TPSODL for both 50% and 100% loading values (as per table below) :

Description	Units	16 KVA
Max. Total Losses at 50% loading at 75°C	**Watts**	**63**
Max. Total Losses at 100% loading) at 75°C	**Watts**	**190**

No positive tolerance shall be allowed on the losses as mentioned above. However, bidder can offer losses less than specified but no consideration in cost will be given for the same.

II. The successful bidder shall guarantee the quoted losses for at least five years. If at any point of time during operation if it is found that the total losses at 50% and 100% load are more than the values given in specifications, then bidder shall be liable to pay a fine of Rs 250 per watt to the amount by which losses at 50% loading and 100% loading increase with respect to the values given in specifications.

III. During testing at Bidder's works if it is found that the actual measured losses are more than the values quoted by the Bidder, TPSODL shall have the right to reject the complete lot.

IV. During testing at Bidder's works, if the temperature rise exceeds the specified values, the entire lot shall be rejected by TPSODL.

5.3 WINDINGS

1) Primary and secondary windings shall be constructed from high- conductivity(aluminium conductors), Double Paper Covered (DPC) aluminium conductor of grade 2(Al 99.6%) as per IS 5484 with min**. 25%** overlap per layer of paper**. Epoxy diamond dotted Kraft paper to be used for DPC conductor all rating.**

2) The current density for HV and LV winding should not be more than **1.6 Ampere per sq.mm**.
3) The insulation between core and bolts and core and clamps shall withstand **2.5 kV for one minute**.
4) Inter layer insulation both for HV and LV windings shall be Epoxy dotted diamond Kraft paper and pressboard of standard make or any other superior material subject to approval of TPSODL
5) All spacers, axial wedges / runners used in windings shall be made of pre-compressed solid pressboard. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges/runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations. Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted as per standards.
6) LV winding shall be such that neutral formation is at the top.
7) All turns of windings shall be adequately supported to prevent movement. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.
8) The joints in the winding shall be avoided but if it is necessary then, these shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. Crimping is not allowed at any joints.
9) **Provide the conductor size and material grade in below table.**

Sl. No	**Insulation materials provided**	**Unit**	**To be furnished by bidder**
1	**For conductors**		
1.1	HV		
1.2	LV		
1.3	Core		
2	**Material and size of the wire used**		
3	**HV Conductor Grade**		
3.1	Size of HV conductor bare/covered	mm	
3.2	Area of cross section	Sq.mm	
3.3	Conductivity & Purity		
4	**LV Conductor Grade**		
4.1	Size of LV conductor bare/covered	mm	
4.2	No. of conductors in parallel	Nos.	
4.3	Total area of cross section	Sq.mm	
4.4	Conductivity & Purity		
5	**Resistance of windings at 20**		
5.1	HV windings	Ohms/phase	
5.2	LV windings	Ohms/phase	
5.3	No. of LV Turns		
5.4	No. of HV Turns		
5.5	No. of parallels		
5.6	Current density of LV winding(calculated)	A/sq.mm	

5.7	Current density of HV winding(calculated)	A/sq.mm	
5.8	Wt. of the LV winding copper without insulation	Kg	
5.9	Wt. of the HV winding copper without insulation	Kg	
5.10	No. of LV coils/phase		
5.11	No. of HV coils/phase		
5.12	Height of LV winding	mm	
5.13	Height of HV winding	mm	
5.14	ID/OD of HV winding	mm	
5.15	ID/OD of LV winding	mm	
5.16	Thickness of the duct in LV winding	mm	
5.17	Thickness of the duct in HV winding	mm	
5.18	Thickness of the duct between HV and LV	mm	
6	Material and their makes offered		Source of Material (Make and factory location)
6.1	Aluminium Conductor		
6.2	Insulating winding wires		

5.4 TRANSFORMER TANK

1) The transformer tank should be round and made of good quality, electrically tested welded mild steel sheet of adequate thickness suitably stiffened to provide sturdy and robust construction to withstand extreme pressure conditions.

2) The Tank shall be fabricated by welding at corners. No Horizontal & vertical joints in Tank sidewalls & its top & bottom covers shall be allowed. The transformer tank shall be of robust construction round in shape and shall be capable of withstanding a pressure of 100 kPa and a vacuum of 760 mm of mercury.

3) The Thickness of the Tank should be as: For Top & bottom plate – 5mm. Min, For sides – 3.15mm. Min.

4) The Circular bottom plate edges of the tank should be folded upward for at least 25mm to have sufficient overlap with Vertical side wall of Transformer so that oil shall not reach bottom surface to avoid oil leakage.

5) The Tank cover shall have plasticized surfaced at top to guard against Bird fault. Alternatively, suitable UV resistance polymeric insulating shrouds (Height 300mm) to be provided on bushing Terminals.
6) The Tank cover shall be conical shape (Slope at least 15 degree taking Horizontal plane as surface)
7) The Tank cover should be fixed to tank through Anti-Theft/ shear bolt arrangement to prevent Theft.
8) There must be sufficient space from core to Top cover to take care of the oil expansion. The oil volume inside the Tank such that even under extreme operating condition the pressure generated inside the tank does not exceed 0.4kg/sq.cm positive or negative and the Tank should have adequate mechanical strength to withstand it.
9) The tank shall be capable of withstanding a pressure up to + 0.8 Kg./cm2 and vacuum of 0.7kg/cm2 of mercury for 30minutes without any deformation.
10) The Tank design shall be such that the core and the winding lifted freely without dismantling the bushing.
11) All joints of Tank & fitting shall be oil tight & free from bulging.
12) Minimum oil level mark shall be embossed inside the tank (at 25 Degree).
13) The Tightening torque chart to be provided for all bolts used in specific rating.This shall be submitted along with drawing.

5.5 Lifting Lugs & Mounting Lugs

1) The Transformer shall be provided with two permanent lifting lugs (enclosed type) of M S Plate for transformer body.

2) The location of the lifting lug such that clearance between lifting chain & nearest part shall be at least 100mm.
3) There shall be facilities for lifting the core coil assembly separately.
4) The lifting lug shall be capable of withstanding two times weight of the Transformer.
5) Calculation sheet for lifting lug design to be submitted by bidder.
6) Thickness of MS Plate for lifting lugs shall be minimum 5mm or more as per calculation.
7) The Transformer shall be provided with two mounting lugs (made of steel of 5mm thickness) suitable for fixing the transformer to a single pole by means of 2 bolts of 20mm dia. as per the calculation.
8) The mounting lug faces should be in one plane.
9) Calculation sheet for mounting lug design to be submitted by bidder.

5.6 GASKET

Gaskets shall be made of synthetic rubber having high chemical properties and long life to reduce oil leakages, provided with the transformers for making oil tight joints, and there shall be no deleterious effects on either gaskets or oil when the gaskets are continuously in contact with hot oil. The gasket provided in between

Top cover plate and tank shall be neoprene rubberized oil resistant cork sheets conforming to type V as per IS 11149, to maintain the seal at extremes of operating temperature. The gasket provided for HV, LV bushing terminal box cover shall be conforming to type c, RC Grade 70 as per IS:4253, to maintain the seal at extremes of operating temperature. Joint free Gasket to be used only. Exterior gaskets shall be weatherproof and shall not be affected by strong sunlight.

5.7 SURFACE PREPARATION AND PAINTING

The Transformers are proposed to install in coastal belt of Odisha. The equipment should be designed & painted for saline weatherproof. All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects. All primers shall be well marked into the surface, particularly in areas where painting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray. However, where ever airless spray is not possible, conventional spray be used with prior approval of purchaser.

After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting. Steel surfaces shall be prepared by shot blast cleaning (IS: 9954) to grade Sq.2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS: 3618). Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical. Manufacturer to explain such areas in the technical offer.

After cleaning and subsequently drying for four hours, they shall be given suitable anti-corrosion protection. Heat resistant (Hot oil proof) paint shall be used for the inside surface and whereas for external surface one coat of thermosetting powder paint or one coat of epoxy primer (zinc chromate) followed by two coats of synthetic enamel/polyurethane base paint. The two coats shall be of oil and weather-resistant nature with final coat as flossy and non-fading paint of shade 631 as per IS 5 or RAL 7032. The transformer body shall be painted with a circle of 50 mm diameter, centrally placed, just below the radiators. This paint shall be UV resistant, non-fading type.

All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm. Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the bidder shall remove the unsatisfactory paint coating and apply another coating. As a rule, dry film thickness shall not exceed the specified minimum dry film thickens by more than 25%. Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.

Any damaged part shall be cleaned to bare metal with an area extending 25 mm around its boundary. A priming coat shall be immediately applied followed by full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage. The repainted surface shall present a smooth surface, which shall be obtained by carefully chamfering the paint edges before and after priming.

The coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips shall be avoided. Each coat of paint shall be allowed to harden before the next is applied. The thickness of the film shall not be lesser at the edges.

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below & should be guaranteed for any type of damage due to harsh climatic condition for **10 Years.**

Sl.No	Paint type	Area to be painted	No. of Coats	Total dry film thickness (min.) (microns)
1.	Thermosetting	Inside	01	30
2.	Powder Paint	Outside	01	60
3.	Liquid paint Epoxy (primer)	Outside	01	30
4.	P.U. Paint (Finish coat)	Outside	02	25 each
5.	Hot oil paint resistant	Inside	01	35

The painted surface shall be tested for paint thickness. The painted surface shall pass the crosshatch adhesion test and impact test as acceptance tests and salt spray test and Hardness test as type test as per relevant ASTM Standards. The supplier shall provide the painting performance requirement for a period of not less than **10 Years.**

5.8 BUSHING & TERMINAL CONNECTORS

1. HT Bushing (17.5KV/250A)

1. The Bushings shall be two part and outdoor type external part shall be made of porcelain material and rods and nuts (Tightening Nut along with check Nut) shall be made of Tinned brass material.
2. The HV Bushing shall be fixed to the top covers.
3. The HV Bushing shall have arcing Horns.
4. IS to be followed: IS 8603(Part- I) and IS 2099 (latest amendment of IS).

5. The HV Bushing shall be fitted with Polymeric moulded heat shrinkable Insulating covers suitable for protection of HT bushing connector.
7. Tinned Brass/Metallic connectors shall be provided connected on HV Bushing rods suitable up to bare dog conductor in Horizontal & vertical direction.

2. LT Bushing (1KV/250A)

1. The Bushings shall be outdoor type external part shall be made of porcelain material and rods and nuts (Tightening Nut along with check Nut) shall be made of Tinned brass material.
2. IS to be followed IS 3347(Part-1) & IS 7421(latest amendment of IS)
3. LV Bushing shall be provided with Cable Box.

5.9 LV BOX with MCCB

1. LV Box should have made of Mild steel of 2.2mm thickness with suitable handle and front cover shall have anti-theft hinge arrangement with side opening angle of 150degree (min).

Epoxy Insulators shall be provided from top side in LV box to support LV busbar

2. The Box cover shall be with bend edges such that it shall protect the gasket on three sides.
3. Door in Door system to be provided. Small Door shall be designed for MCCB operation only. Both Door shall have rain shed and Magnetic Latch arrangement with Key –locking arrangement.
4. The Single phase MCCB Shall be provided with suitable size of Al bus bar w.r.t minimum current density (calculated) of 1A/ sq. mm inside for further distribution of supply.
5. LV Box shall be IP55 and proper slope shall be provided so that water does not accumulate on cable box and ensure drainage of water.
6. LV Box shall be fixed on the Tank with minimum 06 nuts & bolts with rubberized cork sheet placed in between them, in such a way that they can be completely removed whenever required.
7. The approved make MCCB's are L&T, Havells, ABB, Siemens, Schneider, EATON.
8. Arrangement in the BOX shall be N-Ph from left to right when viewed from front.
9. Neutral Bus bar should be extended and taken out (at least 40mm) of box on a bolt of M10 size and it should be insulated from body. Nuts with bimetallic washers shall be provided on it for earthing.

A) 16KVA **– 63A, 20KA** – 4No's Outgoing.

Gland plate shall be mounted separately with nut bolt arrangement and Gasket in-between them. Gland plate to be provided with half punched / knock out type holes for connecting outgoing cables. Each outgoing cable dia. is 20.5mm. Epoxy insulator shall be provided in the LV Box to support LV Bus bar. Painting of the box should be done as per clause 5.14. Insulated flexible Cu wire with Cu lugs to be used to connect MCCB with both Terminals i.e. phase & neutral.

Nominal size of the cable is as below

1) 25Sqmm multi strand Cu cable for 16KVA DT

5.10 Make of the Major component & Material

Sl.no	Raw material/ Equipment	Make
1	MCCB	ABB, Schneider, GE,L&T, Siemens, Havells, C&S
2	**Transformer Raw materials**	
A.	Copper	M/S Sterlite, M/S Hindustan Copper, M/S Hindalco
B.	Core	M/S A K Steels, M/S POSCO, M/S Kawasaki, M/S JFE, M/S Nippon Steel
C.	Insulation Paper	M/s Raman Boards- Mysore M/s Senapathy Whiteley Pvt Ltd- Bangalore
D.	Transformer Oil	Savita/Apar/Gandhar
E.	Gasket & Corks	Nu Cork, Anchor Corks
F.	Steel for Tank	M/S Tisco, M/S Sail, M/S Bhusan Steel, M/S ISSCO, M/S RINL, M/S Jindal Steel

5.11 Equalizing / Equipotential Strip

1. The Transformer top cover shall be connected at two places (diagonally opposite with each other) with the tank by tinned copper strip (30mm wide, 1mm thick).

2. The strip should touch bare surface of tank in order to ensure proper electrical connection of tank with top cover with the strip.

5.12 Earthing Connections

The provision for earthing connection shall be provided for 25x6 mm GI strip with insulated mounting support. The bolts shall be located on the lower side of the transformer and be of M12 size for Body earthing. LV neutral bushing provided shall be used for neutral earthing. Transformer top cover shall be connected at two diagonal places with the tank by tinned copper strip.

5.13 Pressure Release Device

1) The Transformer shall be equipped with a self –sealing pressure release device designed to operate minimum pressure of 8PSI (0.564kg/sq. cm).
2) The pressure release device shall be provided in low voltage terminating portion of the tank above top oil level.

5.14 Overloading capacity

The Transformer shall be suitable for loading as per IS:6600

5.15 Oil

All transformers shall be filled to the required level with new, unused, clean, standard mineral oil in compliance with IS 335/ IEC 296 and shall be free from all traces of polychlorinated biphenyl (PCB) compounds. The use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than 2.5×10^{12} ohm-cm at 27˚C When tested as per IS 6103. Oil shall be filtered and tested for break down Voltage (BDV) and moisture content before filling. Oil shall be filled under vacuum. The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

The Dielectric strength and water content shall meet with given below requirement:

Break Down Voltage (min.)	Water content ppm, (max.)
60	30

5.16 Radio Interference

When operated at voltages up to 12.5% in excess of the normal system rating, transformers shall be substantially free from partial discharges (i.e. corona discharges in either internal or external insulation) which are likely to cause interference with radio or telephone communication.

5.17 FASTENERS

All bolts, studs, screw threads, pipe threads, bolt heads and nut bolts shall comply within the appropriate Indian standards for metric threads. Bolts or studs shall not be less than 6mm 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 shall 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 have electrolytic action between dissimilar metals. Each bolt shall project at least one thread but more than three threads through the nut. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided. The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members. Taper washers shall be provided where necessary. Protective washers of suitable material shall be provided on front and back of the securing screws.

5.18 FITTINGS

The following standard fittings shall be provided:

a) Two Earthing terminals with the earthing symbol and with lugs - 2 Nos.

b) Lifting lugs 2No’s for complete Transformer.

c) HV Side Neutral Earthing Strip.

d) LV Side earthing arrangement.

e) HV Bushing with arcing Horns- 1No's (17.5KV/250A)

f) LV bushing -1No

g) Pressure relief Device.

h) Top cover-fixing clamp

i) Mounting lugs (2No's) & mounting provision for Transformer.

j) MCCB with Distribution Box

k) Terminal connector for HT & Palm connector for LT Side

.

6.0 MARKING:

The **Name Plate** shall be strictly as per IS 1180:2014. Additionally, following points shall be displayed:

1. Actual no load loss of the transformer
2. Actual Total losses of transformer at 50% load

& 100% load

3. Standard Mark (BIS certification)
4. "PROPERTY OF TPSODL" shall be written in bold letters
5. PO number with date has to be mentioned

6.1 Rating Plate

A stainless steel rating plate, of at least 1 mm thickness, shall be fitted to each transformer in a visible position and shall carry all the information as specified in the standards. The letters on the rating plate shall be engraved black on the white/silver background. Fixing screws for outdoor use shall be of stainless steel or any other corrosion resistant metals. Danger notice shall have red lettering on a white background or they may be pictorial as approved by the Purchaser.

<u>The nameplate shall contain following information:</u>

a) Type of transformer
b) Relevant standard.
c) Manufacturer's Name
d) Manufacturer's Serial No.
e) Year of Manufacture
f) No. of phases
g) Rated kVA
h) Rated frequency

i) Rated Voltage
j) Rated current
k) Connection symbol
l) Percentage impedance voltage at rated current
m) Type of cooling
n) Total mass
o) Mass and volume of insulating Oil
p) BIL
q) Standard mark (BIS certification).
r) "**TPSODL**" shall be written in bold letters.
s) PO number with date has to be mentioned.

In addition to the above information, the rating plate shall also contain the following:

a) Guaranteed values of no load losses and full load losses at 50% & 100 % load
b) Temperature rise
c) Table giving the tapping voltage, tapping current and tapping power of each tap.
d) Indication of winding which is fitted with tapings
e) Value of short circuit impedance on extreme tapping and on principal tapping and indication of winding to which
f) Impedance is related.
g) Actual losses of transformer
h) Overall dimensions

7.0 TESTS:

The bidder shall be required to submit complete set of the following test reports along with the offer:

7.1 ACCEPTANCE TESTS:

1. Temperature Rise Test (on one unit of every release order / PO for each rating) [As per IS 2026 (Part 2) Clause no.4]
2. Oil leakage test for acceptance shall be conducted at pressure of 0.35kg/sq.cm for one hour. (IS 1180 (Part 1) clause 21.5.1.3)
3. The painted surface shall pass the Cross Adhesion Test (IS1180 part 1 clause no. 21.4.d).
4. At stage inspection -Checking of weight, dimensions, fitting and accessories, tank sheet thickness, oil quantity, material finish and workmanship, physical verification of core coil assembly and measurement of flux density on one unit of each rating of the offered lot with reference to the GTP and contract drawings. Oil BDV of all offered lot.
5. At least 10% transformer of the offered lot (minimum of one) shall be subjected to all the tests mentioned under the section 'ROUTINE in presence of TPSODL's representative at the place of

manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS: 1180 and IS: 2026.

6. Magnetic Balance Test on HV & LV side, with magnetizing current HV and LV side as per CBIP manual publication no. 317

7. **ROUTINE TESTS**

Sl.No	Test to be done	Reference BIS	Clause no.
1	Measurement of Winding Resistance at each tap	IS 2026 (Part 1)	16.2.1 & 16.2.3
2	Measurement of voltage ratio, check of voltage displacement, polarity, phase sequence and vector group	IS 2026 (Part 1)	16.3
3	Measurement of short circuit impedance and load loss at 50% and 100% load	IS 2026 (Part 1)	16.4
4	Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 112.5% of rated voltage	IS 2026 (Part 1)	16.5
5	Measurement of insulation resistance	IS 2026 (Part 1)	16.6
6	Induced over voltage withstand test	IS 2026 (Part 3)	11
7	Separate Source voltage withstand test	IS 2026 (Part 3)	10
8	Pressure test	IS 1180 (Part 1)	21.5.1.2
9	Oil leakage test	IS 1180 (Part 1)	21.5.1.3
10	BDV and moisture content of oil in transformer (Type-2 oil)	IS 335 (2018)	Table 2
11	Unbalance current or Neutral current measurement: The value of the zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.	CBIP manual publication no. 317	CBIP 317

7.3 TYPE TESTS

i) Lightning Impulse Test [As per IS 2026]
ii) Temperature Rise Test [As per IS 2026]
iii) Short Circuit Withstand test [As per IS 2026]
iv) Pressure Test [As per IS 1180].
v) Determination of sound levels at No load [IS 2026 (part 10)].
vi) Test to verify IP 55 for cable box. (As per IS 60529 clause 11 to 15)

Note: - Out of the above mention type test, the tests under sl. No. 1, 2, 3 and 4 shall be conducted at CPRI/ERDA labs and the balance tests to be conducted at TPSODL recommended NABL lab. **In-house test**

labs are accepted if in-house lab is NABL accredited for these tests.

8.0 TYPE TEST CERTIFICATES:

The Bidder shall furnish the type test certificates of the Transformer for the tests as mentioned above as per the corresponding standards. All the tests shall be conducted at **CPRI / ERDA** or as defined in 7.1 as per the relevant standards. Type tests should have been conducted during the period not exceeding 5 years from the date of opening the bid. In the event of any discrepancy in the test reports, i.e. any test report not acceptable or any/all type tests (including additional type tests, if any) not carried out, it shall be carried out without any cost implication to TPSODL.

9.0 PRE-DISPATCH INSPECTION:

1. Equipment shall be subject to inspection by a duly authorized representative of the TPSODL. Inspection may be made at any stage of manufacture at the option of the purchaser and the equipment if found unsatisfactory as to workmanship or material, the same is liable to rejection.
2. Bidder shall grant free access to the places of manufacture to TPSODL's representatives at all times when the work is in progress. Inspection by the TPSODL or its authorized representatives shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications.
3. The BA shall arrange for complete dispatch ready transformer at least 10% of lot during inspection.
4. Material shall be dispatched after specific MDCC (Material Dispatch Clearance Certificate) is issued by TPSODL .

<u>Following documents shall be sent along with material.</u>

a) Test reports
b) MDCC issued by TPSODL
c) TPSODL Invoice in duplicate
d) Packing list
e) Drawings & catalogue
f) Guarantee / Warrantee card
g) Delivery Challan
h) Other Documents (as applicable).

5. To ascertain the quality of the transformer oil, the original manufacturer's tests report shall be submitted at the time of inspection. Arrangements shall also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of TPSODL's representative. In respect of raw material such as core stampings, winding conductors, insulating paper and oil, bidder shall use materials manufactured/supplied_by_standard manufacturers and furnish the manufacturer's' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

a) Invoice of supplier
b) Mill's certificate
c) Packing List
d) Bill of Landing
e) Bill of entry certificate by custom.

6. To ensure about the quality of transformers, the inspection shall be carried out by the purchaser's representative at following two stages :-

   a) Online anytime during receipt of raw material and manufacture/assembly whenever the purchaser desires.
   b) At finished stage, i.e. transformers are fully assembled and are ready for dispatch.

7. Advance intimation of 7 days for Odisha /12 day outside outside Odisha is required for both stage and final inspections.

8. After the main raw material i.e. core and coil material and tanks are arranged and transformers are taken for production on the shop floor and a few assembly have been completed, the Bidder shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the inspection the bidder shall also furnish the information regarding various components used to manufacture the DTs.

9. During the stage inspection a few assembled core shall be dismantled (only in case of CRGO material) to ensure that the CRGO laminations used are of good quality. Further, about the readiness of the transformers, for final inspection for carrying out tests as per relevant IS/IECs shall be sent by the Bidder along with routine test certificates. The inspection shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection.

10. All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the inspector representing the Purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspectioh during manufacturing stage as well as Active Inspection during Acceptance Tests.

11. The bidder shall provide all services to establish and maintain quality of workmanship in his works and that of his sub-contractors to ensure the mechanical / electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 90.00.

12. The Purchaser has the right to have the test carried out at his own by an independent agency

wherever there is a dispute regarding the quality supplied. Purchaser has right to test 1 % of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser have every right to reject the entire lot or penalize the bidder, which may lead to blacklisting, among other things.

13. TPSODL also reserves the right to inspect the tank of transformer before surface preparation and painting. The same shall be informed to TPSODL accordingly.
14. At the time of inspection the material should be ready as specified, In case of material non readiness or material failure in acceptance, cost of re-inspection shall be borne by bidder.

10.0 INSPECTION AFTER RECEIPT AT STORE:

1. The material received at the TPSODL store shall be inspected for acceptance and shall be liable for rejection, if found different from the reports of the pre-dispatch inspection.
2. In case the transformers proposed for supply against the order are not exactly as per the tested design, the Bidder shall be required to carry out the short circuit test and impulse voltage withstand test at its own cost in the presence of the representative of TPSODL.
3. The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.
4. Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations
5. TPSODL reserves the right to conduct all tests on Transformer after arrival at site / stores and the manufacturer shall guarantee test certificate figures under actual service conditions.
6. TPSODL reserves the right to conduct short circuit test and impulse voltage withstand test in accordance to IS, afresh on each ordered rating at purchaser cost, even if the transformer of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by TPSODL either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to TPSODL stores. The findings and conclusions of these tests shall be binding on the bidder.

11.0 GUARANTEE:

1. Bidder shall stand guarantee towards design, materials, workmanship & quality of process/ manufacturing of items under the contract for due and intended performance of the same, as an integrated product delivered under this contract. In the event any defect is found by the Purchaser up to a period of 48 months from the date of commissioning or 60 months from the date of last supplies made under the contract, whichever is earlier.

2. Bidder shall be liable to undertake to replace/rectify such defects at his own costs within mutually agreed timeframe and to the entire satisfaction of the TPSODL, failing which the TPSODL will be at liberty to get it replaced/rectified at Bidder's risks and costs and recover all such expenses plus the TPSODL's own charges (@ 20% of expenses incurred), from the Bidder or from the "Security cum Performance Deposit" as the case may be.
3. In case of Distribution transformer fails within the guarantee period TPSODL will immediately inform the Bidder who shall take back the failed Distribution Transformer within 15 days from the date of intimation at his own cost and replace / repair the transformer within forty five days of date of intimation with a roll over guarantee. The outage period i.e. period from the date of failure till unit is repaired / replaced shall not be counted for arriving at the guarantee period.
4. Bidder shall further be responsible for 'free replacement' for another period of THREE years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Purchaser.

12.0 PACKING AND TRANSPORT:

1. Bidder shall ensure that all the equipment covered under this specification shall be prepared for rail/road transport in a manner so as to protect the equipment from damage in transit.

   Note: One use plastic not to be used for packing of the material.Packing shall be done with environment friendly recyclable materials.

13.0 TENDER SAMPLE:

All offered transformer detailed documents to be submitted as per clause no.18. The sample shall be not applicable

14.0 QUALITY CONTROL:

The bidder shall submit with the offer Quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. TPSODL's engineer or its nominated representative shall have free access to the manufacturer's/sub-supplier's works to carry out inspections.

The following information shall necessarily be submitted with the bid:

1. List of important raw materials, names of sub-suppliers for raw materials, standards to which raw material is tested and the copies of test reports of the tests carried out on raw materials in presence of Bidder's representatives.
2. List of manufacturing facilities available, level of automation achieved and the areas where manual process exists.
3. List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of these tests and inspections
4. List of testing equipment for final testing with valid calibration reports. Manufacturer shall possess 0.1 class instruments for measurement of losses.

15.0 TESTING FACILITIES:

Bidder shall have adequate in house testing facilities for carrying out all routine tests, acceptance tests and pre-dispatch inspection as per relevant International / Indian standards.

16.0 MANUFACTURING FACILITIES:

The successful bidder will have to submit the bar chart for various manufacturing activities clearly elaborating each stage, with quantity. This bar chart should be in line with the Quality assurance plan submitted' with The offer. This bar chart will have to be submitted within 15 days from the release of the order.

17.0 SPARES, ACCESSORIES AND TOOLS

1. Bidder shall provide a list of recommended spares with quantity and unit prices for 5 years of operation after commissioning. The Purchaser may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be supplied as part of the definite works. The Purchaser may order additional spares at any time during the contract period at the rates stated in the Contract Document.
2. Bidder shall give an assurance that spare parts and consumable items will continue to be available through the life of the equipment, which shall be 25 years minimum. However, the Purchaser shall be given a minimum of 12 months' notice in the event that the Bidder or any sub-vendor plans to discontinue manufacture of any component used in this equipment.
3. Any spare apparatus, parts or tools shall be subject to the same specification, tests and conditions as similar material supplied under the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the plant and must be suitably marked and numbered for identification.

18.0 DRAWINGS AND DOCUMENTS:

Following drawings and documents shall be prepared based on TPSODL specifications and statutory

requirements and shall be submitted with the bid:

a. Completely filled in compliance to each clause of Technical Specification and any Additional Details and Fittings.
b. Description of the transformer and all components drawings.
c. General arrangement for Transformer.
d. LV terminal box drawing along with CT if applicable and cleat arrangement and gland plate drawing.
e. Bill of material.
f. Foundation plans
g. Experience Certificate and list
h. Type test certificates.
i. List of makes of major components as listed above.

Drawings / documents to be submitted for approval after the award of the order within 7 days before mass manufacturing are as under:

List of Drawings/Parameters to be submitted:

1. Clause wise Compliance of the specification
2. General Arrangement Drawing of the Transformer (Front view, Top view and both sides view. Complete list of fittings to be displayed and quantities to be mentioned with the drawing).
3. Internal Core arrangement drawing.
4. Internal Core-coil assembly drawing.
5. Marking plates and Markings (as mentioned in clause 6)
6. Foundation Plan drawing.
7. HV and LV bushings drawing (with internal view and metal parts)
8. HT connector / LT connector (palm connector), Aluminium Busbar
9. LV Box drawing.
10. BH curve of core material offered
11. Gland Plate for LV box.
12. Prismatic oil level gauge drawing.
13. LV Terminal Box drawing with internal wiring arrangement of bus bar etc.
14. Gland plate
15. Cable cleat arrangement
16. Type Test Certificates.
17. Installation Instructions.

18. Quality Assurance plan.

2. **List of Calculations to be submitted:**

All the calculations shall be step by step showing the use of formulas and other practical considerations. **Concise calculations in table or excel sheet shall not be accepted.** Also, the reference (only standard sources as IS, IEC or any such standard is acceptable) of the formulas shall be mentioned.

1. Resistance Calculation (75 deg. C)
2. Load Losses Calculation (at 75 deg. C)
3. No load Losses.
4. Stray Losses.
5. Weight of Aluminium (Bare and with Insulation also).
6. Weight of Core.
7. Flux Density calculations.
8. Current Density Calculations.
9. Short Circuit withstand.
10. Temperature Rise Calculations.
11. Cooling Calculations showing cooling with tank and radiators separately with no. of radiators and fins mentioned specifically.

Additional Documents to be Submitted:

a. List of raw materials as well as bought out accessories and name of sub-suppliers selected from those furnished along with offer.
b. Type test certificates of the raw materials and bought out accessories.
c. The successful Bidder shall submit the **routine test certificates of bought out accessories** and central excise passes for raw material at the time of routine testing.

All the documents & drawings shall be in English language. After the receipt of the order, the successful bidder will be required to furnish all relevant drawings/parameters/calculation to TPSODL for approval.

Instruction Manuals:

Bidder shall furnish softcopies of nicely bound manuals (In English language) covering erection and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices.

19.0 SCHEDULE- "A" GUARANTEED TECHNICAL PARTICULARS:

All clauses and points in the specification to be complied

20.0 SCHEDULE "B" DEVIATIONS:

(TO BE ENCLOSED WITH TECHNICAL BID)

The Bidders, clause by Clause in this schedule, shall set out all deviations from this specification. Unless specifically mentioned in this Schedule, the tender shall be deemed to confirm the purchaser's specifications:

SL. No	Clause No.	Details of deviation with justifications

We confirm that there are no deviations apart from those detailed above.

Seal of the Company:

Signature

Designation

CONTENTS

1. SCOPE:

I. This Specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing forwarding, supply and unloading at site/store and performance of Oil immersed, non-sealed, naturally cooled, three Phase 11/0.433 kV, 50Hz, outdoor conventional type, aluminium winding, Distribution Transformer of 25kVA to 100 KVA ratings.

II. The transformer shall be complete with all components and accessories, which are necessary or usual for their efficient performance and trouble free operation under the various operating and atmospheric conditions specified in clause no. 3

III. Such of the parts that may have not been specifically included, but otherwise form part of the transformer as per standard trade and/or professional practice and/or are necessary for proper operation of transformer, will be deemed to be also included in this specification. The successful bidder shall not be eligible for any extra charges for such accessories etc. notwithstanding the fact that at the time of an initial offer bidder had segregated such items and quoted for them separately.

2. APPLICABLE STANDARDS:

The equipment (and the materials used) covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following Indian standards & other relevant standards for components, BEE & CEA guidelines with latest amendment from time to time, thereof, some of which are listed below:

Indian Standards	Title
IS 1180	Outdoor Type Oil Immersed Distribution Transformers Upto and Including 2500 KVA, 33 kV-Specification
IS 2026 (all parts)	Specification for Power Transformers
IS 104	Specification for ready mixed paint, brushing, zinc chrome, priming
IS 335	Specification for new insulating oil.
IS 649	Testing for steel sheets and strips and magnetic circuits.
IS 5	Specification for Colors for ready mixed paints and enamels
IS 1576	Solid Pressboard for Electrical Purposes -Specification
IS 2099	Specification for bushings for alternating voltages above 1000 volts

IS 2362	Determination of water content in oil by Karl in oil Fischer Method – Test Method.
IS 3024	Grain oriented electrical steel sheets and strips
IS3347 (Part I & Part-3)	Dimensions for Porcelain Transformer Bushings for Use in Normal and Lightly Polluted Atmospheres - Part 1 : Up to and including 1 kV
IS 4253: Part II:	Specification for cork composition sheets- Part II : Cork and Rubber
IS 4257 (Part I)	Dimensions for Clamping Arrangements for Porcelain transformer Bushings - Part I: For 12 kV to 36 kV Bushings
IS 5082	Wrought Aluminum and Aluminum Alloy bars, Rods , Tubes, Sections, Plates and Sheets for Electrical Applications
IS 5561	Specification for Electric Power Connectors
IS 6103	Specification for Testing of specific resistance of electrical insulating liquids
IS 6600	Guide for loading of Oil-immersed transformer
IS 6792	Method for Determination of Electric Strength of Insulating Oil
IS 7404 (Part-1	Paper Covered conductors: Round Conductors
IS 7421	Specification for porcelain bushings for alternating voltages up to and including 1000kv
IS 8603 (Part-1)	Dimensions for Porcelain Transformer Bushings for Use in Heavily Polluted Atmospheres - Part I:12 kV and 17.5 kV Bushings
IS 9335	Specification for Cellulosic Papers for Electrical Purposes
IS 10028	Code of Practice for Selection, Installation and Maintenance of Transformers
IS 11149	Specification for rubber gaskets
IS 12444	Specification for Continuously Cast and Rolled Electrolytic Copper Wire Rods for Electrical Conductors.
IS 4026	Aluminium Ingots

IS 6160	Rectangular electrical conductors for electrical machines
IS 13964	Methods of measurement of transformer and reactor sound levels
IS 3401	Specification of silica Gel
IS 1897	Copper strip for electrical purposes
IS 60529	Degree of protection provided by enclosure
IS 816	Welding of Mild Steel
CEA	Guidelines for specifications of energy efficient outdoor type single and three phase distribution transformers
IS 6162	Paper covered aluminium conductor
IS 16659	Fluids For Electro technical Applications - Unused Natural Esters For Transformers And Similar Electrical Equipment
IS 16081	Insulating liquids — Specifications for. Unused synthetic organic esters for Electrical purposes
IEC 60156	Method of determination of electric strength of insulating oils.
IEC 60296	Specification for unused mineral insulating oils for transformers and switchgear.
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IS 1852	Rolling and cutting tolerances for hot rolled steel products
IS 504	Methods of chemical analysis of aluminium

3. CLIMATIC CONDITIONS:

1	Maximum ambient temperature	50 deg C
2	Max. Daily average ambient temp	35 deg C
3	Min Ambient Temperature	0 deg C
4	Maximum Humidity	95%
5	Average Annual Rainfall	1500mm

6	Average No. of rainy days per annum	120
7	Altitude above MSL not exceeding	1000m
8	Wind Pressure	300 Km/hr
9	Earthquakes of an intensity in horizontal direction	equivalent to seismic acceleration of 0.3g
10	Earthquakes of an intensity in vertical direction	equivalent to seismic acceleration of 0.15g (g being acceleration due to gravity)

TPSODL service area has heavy saline conditions along the coast and High cyclonic Intensity winds with speed upto 300 Kmph. The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months.

4. GENERAL TECHNICAL REQUIREMENTS:

Sl No	Description	Standard Sizes as per IS 1180 (Part-1) :2014		
SL. No.	TECHNICAL PARTICULARS	DESIRED VALUE		
1	Continuous Rated Capacity (kVA)	**25 kVA**	**63 kVA**	**100 kVA**
2	Application	Outdoor		
3	System voltage (max.)	12 kV		
4	Rated voltage HV (kV)	11		
5	Rated voltage LV (V)	433-250		
6	Line current HV (A)	1.312 A	3.306 A	5.25 A
7	Line current LV (A)	33.33 A	84.10 A	133.34 A
8	Frequency (Hz)	50 Hz		

9	No. of Phases	Three		
10	Connection HV	Delta		
11	Connection LV	Star (Neutral Brought out)		
12	Vector group	Dyn11		
13	Type of cooling	ONAN		
14	Noise level at rated voltage and frequency	48 dB	51 dB	51 dB
15	Permissible temperature rise over ambient:			
15.1	Of top oil measured by thermometer	35 ºC	35 ºC	35 ºC
15.2	Of winding measured by resistance	40 ºC	40 ºC	40 ºC
16	Max. Total Losses at 50% loading at 75°C (watts)	175	300	435
17	Max. Total Losses at 100% loading) at 75°C (Watts)	595	1050	1500
18	Short circuit impedance voltage at 75°C (±10% tolerance)	4.50%		
19	Insulation Class	A		
20	Normal Flux Density (at rated voltage and frequency)	1.6 T		

21	Maximum flux density (Increase of +12.5% combined voltage and frequency variation from rated voltage and frequency)	1.9 T (Max.)
22	Maximum current density (A/mm²)	1.6
23	Impulse withstand voltage	75 kVp
24	Power frequency withstand voltage	28 kV
25	Voltage fluctuations permissible	+12.5% to -12.5%
26	Neutral Terminal	Two separate brought out neutral from main neutral bus bar, one for taking out the neutral for 4 wire system and other additional neutral for solid earthing outside LV box on side
27	**Minimum clearances in air (mm) :**	
27.1	HV phase to phase/ phase to earth	255 / 140
27.2	LV phase to phase/ phase to earth	75 / 40
28	**Minimum clearances in Cable Box (mm):**	
28.1	HV phase to phase/ phase to earth	130 / 80

28.2	LV phase to phase/ phase to earth	25 / 20

5. GENERAL CONSTRUCTION:

I. The transformer shall be double wound, aluminium coil, oil immersed, naturally cooled (ONAN) and non-sealed type with rectangular tank.

II. The transformer shall be suitable for service with fluctuations in supply voltage up to +12.5% to -12.5%.

III. The transformer and accessories shall be designed to facilitate trouble free operation, inspection, maintenance and repairs under the various operating and atmospheric conditions specified in clause no. 3.The design shall incorporate every precaution and provision for the safety of the equipment as well as staff engaged in operation and maintenance of the equipment.

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

5.1 CORE:

I. Transformer core shall be stack/wound type, constructed from high grade cold rolled, non-ageing, grain oriented, silicon steel lamination which shall be properly annealed (under inert atmosphere, if required) to relieve stresses.

II. The core shall have low loss and good grain properties. It should be coated with hot oil proof insulation, bolted together with frames to prevent vibration and noise.

III. The core thickness should be 0.23mm. Grade shall be 23HP85 as per IS 3024 or better with Minimum Polarization in Tesla at a Field Strength of 800 A/m.

IV. All core clamping bolts (if any) shall be effectively insulated.

V. Only one grade and one thickness of core shall be accepted and mixing of different grades shall not be allowed.

VI. The handing of core lamination and stacking should be smooth and uniform.

VII. The complete design of the core must ensure maximum permanency of the core losses without continuous working of the transformers.

VIII. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated. The vendor shall submit the calculations in support of the

same.

IX. The transformer shall be suitable for continuous service without damage under over fluxing where the ratio of voltage over frequency exceeds the corresponding ratio at rated voltage and rated frequency up to 12.5% and the core shall not get saturated . The BH graph to be submitted for material.

X. The **No load current shall not exceed 2% of 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 5% maximum of full load current.**

XI. The bidder shall be required to submit the following documents in regard to procurement of core material during stage inspection:

a. Invoice of supplier
b. Mill's test certificate
c. Packing list
d. Bill of landing
e. Bill of entry certificate by custom (if required)
f. Description of material, electrical analysis, physical inspection certificate for surface defects, thickness and width of material.

XII. The bidder shall offer the core for inspection and approval of TPSODL during manufacturing stage. Heavy penalty or black listing shall be imposed on the bidders using seconds/defective CRGO sheets i.e in case of nonconformance w.r.t TPSODL Specifications.

XIII. The core coil assembly shall have four enclosed (no hook) lifting lugs.

Sr. No.	Magnetizing (no load) current at:	Unit	To be furnished by bidder
1	90% Voltage	%	
2	100 % Voltage	%	
3	112.5% voltage	%	
4	Core grade and make		
5	Thickness of core	mm	
6	Core Diameter	mm	
7	Gross core area	Sq. cm	
8	Net Core area	Sq. cm	
9	Flux Density (calculated)	Tesla	
10	Overfluxing without saturation (BH curve to be submitted)	Tesla	

11	Mass of core		
12	Loss per Kg. of the core at the above specified flux density	Watt	
13	Core window height	mm	
14	Center to center distance of the core	mm	
15	**Mass of:**		
15.1	Core Lamination (minimum)	kg	
15.2	Windings with insulation (minimum)	kg	
15.3	Tank and fittings	kg	
15.4	Oil	kg	
15.5	Oil Quantity (minimum)	Ltr	
15.6	Total Weight	kg	
16	Material and their makes offered		**Source of material (make and factory location)**
16.1	Core laminations		
16.2	Press Boards		
16.3	Kraft paper		

5.2 WINDING CONNECTIONS

I. Primary and secondary windings shall be constructed from high- conductivity(aluminium conductors), Double Paper Covered (DPC) aluminium conductor of grade 2(Al 99.6%) as per IS 5484 with min**. 25%** overlap per layer of paper**. Epoxy diamond dotted Kraft paper to be used for DPC conductor all rating.**

II. The current density for HV and LV winding should not be more than **1.6 Ampere per sq.mm**.

III. The insulation between core and bolts and core and clamps shall withstand **2.5 kV for one minute**.

IV. Inter layer insulation both for HV and LV windings shall be Epoxy dotted diamond Kraft paper and pressboard of standard make or any other superior material subject to approval of TPSODL

V. All spacers, axial wedges / runners used in windings shall be made of pre-compressed solid pressboard. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges/runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations. Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted as per standards.

VI. LV winding shall be such that neutral formation is at the top.

VII. All turns of windings shall be adequately supported to prevent movement. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

VIII. The joints in the winding shall be avoided but if it is necessary then, these shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. Crimping is not allowed at any joints.

IX. Provide the conductor size and material grade in below table.

SNo	Insulation materials provided	Unit	To be furnished by bidder
1	**For conductors**		
1.1	HV		
1.2	LV		
1.3	Core		
2	**Material and size of the wire used**		
3	**HV Conductor Grade**		
3.1	Size of HV conductor bare/covered	mm	
3.2	Area of cross section	Sq.mm	
3.3	Conductivity & Purity		
4	**LV Conductor Grade**		
4.1	Size of LV conductor bare/covered	mm	
4.2	No. of conductors in parallel	Nos.	
4.3	Total area of cross section	Sq.mm	
4.4	Conductivity & Purity		
5	**Resistance of windings at 20**		
5.1	HV windings	Ohms/phase	
5.2	LV windings	Ohms/phase	
5.3	No. of LV Turns		
5.4	No. of HV Turns		
5.5	No. of parallels		
5.6	Current density of LV winding(calculated)	A/sq.mm	
5.7	Current density of HV winding(calculated)	A/sq.mm	
5.8	Wt. of the LV winding copper without insulation	Kg	
5.9	Wt. of the HV winding copper without insulation	Kg	
5.10	No. of LV coils/phase		
5.11	No. of HV coils/phase		
5.12	Height of LV winding	mm	
5.13	Height of HV winding	mm	
5.14	ID/OD of HV winding	mm	

5.15	ID/OD of LV winding	mm	
5.16	Thickness of the duct in LV winding	mm	
5.17	Thickness of the duct in HV winding	mm	
5.18	Thickness of the duct between HV and LV	mm	
6	Material and their makes offered		Source of Material (Make and factory location)
6.1	Aluminium Conductor		
6.2	Insulating winding wires		

5.3 LOSSES

I. The bidder shall also guarantee the total loss at 50% and 100% load condition (at rated voltage and frequency and these should be within the limits of maximum total losses declared by TPSODL for both 50% and 100% loading values (as per table below) :

Description	Rating (kVA)		
	25	**63**	**100**
Maximum total Losses at 50% loading at 75ºC (Watts)	175	300	435
Maximum total Losses at 100% loading at 75ºC (Watts)	595	1050	1500

No positive tolerance shall be allowed on the losses as mentioned above. However, bidder can offer losses less than specified but no consideration in cost will be given for the same.

II. The successful bidder shall guarantee the quoted losses for at least five years. If at any point of time during operation if it is found that the total losses at 50% and 100% load are more than the values given in specifications, then bidder shall be liable to pay a fine of Rs 250 per watt to the amount by which losses at 50% loading and 100% loading increase with respect to the values given in specifications.

III. During testing at Bidder's works if it is found that the actual measured losses are more than the values quoted by the Bidder, TPSODLshall have the right to reject the complete lot.

IV. During testing at Bidder's works, if the temperature rise exceeds the specified values, the entire lot shall be rejected by TPSODL.

V. During testing at Bidder's works, if the impedance values differ from the guaranteed values including tolerance, the entire lot shall be rejected by TPSODL.

VI. Transformer losses shall be checked on any one of DT from supplied lot at TPSODL workshop.

VII. The core of coil assembly shall be provided with four lifting hooks.

VIII. **Bidder shall provide the below details in below table:**

Sl. No.	Description	Unit	As furnished by bidder
1	No Load losses	Watt	
2	Load losses at 50%loading at 75° C	Watt	
3	Load losses at 100% loading at 75° C	Watt	
4	Total losses at 50%load at 75° C	Watt	
5	Total losses at 100% load at 75° C	Watt	
6	**Efficiency at 75 deg. C**		
7	**Efficiency at Unity P.F.**		
7.1	125% load	%	
7.2	100% load	%	
7.3	75% load	%	
7.4	50% load	%	
7.5	25% load	%	
8	**Efficiency at 0.8 P.F.**		
8.1	125% load	%	
8.2	100% load	%	
8.3	75% load	%	

8.4	50% load	%	
8.5	25% load	%	
9	**Regulation at :**		
9.1	Unity P.F. at 75 deg. C	%	
9.2	0.8 P.F. at 75 deg. C	%	
9.3	% Impedance at 75 deg. C	%	

5.4 TRANSFORMER TANK AND TANK CONSTRUCTION

I. The transformer tank shall be of robust construction, rectangular and shall be built up of electrically tested welded mild steel plates of thickness 5 mm (min.) for bottom and top and 3.15 mm (min) for the sides for all the three ratings of distribution transformers. The tolerances as per IS 1852 shall be applicable. The tank shall be fabricated by welding at corners. No horizontal or vertical joints in tank side walls and its bottom or top cover shall be allowed. In addition the cover of the main tank shall be provided with an air release plug. 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. The top cover shall have no cut at point of lifting lug. The transformer tank covers shall be bolted/clamped alternatively welded with tank rim so as to make a leak proof joint. The transformer tank shall be of adequate mechanical strength to withstand positive' and negative pressure built up inside the tank while the transformer is in operation. The tank design shall be such that the core and windings can be lifted freely. There shall be no joint at corners and not more than 2 joints in total. Under operating conditions, the pressure generated inside the tank should not exceed 0.4 kg/sq.cm positive or negative. The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank. The permanent deflection when the tank without oil is subjected to a vacuum of 250 mm of mercury for rectangular tank shall not be more than 5mm up to 750mm horizontal length of flat plate and 6.5mm up to 1250mm horizontal length of flat pia . Pressure test shall be performed carefully at the time of 1st stage inspection only to confirm the adequacy of reinforcement angle & gauge of the tank. The tank shall be further capable of withstanding a pre_ssure of 0.8 kg/sq.cm (g) for 30 minutes and a vacuum of 0.34 kg/sq.cm (g) without any deformation.

II. The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings. All joints of tank and fittings shall be oil tight and no bulging shall occur during service. Inside of tank shall be painted with hot oil resistant paint. The top cover of the tank shall be slightly sloping to drain rain water approximately 5° to 10° towards HV bushing. The tank cover shall be provided with suitable insulating shrouds on

bushing terminals. The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle. Bidder shall carry out all welding operations as per relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the Purchaser.

III. All matching faces of joints be made oil tight with a smooth surface finish to ensure that the gasket material makes a satisfactory joint. Bolts shall be spaced at sufficiently close intervals to avoid buckling of either flange or covers and provide reasonably uniform compression of the gasket. The transformer shall be provided with a minimum of two welded heavy duty closed lifting lugs of MS plate of 8mm thickness suitably reinforced by vertical supporting flat welded edgewise below the lug on the side walls up to reinforcing angle. They shall be so extended that cutting bend plate is not required. The lifting lugs shall be capable of withstanding the total weight of the transformer, fully filled with oil. The transformer shall be provided with four pUlling lugs of MS plate of 8mm thick to pull the transformer horizontally.

IV. Bidder shall provide the transformer size and clearances in below table

SNo	Transformer:	Unit	To be furnished by bidder
1	Overall length × Breadth × Height	mm X mm X mm	
2	Only Tank length × breadth × height	mm X mm X mm	
3	Clearances		
3.1	Core and LV	mm	
3.2	LV and HV	mm	
3.3	HV Phase to phase	mm	
3.4	Between HV winding and Yoke	mm	
3.5	Between LV winding and Yoke	mm	
3.6	Between yoke and inside of tank to cover	mm	
3.7	Between yoke and bottom	mm	
3.8	Any point of winding to tank	mm	
4	Calculated Impedance	%	
4.1	HV to earth creep age distance in oil	mm	
4.2	LV to earth creep age distance in oil	mm	
5	Material and their makes offered		Source of Material (Make and factory location)
5.1	Tank material		
5.2	Gaskets		
5.3	Paint		

5.5 RADIATORS

I. Radiators of pressed steel type conforming to the design requirement shall be used.

II. The pressed steel type should be used in vertical formation without any bending and should be individually tested for leakage and pressure test etc. before welding with main tank.

III. Thickness of sheet for radiators shall be **1.20 mm** .

IV. The mounting of the radiators shall be **non detachable.** (i.e they should be welded permanently with the tank.)

V. The number of cross section/ length / fixing arrangement of radiators shall be indicated in the general assembly drawing.

5.6 GASKET

I. **Cork rubber gaskets** conforming to Type C , grade RC70 as per IS 4253 (Part-2) shall be provided for all oil bearing & water ingress resistant requirements for components like HV & LV bushings bottom gasket, HV & LV terminal box, Top Cover, Conservator, Valves etc.

II. **Nitrile/Neoprene rubber gaskets** conforming to Type IV – 4C (heat and oil resistant) as per IS 11149 shall be provided for bushing O ring (oil gaskets).

5.7 BUSHINGS

Bushing shall be two part bushing & terminal arrangement shall be such that it shall be possible to replace external part without opening cover and without affecting sealing of the transformer,

1. HT Bushings (17.5 kV/250 A):

Pole mounted transformers; Outdoor Bushings on Top.

I. The bushings shall be outdoor type external part shall be made of porcelain material and rods and nuts shall be made of tinned brass material.

II. The metal portion of the internal HV & LV bushing inside the tank shall remain dipped in oil in all operating condition.

III. IS to be followed: IS 8603(Part- I) and IS 2099 (latest amendment of IS).

IV. Multiple insulation paper shall be wrapped on multistrand copper wire which is used inside the bushing. Insulation paper shall withstand for 11 kV class.

V. Cross section area of multistrand copper wire used in bushing shall be as per below table.

Sl.No.	Rating (kVA)	Minimum cross section area of copper wire (sqmm)
1	25	2.5
2	63	4

3	100	10

VI. The HV bushings shall be mounted on top cover of the tank.

2. LT bushings(1.1 kV/suitable current rating): Side straight mounted in box with common box

I. The bushings shall be of two part and outdoor type; external part shall be made of porcelain material and rods and nuts shall be made of tinned copper material.

II. The metal portion of the internal HV & LV bushings inside the tank shall remain dipped in oil in all operating condition.

III. IS to be followed : IS 3347(part-1) and IS 7421 (latest amendment of IS)

IV. LV bushings shall be provided witin cable box.

V. **Provide HV & LV bushings maker's details**.

Sr.No.	Material and their makes offered	Source of material (make and factory location)
1	Bushing HV/LV	

5.8 CABLE BOXES

I. Cable boxes made up of Mild Steel with suitable handle and removable front cover shall be bolted type on LV side. The cover shall be with bend edges such that it shall protect the gasket on three sides.

II. Water should not accumulate on cable boxes and proper slope shall be provided in order to ensure drainage of water.

III. Cable box protection should be IP 55.

IV. LV cable boxes shall be fixed on the tank with nuts and bolts (gasket placed in between them) in such a way that they can be completely removed whenever required.

V. Suitable cable clamping/ wooden cleating arrangements shall be provided on LV side to keep Cable straight and to support cables to avoid tension on bushings/busbar due to cable weight. (As mentioned below in 13 & 14 number point).

VI. Non-magnetic Gland plates shall be provided for LV cable box drilled with suitable no. of holes required for installation (as mentioned below in 13 & 14 number point).

VII. Gland plates shall be mounted separately with nut & bolt arrangement and gasket in between them. The gland plate shall be in two parts so that cable can be removed/replaced without cutting of lug/termination etc.

VIII. Support for GI earth strip size of 50 x 6 mm shall be provided so as to avoid tension on secondary neutral bushing.

IX. Neutral terminal of LV winding shall be brought out on LV phase terminals to form four wire system.

X. The LV cable box shall be provided with tinned brass palm connector with aluminium busbar and shall be fitted with brass glands for LV cable .

XI. The length of LV bus bar shall be sufficient for terminating 4C x 150 sqmm. Aluminium conductor ,1.1 kV class, XLPE cable.

XII. The aluminium lugs suitable for terminating the cable of size 4C x 150 sqmm shall also be provided.

5.9 TERMINAL CONNECTORS

HT TERMINAL CONNECTOR:

1. Tinned Brass connector shall be provided connected on HV bushing rods suitable for bare dog conductor connections.

LT TERMINAL CONNECTOR:

2. As per details in clause 5.8.

5.10 EQUILISING/ EQUIPOTENTIAL STRIP

I. The Transformer top cover shall be connected at two places (diagonally opposite with each other) with the tank by **tinned copper strip (30mm wide, 0.7mm thick)**.

II. The strip should touch bare surface of tank in order to ensure proper electrical connection of tank body with top cover with the strip.

5.11 OIL

I. All transformers shall be filled 'to the required level with new, unused, clean, standard mineral oil in compliance with IS 335/ IEC 296 and shall be free from all traces of polychlorinated biphenyl (PCB) compounds. The use of recycled oil is not acceptable.

II. Oil shall be filled under vacuum before filling it shall be filtered and tested (as per IS 6103).

Test parameters	Values
Break Down Voltage (min.)	60 kV
Water content pppm(max.)	20 ppm
Specific resistance (min.) (at 27 deg C)	2.5 x 10^{12} ohm -cm

Bidder has to provide the oil data in below table.

S. No.	Oil data	Unit	To be Furnished by Bidder
1	Quantity for first filling (minimum)	Ltr	
2	Grade of oil used		
3	Marker's name		
4	BDV at the time of filling	KV	

5	**Material and their makes offered**		**Source of material (make and factory location)**
5.1	Transformer oil		

5.12 EXPLOSION VENT

I. Explosion vent shall be provided on the top cover.

II. Double diaphragm with oil observation gauge (prismatic Type with red colored background) shall be provided on explosion vent pipe.

5.13 FASTENERS

I. All the bolts or studs shall be **at least 6 mm in diameter** except when used for small wiring terminals.

II. All nuts/bolts/washers exposed to atmosphere shall be as follows:

Size 12 mm or below	Stainless Steel
Above 12 mm	Steel with antirust coating, Hot dip galvanized

III. All ferrous bolts, nuts and washers placed in outdoor positions shall be hot dip galvanized to prevent corrosion (except high tensile steel bolts and spring washers which shall have electrolytic action between dissimilar metals). In case the galvanization is removed due to welding or manufacturing, the parts should be properly cleaned and painted to avoid exposure to atmosphere.

IV. Each bolt shall project at least one thread but more than three threads through the nut. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided. The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.

V. Taper washers shall be provided where necessary. Protective washers of suitable material shall be provided on front and back of the securing screws.

5.14 SURFACE PREPARATION AND PAINTING

I. The paint shall be applied by airless spray.

II. Steel surfaces shall be prepared by **shot blast cleaning** (IS-9954) to grade Sq.2.5 of ISO 8501-1 or **chemical cleaning** including phosphating of the appropriate quality (IS 3618).

III. **Heat resistant (Hot oil proof) paint** shall be used for the **inside surface** and whereas for **external surface one coat of thermosetting powder paint or one coat of epoxy primer**

(zinc chromate) followed by two coats of polyurethane (P.U.) base paint. as per table given below:

S.No.	Paint type .	Area to be painted	No. of Coats	Total dry film thickness (min.) (microns)
1.	Thermosetting paint	Inside outside	01 01	30 60
2.	Liquid paint . a)Epoxy (primer) b)P.U. Paint .(Finish coat) c)Hot oil resistant	 Outside Outside Inside	 01 02 01	. 30 25 each 35

The two coats shall be of oil and weather-resistant nature with final coat as flossy and non-fading paint of shade 631 as per IS 5.

IV. The dry film thickness shall not exceed the specified minimum dry film thickens by more than 25%.

V. Any damaged part shall be cleaned to bare metal with an area extending 25 mm around its boundary. A priming coat shall be immediately applied followed by full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage. The repainted surface shall present a smooth surface which shall be obtained by carefully chamfering the paint edges before and after priming.

VI. Painting shall not affect by weather changes & performance against pilling out or fading etc. to be guaranteed for 5 Years.

5.15 RADIO INTEREFENCE

When operated at voltages up to **12.5%** in excess of the normal system rating, transformers shall be substantially free from partial discharges (i.e. corona discharges in either internal or external insulation) which are likely to cause interference with radio or telephone communication.

5.16 OVERLOAD CAPACITY

The transformer shall be suitable for loading as per IS 6600.

5.17 CONSERVATOR

I. The- conservator shall be provided on all transformers of ratings 63 kVA and above with plain tank construction.

II. The oil conservator shall be fitted with oil level indicator with minimum level marked. The oil level gauge shall be prismatic type. The connecting pipe of the conservator shall be so fitted to transformer tank that the pipe can be detached from the tank. The conservator shall be

supported / fixed on the main body of the transformer tank. The conservator shall be provided with oil gauge and the plain or dehydrating breathing device shall be fixed to the conservator which shall also be provided with a drain plug and a fitting hole with cover.

III. The conservator shall be provided with detachable end plate on one side, preferably on the side on which the gauge glass is fitted, to enable the maintenance staff to periodically clean the inside of the conservator tank. The oil gauge glass shall be removable and so embodied in the end plate so as to prevent oil leakage.

IV. In addition, the cover of the main tank shall be provided with an air release plug. Conservator shall be provided with drain and oil filling hole with plugs. The diameter of the oil filling hole shall be 32mm.The capacity of the conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain 10% quantity of the oil. Normally 3% quantity of the oil shall be contained in the conservator.

V. The cover of the main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank: The inside diameter of the pipe connecting the conservator to the main tank shall be within 25 to 50 mm and it shall project into the conservator so that its end is approximately 20mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level corresponding to -5°C should be above the sump level.

5.18 TERMINAL CONNECTIONS

All transformers shall have the primary and secondary terminal markings plainly and indelibly marked on the transformer adjacent to the relevant terminal. High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside.with capital letter 1 U, 1V, 1W and low voltage winding for the same phase marked by corresponding small letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n. Neutral terminal shall be brought out and connected to local grounding terminal by the earthing strip.

5.19 EARTHING CONNECTIONS

The HV bushing stems shall be provided with tinned brass connectors suitable for the specified cable sizes and current, as per IS 5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eyebolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.

5.20 DRAIN VALVE AND FILTER VALVE

The drain valve & Filter valve shall be of mild steel (M.S.) with gate type of valve.
The drain valve and filter valve shall be provided with embossed name plate stating drain valve and filter valve. The valves shall be covered with a MS box by welding on tank. Locking rod shall be provided to stop movement of hand wheel.

5.21 DEHYDRATING BREATHER

The volume of breather shall be suitable for 250 gms of silica gel for 25; 500gm of silica gel for 63 kVA & 100 kVA ratings conforming to IS 3401. The breather pipe shall enter the conservator from the upper side of the conservator.
The silica gel shall be blue colored and shall be as per IS: 3401 — 1992. The silica gel shall be 3-4 Mesh size. The body of the breather shall be UV protected seamless acrylic tube(Transparent).The top cover shall be of die cast aluminum and powder coated or polyurethane painted. The oil cup shall be of UV protected acrylic or polycarbonate.

5.22 FITTINGS

The following standard fittings shall be provided:

1. Two earthing terminals with earthing symbol ⏚ for body earthing.
2. Air Release Device.
3. Double diaphragm Explosion vent with oil window
4. LV cable Boxes.
5. LV cable cleats arrangement
6. HV and LV Bushings.
7. Terminal Connectors for HV/LV side (palm connector, suitable bimetallic washer, Al busbar).
8. LV Gland plates (Non-Magnetic) with glands.
9. Prismatic Oil level Gauge with red color background
10. Closed type Lifting 4 no. lugs for complete transformer,
11. 2 Base channels.
12. Marking Plates as asked in clause 6.1
13. Two GI strip for neutral earthing with minimum GI coating thickness of 86 microns. Size of GI strip shall be, 50x6 mm
14. Conservator

5.23 MAKE OF MAJOR COMPONENTS & RAW MATERIALS

The BA shall procure the following constituent items from the designated vendors as follows:

SNo	Raw Material/Equipment	Make
a)	Aluminium	M/S Sterlite, M/S Hindustan Aluminium, M/S Hindalco or equivalent on approval of bidder.
b)	Core	M/S AK Steels, POSCO, Kawasaki/ JFE, Nippon Steel or equivalent on approval of bidder.
c)	Insulation paper	Raman Boards- Mysore, Senapathy Whiteley Bangalore, ITC paper, ABB approval of bidder.
d)	Transformer Oil	Savita, Apar, Gandhar or equivalent on approval of bidder.
e)	Gaskets & Corks	Nu Cork, Anchor Corks or equivalent on approval of bidder.
f)	Steel For Tank	M/S TISCO, M/S SAIL, M/S Bhushan Steel, M/S ISSCO, M/S RINL, M/S Jindal Steel.
g)	Bushings HV & LV	GE, Rashtriya Electricals,Hindustan Chemicals, LAMCO
h)	Bucholz, PRD, SPR, OTI , WTI, and other devices	Reputed make to be approved by TPSODL during detailed engineering.
i)	Dehydrating Breather	Yogya, Anushree, Electrical engineers

Bidder has to provide all test certificates from original manufacturers & relevant sourcing documents. BA shall also have shot blasting facility.

5.24 INSULATING PAPER AND INSULATING PRESSBOARD

I. Inter layer insulation both for HV and LV windings shall be Epoxy diamond dotted Kraft paper and compressed pressboard of make (refer Clause no.5.32) subject to approval of TPSODL

II. Primary and secondary windings shall be constructed from high- conductivity (copper conductors), Double Paper Covered (DPC) copper conductor with min. 25% overlap per layer of paper.

III. Kraft paper and Pressboard should be made of pure Cellulose from soft wood pulp manufactured from sulphate process. No additive, adhesive or coloring matter shall be present.

IV. Kraft paper and Pressboard should be of class A (105°C) insulation material.

V. All spacers, axial wedges / runners used in windings shall be made of pre-compressed solid pressboard.

VI. All axial wedges/runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely.

VII. Insulation shearing, milling and punching operations shall be carried out in such a way, that there should not be any burr, sharp edges and dimensional variations.

VIII. Kraft paper self-adhesive tape to be used for bonding of insulating paper layer, spanner and paperboards that are immersed in the oil filled transformer.

IX. Below required values could be verified if required at any stage of the inspection and it should fulfill the requirement as per below table:

Characteristics	Kraft Paper	Pressboard (all Sizes)
1. Dimension	As specified by bidder with ±5% tolerance.	As specified by bidder with tolerance as per IS1576.
2. Apparent Density	>0.80 g/cm^3	as per IS 1576 w.r.t Thickness
3. pH of Aqueous extract	6-8%	6-8%

4. Electrical strength i) in air ii) In Oil	7KV/mm ----------	12KV/mm 35KV/mm
5. Ash content	Maximum 1%	Maximum 0.7
6. Moisture content	Maximum 8%	Maximum 8%
7. Oil absorption	----------	Minimum 9%
8. Heat stability	As per IS 9335-part 3	As per IS 1576
9. Tear index	As per IS 9335-part 3	As per IS 1576

Bidder has to submit the test certificates as per IS-9335, IS-1576 for all type of insulating materials covering above stated parameters along with **below parameters during stage inspection :**

a. Substance (Grammage) (g/m3)
b. Compressibility
c. Tensile strength
d. Conductivity of water extract
e. Shrinkage in air
f. Flexibility
g. Cohesion between plies1.
h. Elongation
i. Air permeability
j. Bidder shall provide the below details in below table

Sl. No.	Description	Unit	As furnished by bidder
1.	DPC Paper for HV and LV conductors :		
	Type of DPC Paper		
	Make of DPC Paper		
	Thickness DPC Paper	mm	
	Percentage Overlapping (not less than 60%)	%	
2.	Type of Paper for Interlayer Insulation		
	Make of Paper for Interlayer Insulation		
	Thickness of Paper for Interlayer Insulation	mm	
3.	Type of Paper for Insulation Between HV and LV winding		

	Make of Paper for Insulation Between HV and LV winding		
	Thickness of Paper for Insulation Between HV and LV winding (for all sizes)	mm	
4.	Type of Pressboards used for Insulation Between HV and LV winding		
	Make of Pressboards used for Insulation Between HV and LV winding		
	Thickness of Pressboards for Insulation Between HV and LV winding (all size)	mm	
5.	Type of Paper used for insulation between core and LV		
	Make of Paper used for insulation between core and LV		
	Thickness of Paper used for insulation between core and LV (All sizes)		
6.	Type of Pressboard used for insulation between core and LV		
	Make of Pressboard used for insulation between core and LV		
	Thickness of Pressboard used for insulation between core and LV (All sizes)		
7.	Material used for top and bottom yoke insulation		
	Make of material used for top and bottom yoke insulation		
	Thickness of material used for top and bottom yoke insulation	mm	

8.	Type of material used for Spanner, wedge and Axial for insulation		
	Make of material used for Spanner, wedge and Axial for insulation		
	Thickness of material used for Spanner, wedge and Axial for insulation (all sizes)	mm	

6. MARKING:

6.1 Marking Plates

1. **Name Plate (Rating) Plate :**

A rating plate shall be fitted to each transformer in a visible position and shall carry all the information as **specified in clause no. 6.2**

2. **Terminal Marking Plate :**

- The terminal marking plate shall be provided which shall be strictly in accordance with **figure 4 of IS 1180-Part 1: 2014**. This plate may be combined with the rating plate or can be provided separately.
- Value of short circuit impedance on extreme tapping and on principal tapping and indication of winding to which impedance is related has to be displayed additionally.

3. **Details Plate :**

A separate plate of **size 125 mm x 125 mm** shall be provided having following details:

- Name of the firm.
- Serial No.
- Rating of transformer
- Order No. and date
- Date of dispatch

4. **Guarantee Plate :**

A separate warranty plate made of **Stainless Steel** with following clause written on it.

"THE EQUIPMENT GUARANTEED UPTO A PERIOD OF 48 MONTHS FROM THE DATE OF COMMISSIONING OR 60 MONTHS FROM THE DATE OF LAST SUPPLY"

All the plates described above (clause 1 to 4) should be as followings:

Material	Stainless Steel
Thickness	1 mm

Engraving	The letters on the rating plate shall be engraved black on the white/silver back ground
Fixing	Fixing screws shall be of stainless steel.

5. Danger Plate:
Danger notice shall have red lettering on a white background on a plate as specified in **IS: 2551**

6. **BIS Certification Mark:**

The Bidder is required to get approval from BIS and display BIS mark on the name plate.

7. BEE LABEL:

A label shall be affixed on the front of the distribution transformer near the name plate, so as to be prominently visible. The label shall be non-detachable weather proof type with the following particulars shall be displayed on its label, namely:

1. the logo of the Bureau of Energy Efficiency
2. that the equipment is a distribution transformer
3. that it is an oil filled, naturally cooled type
4. name of the manufacturer and brand
5. Capacity in KVA as tested
6. Voltage is up to 11 KV
7. Total losses at 50% loading in watts
8. Total losses at 100% loading in watts
9. Star level
10. Model and year of manufacturing.
11. Bureau's authorisation number

6.2 Name Plate Details

The name plate shall be strictly as per **IS 1180: 2014 (figure 1)**. Additionally, following points shall be displayed :

1. Actual no load losses of transformer.
2. Actual total losses of transformer at 50% load and 100% load.
3. Standard mark (BIS certification).
4. "**TPSODL**" shall be written in bold letters.
5. PO number with date has to be mentioned.
6. Overall dimensions of the transformer.

a. MARKING

1. All transformers shall have HV phase windings marked in both, the terminal boards inside the tank and outside with capital letter 1U, 1V, 1W. The LV winding for the same phase shall be marked by corresponding small letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n.
2. The markings shall be done by steel strips in which marks had been engraved in black colour.
3. Colour marking of the HV & LV bushings top cap shall be done.
4. On the top cover of tank and the core .

7. TESTS:

I. All routine, acceptance & type tests shall be carried out in accordance with the IS 2026 and IS 1180: Part-1 (2014).

II. All routine tests/ type test shall be witnessed by the TPSODL/his authorized representative as reuired.

III. All the components shall also be type tested as per the relevant standards.

Following tests shall be necessarily conducted on the Distribution Transformers in addition to others specified in IS/IEC standards.

7.1 TYPE TESTS

1. Lightning Impulse Test [As per IS 2026 (Part 3) Clause no. 12].
2. Temperature Rise Test [As per IS 2026 (Part 2) Clause no.4]

   NOTE: Maximum measured total loss (No load at Rated excitation load loss at maximum current tap converted to 75°C reference temperature) at 100 percent loading shall be supplied during temperature rise test.
3. Short Circuit Withstand test upto 200kVA rating [As per IS 2026 (Part 1) clause no. 16.11 & 2026 part 5].

   NOTE: Routine tests before and after short circuit test shall be conducted as per IS 2026(Part 1).
4. Pressure Test [As per IS 1180: Part 1 (2014) clause no. 21.5.1.1].
5. Determination of sound levels at No load [IS 2026 (part 10)].
6. Test to verify IP 55 for cable box. (As per IS 60529 clause 11 to 15)

Note: - Out of the above mention type test, the tests under sl. No. 1, 2 ,3 and 4 shall be conducted at CPRI/ERDA labs and the balance tests to be conducted at TPSODL

recommended NABL lab.**In-house test labs are accepted if in-house lab is NABL accredited for these tests.**

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7.2 ROUTINE TESTS

SNo	Test to be done	Reference BIS	Clause no.
1	Measurement of Winding Resistance at each tap	IS 2026 (Part 1)	16.2.1 & 16.2.3
2	Measurement of voltage ratio, check of voltage displacement, polarity, phase sequence and vector group	IS 2026 (Part 1)	16.3
3	Measurement of short circuit impedance and load loss at 50% and 100% load	IS 2026 (Part 1)	16.4
4	Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 112.5% of rated voltage	IS 2026 (Part 1)	16.5
5	Measurement of insulation resistance	IS 2026 (Part 1)	16.6
6	Induced over voltage withstand test	IS 2026 (Part 3)	11
7	Separate Source voltage withstand test	IS 2026 (Part 3)	10
8	Pressure test	IS 1180 (Part 1)	21.5.1.2
9	Oil leakage test	IS 1180 (Part 1)	21.5.1.3
10	BDV and moisture content of oil in transformer (Type-2 oil)	IS 335 (2018)	Table 2
11	Unbalance current or Neutral current measurement: The value of the zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.	CBIP manual publication no. 317	CBIP 317

7.3 ACCEPTANCE TESTS

1. Temperature Rise Test (on one unit of every release order / PO for each rating) [As per IS 2026 (Part 2) Clause no.4]
2. Oil leakage test for acceptance shall be conducted at pressure of 0.35kg/sq.cm for one hour. (IS 1180 (Part 1) clause 21.5.1.3)
3. The painted surface shall pass the Cross Adhesion Test (IS1180 part 1 clause no. 21.4.d).
4. At stage inspection -Checking of weight, dimensions, fitting and accessories, tank sheet thickness, oil quantity, material finish and workmanship, physical verification of core coil assembly and

measurement of flux density on one unit of each rating of the offered lot with reference to the GTP and contract drawings. Oil BDV of all offered lot.

5. At least 10% transformer of the offered lot (minimum of one) shall be subjected to all the tests mentioned under the section 'ROUTINE in presence of TPSODL's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS: 1180 and IS: 2026.
6. Magnetic Balance Test on HV & LV side, with magnetizing current HV and LV side as per CBIP manual publication no. 317

8. TYPE TEST CERTIFICATES:

The Bidder shall furnish the type test certificates of the Transformer for the tests as mentioned above as per the corresponding standards. All the tests shall be conducted at CPRI / ERDA or as defined in 7.1 as per the relevant standards. Type tests should have been conducted during the period not exceeding 5 years from the date of opening the bid. In the event of any discrepancy in the test reports, i.e. any test report not acceptable or any/all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication to TPSODL.

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9. PRE-DISPATCH INSPECTION:

I. Equipment shall be subject to inspection by a duly authorized representative of the TPSODL. Inspection may be made at any stage of manufacture at the option of the purchaser and the equipment if found unsatisfactory as to workmanship or material, the same is liable to rejection.

II. Bidder shall grant free access to the places of manufacture to TPSODL 's representatives at all times when the work is in progress. Inspection by theTPSODLor it's authorized representatives shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications.

III. The BA shall arrange for complete dispatch ready transformer at least 10% of lot during inspection.

IV. Material shall be dispatched after specific MDCC (Material Dispatch Clearance Certificate) is issued by TPSODL .Following documents shall be sent along with material:

a) Test reports
b) MDCC issued by TPSODL
c) Invoice in duplicate
d) Packing list

e) Drawings & catalogue

f) Guarantee / Warrantee card

g) Delivery Challan

h) Other Documents (as applicable)

V. To ascertain the quality of the transformer oil, the original manufacturer's tests report shall be submitted at the time of inspection. Arrangements shall also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of TPSODL's representative. In respect of raw material such as core stampings, winding conductors, insulating paper and oil, bidder shall use materials manufactured/supplied_by_standard manufacturers and fumish the nruanufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

a) Invoice of supplier

b) Mill's certificate

c) Packing List

d) Bill of Landing

e) Bill of entry certificate by custom.

VI. To ensure about the quality of transformers, the inspection shall be carried out by the purchaser's representative at following two stages;-

a) Online anytime during receipt of raw material and manufacture/assembly whenever the purchaser desires.

b) At finished stage i.e. transformers are fully assembled and are ready for dispatch.

VII. Advance intimation of 7 days for Odisha /12 day outside outside Odisha is required for both stage and final inspections.

VIII. After the main raw material i.e. core and coil material and tanks are arranged and transformers are taken for production on the shop floor and a few assembly have been completed, the Bidder shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the inspection the bidder shall also furnish the information regarding various components used to manufacture the DTs.

IX. During the stage inspection a few assembled core shall be dismantled (only in case of

CRGO material) to ensure that the CRGO laminations used are of good quality. Further, about the readiness of the transformers, for final inspection for carrying out tests as per relevant IS/IECs shall be sent by the Bidder along with routine test certificates. The inspection shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection.

X. All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the inspector representing the Purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspectioh during manufacturing stage as well as Active Inspection during Acceptance Tests.

XI. The bidder shall provide all services to establish and maintain quality of workmanship in his works and that of his sub-contractors to ensure the mechanical / electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 90.00.

XII. The Purchaser has the right to have the test carried out at his own by an independent agency wherever there is a dispute regarding the quality supplied. Purchaser has right to test 1 % of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser have every right to reject the entire lot or penalize the bidder, which may lead to blacklisting, among other things.

XIII. TPSODL also reserves the right to inspect the tank of transformer before surface preparation and painting. The same shall be informed to TPSODL accordingly.

XIV. At the time of inspection the material should be ready as specified, In case of material non readiness or material failure in acceptance, cost of re-inspection shall be borne by bidder.

10. INSPECTION AFTER RECEIPT AT STORE:

I. The material received at the TPSODL store shall be inspected for acceptance and shall be liable for rejection, if found different from the reports of the pre-dispatch inspection.

II. In case the transformers proposed for supply against the order are not exactly as per the tested design, the Bidder shall be required to carry out the short circuit test and impulse voltage withstand test at its own cost in the presence of the representative of TPSODL.

III. The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

IV. Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations

V. TPSODL reserves the right to conduct all tests on Transformer after arrival at site / stores and the manufacturer shall guarantee test certificate figures under actual service conditions.

VI. TPSODL reserves the right to conduct short circuit test and impulse voltage withstand test in accordance to IS, afresh on each ordered rating at purchaser cost, even if the transformer of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by TPSODL either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to TPSODL stores. The findings and conclusions of these tests shall be binding on the bidder.

11. GUARANTEE:

I. Bidder shall stand guarantee towards design, materials, workmanship & quality of process/ manufacturing of items under the contract for due and intended performance of the same, as an integrated product delivered under this contract. In the event any defect is found by the Purchaser up to a period of 48 months from the date of commissioning or 60 months from the date of last supplies made under the contract, whichever is earlier.

II. Bidder shall be liable to undertake to replace/rectify such defects at his own costs within mutually agreed timeframe and to the entire satisfaction of the TPSODL, failing which the TPSODL will be at liberty to get it replaced/rectified at Bidder's risks and costs and recover all such expenses plus the TPSODL's own charges (@ 20% of expenses incurred), from the Bidder or from the "Security cum Performance Deposit" as the case may be.

III. In case of Distribution transformer fails within the guarantee period TPSODL will immediately inform the Bidder who shall take back the failed Distribution Transformer within 15 days from the date of intimation at his own cost and replace / repair the transformer within forty five days of date of intimation with a roll over guarantee. The outage period i.e. period from the date of failure till unit is repaired / replaced shall not be counted for arriving at the guarantee period.

IV. Bidder shall further be responsible for 'free replacement' for another period of THREE years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Purchaser.

12. PACKING AND TRANSPORT:

I. Bidder shall ensure that all the equipment covered under this specification shall be prepared for rail/road transport in a manner so as to protect the equipment from damage in transit.

Note: One use plastic not to be used for packing of the material.Packing shall be done with environment friendly recyclable materials.

13. TENDER SAMPLE:

All offered transformer detailed documents to be submitted as per clause no.18. The sample shall be not applicable

14. QUALITY CONTROL:

The bidder shall submit with the offer Quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. TPSODL's engineer or its nominated representative shall have free access to the manufacturer's/sub-supplier's works to carry out inspections.

The following information shall necessarily be submitted with the bid:

I. List of important raw materials, names of sub-suppliers for raw materials, standards to which raw material is tested and the copies of test reports of the tests carried out on raw materials in presence of Bidder's representatives.

II. List of manufacturing facilities available, level of automation achieved and the areas where manual process exists.

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

IV. List of testing equipment for final testing with valid calibration reports. Manufacturer shall possess 0.1 class instruments for measurement of losses.

15. TESTING FACILITIES:

Bidder shall have adequate in house testing facilities for carrying out all routine tests, acceptance tests and pre-dispatch inspection as per relevant International / Indian

standards.

16. MANUFACTURING FACILITIES:

The successful bidder will have to submit the bar chart for various manufacturing activities clearly elaborating each stage, with quantity. This bar chart should be in line with the Quality assurance plan submitted' with The offer. This bar chart will have to be submitted within 15 days from the release of the order.

17. SPARES, ACCESSORIES AND TOOLS

I. Bidder shall provide a list of recommended spares with quantity and unit prices for 5 years of operation after commissioning. The Purchaser may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be supplied as part of the definite works. The Purchaser may order additional spares at any time during the contract period at the rates stated in the Contract Document.

II. Bidder shall give an assurance that spare parts and consumable items will continue to be available through the life of the equipment which shall be 25 years minimum. However, the Purchaser shall be given a minimum of 12 months notice in the event that the Bidder or any sub-vendor plans to discontinue manufacture of any component used in this equipment.

III. Any spare apparatus, parts or tools shall be subject to the same specification, tests and conditions as similar material supplied under the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the plant and must be suitably marked and numbered for identification.

18. DRAWINGS AND DOCUMENTS:

Following drawings and documents shall be prepared based on TPSODL specifications and statutory requirements and shall be submitted with the bid:

a. Completely filled in compliance to each clause of Technical Specification and any Additional Details and Fittings.
b. Description of the transformer and all components drawings.
c. General arrangement for Transformer.
d. LV terminal box drawing along with CT if applicable and cleat arrangement and gland plate drawing.
e. Bill of material.
f. Foundation plans
g. Experience Certificate and list

h. Type test certificates.

i. List of makes of major components as listed above.

Drawings / documents to be submitted for approval after the award of the order within 7 days before mass manufacturing are as under:

List of Drawings/Parameters to be submitted:

1. Clause wise Compliance of the specification
2. General Arrangement Drawing of the Transformer (Front view, Top view and both sides view. Complete list of fittings to be displayed and quantities to be mentioned with the drawing).
3. Internal Core arrangement drawing.
4. Internal Core-coil assembly drawing.
5. Marking plates and Markings (as mentioned in clause 6)
6. Foundation Plan drawing.
7. HV and LV bushings drawing (with internal view and metal parts)
8. HT connector / LT connector (palm connector), Aluminium Busbar
9. HV and LV Box drawing.
10. BH curve of core material offered
11. Gland Plate for HV/LV box.
12. Prismatic oil level gauge drawing.
13. LV Terminal Box drawing with internal wiring arrangement of bus bar etc.
14. Gland plate
15. Cable cleat arrangement
16. Type Test Certificates.
17. Installation Instructions.
18. Quality Assurance plan.

2. **List of Calculations to be submitted:**

All the calculations shall be step by step showing the use of formulas and other practical considerations. **Concise calculations in table or excel sheet shall not be accepted.** Also, the reference (only standard sources as IS, IEC or any such standard is acceptable) of the formulas shall be mentioned.

1. Resistance Calculation (75 deg. C)
2. Load Losses Calculation (at 75 deg. C)
3. No load Losses.

4. Stray Losses.
5. Weight of Aluminium (Bare and with Insulation also).
6. Weight of Core.
7. Flux Density calculations.
8. Current Density Calculations.
9. Short Circuit withstand.
10. Temperature Rise Calculations.
11. Cooling Calculations showing cooling with tank and radiators separately with no. of radiators and fins mentioned specifically.

Additional Documents to be submitted :

a. List of raw materials as well as bought out accessories and name of sub-suppliers selected from those furnished along with offer.
b. Type test certificates of the raw materials and bought out accessories.
c. The successful Bidder shall submit the **routine test certificates of bought out accessories** and central excise passes for raw material at the time of routine testing.

All the documents & drawings shall be in English language. After the receipt of the order, the successful bidder will be required to furnish all relevant drawings/parameters/calculation to TPSODL for approval.

Instruction Manuals:

Bidder shall furnish softcopies of nicely bound manuals (In English language) covering erection and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices.

19. SCHEDULE- "A" GUARANTEED TECHNICAL PARTICULARS:

All clauses and points in the specification to be complied.

20. SCHEDULE "B" DEVIATIONS:

(TO BE ENCLOSED WITH TECHNICAL BID)

All deviations from this specification shall be set out by the Bidders, clause by Clause in this schedule. Unless specifically mentioned in this Schedule, the tender shall be deemed to confirm the purchaser's specifications:

SL. No	Clause No.	Details of deviation with justifications

We confirm that there are no deviations apart from those detailed above.

Seal of the Company:

Signature

Designation

CONTENTS

1. SCOPE:

I. This Specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing forwarding, supply and unloading at site/store and performance of Oil immersed, non-sealed, naturally cooled, three Phase 11/0.433 kV, 50Hz, outdoor conventional type, copper winding, Distribution Transformer of 250kVA to 2MVA ratings.

II. The transformer shall be complete with all components and accessories, which are necessary or usual for their efficient performance and trouble free operation under the various operating and atmospheric conditions specified in clause no. 3

III. Such of the parts that may have not been specifically included, but otherwise form part of the transformer as per standard trade and/or professional practice and/or are necessary for proper operation of transformer, will be deemed to be also included in this specification. The successful bidder shall not be eligible for any extra charges for such accessories etc. notwithstanding the fact that at the time of an initial offer bidder had segregated such items and quoted for them separately.

2. APPLICABLE STANDARDS:

The equipment (and the materials used) covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following Indian standards & other relevant standards for components, BEE & CEA guidelines with latest amendment from time to time, thereof, some of which are listed below:

Indian Standards	Title
IS 1180	Outdoor Type Oil Immersed Distribution Transformers Upto and Including 2500 KVA, 33 kV-Specification
IS 2026 (all parts)	Specification for Power Transformers
IS 104	Specification for ready mixed paint, brushing, zinc chrome, priming
IS 335	Specification for new insulating oil.
IS 649	Testing for steel sheets and strips and magnetic circuits.
IS 5	Specification for Colors for ready mixed paints and enamels
IS 1576	Solid Pressboard for Electrical Purposes -Specification

IS 2099	Specification for bushings for alternating voltages above 1000 volts
IS 2362	Determination of water content in oil by Karl in oil Fischer Method – Test Method.
IS 3024	Grain oriented electrical steel sheets and strips
IS3347 (Part I & Part-3)	Dimensions for Porcelain Transformer Bushings for Use in Normal and Lightly Polluted Atmospheres - Part 1 : Up to and including 1 kV
IS 4253: Part II:	Specification for cork composition sheets- Part II : Cork and Rubber
IS 4257(Part I):	Dimensions for Clamping Arrangements for Porcelain transformer Bushings - Part I: For 12 kV to 36 kV Bushings
IS 5082	Wrought Aluminum and Aluminum Alloy bars, Rods , Tubes, Sections, Plates and Sheets for Electrical Applications
IS 5561	Specification for Electric Power Connectors
IS 6103	Specification for Testing of specific resistance of electrical insulating liquids
IS 2026 part 7	Guide for loading of Oil-immersed transformer
IS 6792	Method for Determination of Electric Strength of Insulating Oil
IS 7404 (Part-1):	Paper Covered conductors: Round Conductors
IS 7421	Specification for porcelain bushings for alternating voltages up to and including 1000kv
IS 8603 (Part-1) :	Dimensions for Porcelain Transformer Bushings for Use in Heavily Polluted Atmospheres - Part I:12 kV and 17.5 kV Bushings
IS 9335	Specification for Cellulosic Papers for Electrical Purposes
IS 10028	Code of Practice for Selection, Installation and Maintenance of Transformers
IS 11149	Specification for rubber gaskets
IS 12444	Specification for Continuously Cast and Rolled Electrolytic Copper Wire Rods for Electrical Conductors.
IS/IEC 60947 (PART 1& PART 2)	Specification for LV Switchgear & Control gear
IS 6160	Rectangular electrical conductors for electrical machines
IS 13964	Methods of measurement of transformer and reactor sound levels

IS 3401	Specification of silica Gel
IS 1897	Copper strip for electrical purposes
IS 60529	Degree of protection provided by enclosure
IS 816	Welding of Mild Steel
CEA	Guidelines for specifications of energy efficient outdoor type single and three phase distribution transformers
IS 6262	Method of test for power factor and dielectric constant of electrical insulating liquids
IS 16659	Fluids For Electro technical Applications - Unused Natural Esters For Transformers And Similar Electrical Equipment
IS 16081	Insulating liquids — Specifications for. Unused synthetic organic esters for Electrical purposes
IEC 60156	Method of determination of electric strength of insulating oils.
IEC 60296	Specification for unused mineral insulating oils for transformers and switchgear.
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IS 1852	: Rolling and cutting tolerances for hot rolled steel products

3. CLIMATIC CONDITIONS:

1	Maximum ambient temperature	50 deg C
2	Max. Daily average ambient temp	35 deg C
3	Min Ambient Temperature	0 deg C
4	Maximum Humidity	95%
5	Average Annual Rainfall	1500 mm
6	Average No. of rainy days per annum	120
7	Altitude above MSL not exceeding	1000m
8	Wind Pressure	300 Km/hr

9	Earthquakes of an intensity in horizontal direction	equivalent to seismic acceleration of 0.3g
10	Earthquakes of an intensity in vertical direction	equivalent to seismic acceleration of 0.15g (g being acceleration due to gravity)

TPSODL service area has heavy saline conditions along the coast and High cyclonic Intensity winds with speed upto 300 Kmph. The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months.

4. GENERAL TECHNICAL REQUIREMENTS:

S. No.	Description	Requirements									
			*	*		*	*		*	*	
1.	Continuous Rated Capacity (kVA)	**250 kVA**	**315 kVA**	**400 kVA**	**500 kVA**	**630 kVA**	**800 kVA**	**1 MVA**	**1.25 MVA**	**1.6 MVA**	**2 MVA**
2.	Application	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
3.	System voltage (max.)	12 kV	12 kV	12 kV	12 kV	12 kV	12	12	12	12	12
4.	Rated voltage HV	11Kv	11Kv	11Kv	11Kv	11Kv	11Kv	11Kv	11Kv	11Kv	11Kv
5.	Rated voltage LV (V)	433-250	433-250	433-250	433-250	433-250	433-250	433-250	433 - 250V	433 V-250V	433 V-250V
6.	Line current HV (A)	13.12 A	16.53 A	20.96 A	26.25 A	33.06 A	42A	52.48 A	65.6 A	83.98 A	104.97A
7.	Line current LV (A)	333.34 A	420.02 A	533.36 A	666.68 A	840.02 A	1066.7A	1333.4 A	1666.7 A	2133.5 A	2666.7
8.	Frequency (Hz)	50 Hz	50 Hz	50 Hz	50 Hz	50 Hz	50 Hz	50Hz	50Hz	50Hz	50Hz
9.	No. of Phases	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
10.	Connection HV	Delta	Delta	Delta	Delta	Delta	Delta	Delta	Delta	Delta	Delta
11.	Connection LV	Star (Neutral Brought out)	Star (Neutral Brought out)	Star (Neutral Brought out)	Star (Neutral Brought out)	Star (Neutral Brought out)	Star (Neutral Brought out)	Star (Neutral Brought out)	Star (Neutral Brought out)	Star (Neutral Brought out)	Star (Neutral Brought out)
12.	Vector group	Dyn-11	Dyn-11	Dyn-11	Dyn-11	Dyn-11	Dyn-11	Dyn-11	Dyn-11	Dyn-11	Dyn-11
13.	Type of cooling	ONAN	ONAN	ONAN	ONAN	ONAN	ONAN	ONAN	ONAN	ONAN	ONAN
14.	Tap changing arrangement (off load)	+5.0% to –10% in steps of 2.5%		+5.0% to –10% in steps of 2.5%			+5.0% to -10% in steps of 2.5%		+5.0% to –10% in steps of 2.5%		
15.	No. of tap positions	7	7	7			7	7			7
16.	Noise level at rated voltage and frequency	55 dB	56 dB	56 dB	56 dB	57 dB	58 dB	58 dB	60 dB	60 dB	61 dB

17.	**Permissible temperature rise over ambient:**										
17.1	Of top oil	40 ºC	40 ºC	40 ºC	40 ºC	40 ºC	40 ºC	40 ºC	40 ºC	40 ºC	40 ºC
17.2	Of winding	45 ºC	45 ºC	45 ºC	45 ºC	45 ºC	45 ºC	45 ºC	45 ºC	45 ºC	45 ºC
18.	Max. Total Losses at 50% loading at 75°C (watts)	920	955	1150	1430	1745	2147	2620	3220	3970	4790
19.	Max. Total Losses at 100% loading) at 75°C (Watts).	2700	2750	3330	4100	4850	5838	7000	8400	11300	14100
20.	Short circuit impedance voltage at 75°C (±10% tolerance)	4.5%	4.5%	4.5%	4.5%	4.5%	5%	5%	5%	6.25%	6.25%
21	Insulation Class	A	A	A	A	A	A	A	A	A	A
22.	Normal Flux Density (at rated voltage and frequency)	1.6 T	1.6 T	1.6 T	1.6 T	1.6 T	1.6 T	1.6 T	1.6 T	1.6 T	1.6 T
23.	Maximum current density (A/mm²)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
24.	Impulse withstand voltage	75 kVp	75 kVp	75 kVp	75 kVp	75 kVp	75 kVp	75 kVp	75 kVp	75 kVp	75 kVp
25.	Power frequency withstand voltage	28 kV	28 kV	28 kV	28 kV	28 kV	28 kV	28 kV	28 kV	28 kV	28 kV
26.	Max. flux density (Increase of +12.5 % combined voltage & frequency variation from rated voltage & frequency)	1.9 T(Max.)									
27.	Voltage fluctuations permissible	+12.5% to -12.5%	+12.5 % to -12.5%	+12.5 % to - 12.5%	+12.5 % to - 12.5%	+12.5 % to - 12.5%	+12.5 % to - 12.5%	+12.5 % to - 12.5%	+12.5 % to - 12.5%	+12.5% to -12.5%	+12.5% to -12.5%
28.	**Metering CT for LV side**	400/5	500/5	600/5	800/5	1000/5	1200/5	1500/5	2000/5 A	2500/5 A	3000/5A
28.1	Accuracy Class for metering CT	0.5s	0.5s	0.5s	0.5s	0.5s	0.5s	0.5s	0.5s	0.5s	0.5s
28.2	Burden	20 VA	20 VA	20 VA	20 VA	20 VA	20 VA	20 VA	20 VA	20 VA	20 VA
28.3	ISF (Instrument security factor)	5	5	5	5	5	5	5	5	5	5
29.	Neutral terminal	Two separate brought out neutral from main neutral bus bar, One for taking out the neutral for 4 wire system and other additional neutral for solid earthing.									
30.	**Minimum clearances in air (mm) :**										

30.1	HV phase to phase/ phase to earth	255 / 140	255 / 140	255 / 140	255 / 140	255 / 140	255 / 140	255 / 140	255 / 140	255 / 140	255 / 140
30.2	LV phase to phase/ phase to earth	75 / 40	75 / 40	75 / 40	75 / 40	75 / 40	75/40	75 / 40	75 / 40	75 / 40	75 / 40
31.	**Minimum clearances in Cable Box (mm) :**										
31.11	HV phase to phase/ phase to earth	130 / 90	130 / 90	130 / 90	130 / 90	130 / 90	130/90	130 / 90	130 / 90	130 / 90	130 / 90
31.2	LV phase to phase / phase to earth	25 / 20	25 / 20	25 / 20	25 / 20	25 / 20	25/20	25 / 20	25 / 20	25 / 20	25 / 20
32	**Wheels**	The transformer shall be provided with four uni-directional rollers with locking arrangement suitable for rail gauges in both the axis for movement of transformer in either direction. Distance between wheels shall be center to center 820mm									
*** : Ratings are for optional/ future use**											

5. GENERAL CONSTRUCTION:

I. The transformer shall be stacked core, copper coil, oil immersed, naturally cooled (ONAN), non-sealed type with plain rectangular tank.

II. The transformer shall be suitable for service with fluctuations in supply voltage up to +12.5% to -12.5%.

III. The transformer shall be designed suitable for service life of 25years.

IV. The transformer and accessories shall be designed to facilitate trouble free operation, inspection, maintenance and repairs under the various operating and atmospheric conditions specified in clause no. 3.

V. The design shall incorporate every precaution and provision for the safety of the equipment as well as staff engaged in operation and maintenance of the equipment.

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

5.1 CORE:

I. Transformer core shall be stack type, 2D, constructed from high grade cold rolled, non-ageing, grain oriented, silicon steel lamination which shall be properly annealed (under inert atmosphere, if required) to relieve stresses.

II. The core shall have low loss and good grain properties.

III. Core should be coated with hot oil proof, with insulation coating, an inorganic coating equivalent to C-5 type as ASTM A976 or IS 3024, like Carlite -3.

IV. All core should be clamped together with frames to prevent vibration and noise. The core

clamping shall be preferably without through bolts and if any bolt used same shall be effectively insulated.

V. The core thickness should be 0.23mm or less. 23HP85 as per IS 3024 or better with Minimum Polarization in Tesla at a Field Strength of 800 A/m

VI. Only single grade and same thickness of core stampings shall be accepted and mixing of different grades shall not be allowed.

VII. The complete design of the core must ensure maximum permanency of the core losses without continuous working of the transformers.

VIII. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated. The vendor shall submit the calculations in support of the same.

IX. The handling of core lamination and stacking should be smooth and uniform.

X. The transformer shall be suitable for continuous service without damage under 'over fluxing' where the ratio of voltage over frequency exceeds the corresponding ratio at rated voltage and rated frequency up to 12.5% and the core shall not get saturated. The BH graph to be submitted by bidder for core material.

XI. The No Load current shall not exceed 2% of the Full Load current for >=250kVA and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% maximum of full load current for >=250kVA rating

XII. The bidder shall be required to submit the following documents in regard to procurement of core material during stage inspection:

a. Invoice of supplier
b. Mill's test certificate
c. Packing list
d. Bill of landing
e. Bill of entry certificate by custom (if required)
f. Description of material, electrical analysis, physical inspection certificate for surface defects, thickness and width of material.

XIII. The bidder shall offer the core for inspection and approval of TPSODLduring manufacturing stage. Heavy penalty or black listing shall be imposed on the bidders using defective CRGO sheets i.e in case of nonconformance w.r.t TPSODLSpecifications.

XIV. Transformer core assembly shall have enclosed type lifting lugs for lifting arrangement.

XV. **Bidder shall provide the below details in below table**:

Sl. No.	Description	Unit	To be furnished by bidder
1	Magnetizing (No Load) Current		
	90% Voltage	%	
	100% Voltage	%	
	112.5% Voltage	%	
2.	Core grade		
3.	Thickness of core Lamination	Mm	
4.	Core Dimension: Length X height X diameter	mm x mm	
5.	Gross core area	Sq.cm	
6.	Net core area	Sq.cm	
7.	Flux density (calculated)	Tesla	
8.	Over fluxing without saturation (BH curve to be submitted)	Tesla	
9.	Mass of core	Kg	
10.	Loss per Kg of core at the above specified flux	Watt	
11.	Core window height	Mm	
12.	Center to center distance of the core	Mm	
13	Mass of Core Lamination (min.)	Kg	
14	Make of Core offered		

5.2 WINDING CONNECTIONS

I. Primary and secondary windings shall be constructed from high- conductivity (copper conductors), Double Paper Covered (DPC) copper conductor with min. 25% overlap per layer of paper.
II. The conductor should be drawn uniformly without any deformation and any burr.
III. No metallic or non-metallic dust should be present in-between DPC conductor.
IV. The current density for HV and LV winding should not be more than 2.5 Ampere per sq.mm.
V. The insulation between core and bolts, core and clamps shall withstand **2.5 kV for one minute.**
VI. Proper bonding of inter layer insulation with the conductor shall be ensured.
VII. All turns of windings shall be adequately supported (by which material) to prevent movement. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.
VIII. The joints in the winding shall be avoided but if it is necessary then, they shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. Crimping is not allowed at any joints.
IX. LV winding shall be such that neutral formation is at the top.
X. Bidder shall provide the below details in below table:

Sl. No.	**Description**	**Unit**	**To be furnished by bidder**
1.	No. of LV coils		
2.	No. of HV coils		
3.	HV conductor grade		
4.	Dia of HV conductor (Bare)	Mm	
5.	Dia of HV conductor with (DPC)	Mm	
6.	Conductivity of HV conductor	%	
7.	Purity of HV conductor	%	
8.	No. of HV Turns	Nos.	
9.	Current density of HV winding(calculated)		
10.	Wt. of the HV winding copper without insulation	Kg	
11.	LV conductor grade		
12.	Dimension of LV conductor (Bare)	mm x mm	
13.	Dimension of LV conductor with (DPC)	mm x mm	

14.	Conductivity of LV conductor	%	
15.	Purity of LV conductor	%	
16.	No. of LV Turns	Nos.	
17.	Current density of LV winding(calculated)	A	
18.	No. of parallels of LV conductor	Nos.	
19.	Wt. of the LV winding copper without insulation	Kg	
20.	Resistance of windings at 20^0C		
	HV winding	Ohm	
	LV winding	Ohm	
21.	Height of LV winding	Mm	
22.	Height of HV winding	Mm	
23.	ID of HV winding	Mm	
24.	OD of HV winding	Mm	
25.	ID of LV winding	Mm	
26.	OD of LV winding	Mm	
27.	Thickness of the duct in LV winding	Mm	
28.	Thickness of the duct in HV winding	Mm	
29.	Thickness of the duct between HV & LV	Mm	
30.	Make of the copper winding conductors		

5.3 INSULATING PAPER AND INSULATING PRESSBOARD

I. Inter layer insulation both for HV and LV windings shall be Epoxy diamond dotted Kraft paper and compressed pressboard of make (refer Clause no.5.32) subject to approval of TPSODL

II. Primary and secondary windings shall be constructed from high- conductivity (copper conductors), Double Paper Covered (DPC) copper conductor with min. 25% overlap per layer of paper.

III. Kraft paper and Pressboard should be made of pure Cellulose from soft wood pulp manufactured from sulphate process. No additive, adhesive or coloring matter shall be present.

IV. Kraft paper and Pressboard should be of class A (105°C) insulation material.
V. All spacers, axial wedges / runners used in windings shall be made of pre-compressed solid pressboard.
VI. All axial wedges/runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely.
VII. Insulation shearing, milling and punching operations shall be carried out in such a way, that there should not be any burr, sharp edges and dimensional variations.
VIII. Kraft paper self-adhesive tape to be used for bonding of insulating paper layer, spanner and paperboards that are immersed in the oil filled transformer.
IX. Below required values could be verified if required at any stage of the inspection and it should fulfill the requirement as per below table:

Characteristics	**Kraft Paper**	**Pressboard (all Sizes)**
1. Dimension	As specified by bidder with ±5% tolerance.	As specified by bidder with tolerance as per IS1576.
2. Apparent Density	>0.80 g/cm^3	as per IS 1576 w.r.t Thickness
3. pH of Aqueous extract	6-8%	6-8%
4. Electrical strength i) in air ii) In Oil	7KV/mm ----------	12KV/mm 35KV/mm
5. Ash content	Maximum 1%	Maximum 0.7
6. Moisture content	Maximum 8%	Maximum 8%
7. Oil absorption	----------	Minimum 9%
8. Heat stability	As per IS 9335-part 3	As per IS 1576
9. Tear index	As per IS 9335-part 3	As per IS 1576

Bidder has to submit the test certificates as per IS-9335, IS-1576 for all type of insulating materials covering above stated parameters along with **below parameters during stage inspection :**

a. Substance (Grammage) (g/m3)
b. Compressibility
c. Tensile strength
d. Conductivity of water extract
e. Shrinkage in air
f. Flexibility
g. Cohesion between plies.
h. Elongation
i. Air permeability
j. Bidder shall provide the below details in below table

Sl. No.	**Description**	**Unit**	**As furnished by bidder**
1.	DPC Paper for HV and LV conductors :		

	Type of DPC Paper		
	Make of DPC Paper		
	Thickness DPC Paper	mm	
	Percentage Overlapping (not less than 60%)	%	
2.	Type of Paper for Interlayer Insulation		
	Make of Paper for Interlayer Insulation		
	Thickness of Paper for Interlayer Insulation	mm	
3.	Type of Paper for Insulation Between HV and LV winding		
	Make of Paper for Insulation Between HV and LV winding		
	Thickness of Paper for Insulation Between HV and LV winding (for all sizes)	mm	
4.	Type of Pressboards used for Insulation Between HV and LV winding		
	Make of Pressboards used for Insulation Between HV and LV winding		
	Thickness of Pressboards for Insulation Between HV and LV winding (all size)	mm	
5.	Type of Paper used for insulation between core and LV		
	Make of Paper used for insulation between core and LV		
	Thickness of Paper used for insulation between core and LV (All		

	sizes)		
6.	Type of Pressboard used for insulation between core and LV		
	Make of Pressboard used for insulation between core and LV		
	Thickness of Pressboard used for insulation between core and LV (All sizes)		
7.	Material used for top and bottom yoke insulation		
	Make of material used for top and bottom yoke insulation		
	Thickness of material used for top and bottom yoke insulation	mm	
8.	Type of material used for Spanner, wedge and Axial for insulation		
	Make of material used for Spanner, wedge and Axial for insulation		
	Thickness of material used for Spanner, wedge and Axial for insulation (all sizes)	mm	

5.4 LOSSES

I. The bidder shall individually guarantee No load loss (Iron loss at rated voltage and frequency) and full load Copper Loss (at 75ºC) without any positive tolerance.

II. **The bidder shall also guarantee the total loss at 50% and 100% load condition (at rated voltage and frequency and these should be within the limits of maximum total losses declared by TPSODLfor both 50% and 100% loading values (as per table below)** :

Description	**Rating (kVA)**				
	250	**315 ***	**400 ***	**500**	**630***
Maximum Losses at 50% loading at 75ºC (Watts)	920	955	1150	1430	1745

Maximum Losses at 100% loading at 75ºC (Watts)	2700	2750	3330	4100	4850

Description	Rating (kVA)				
	800*	**1000**	**1200***	**1600***	**2000**
Maximum Losses at 50% loading at 75ºC (Watts)	2147	2620	3220	3970	4790
Maximum Losses at 100% loading at 75ºC (Watts)	5838	7000	8400	11300	14100

No positive tolerance shall be allowed on the losses as mentioned above. However, bidder can offer losses less than specified but no consideration in cost will be given for the same.

*** : Ratings are for optional/ future use**

III. **The successful bidder shall guarantee the quoted losses for at least five years**. If at any point of time during operation if it is found that the total losses at 50% and 100% load are more than the values given in specifications, then bidder shall be liable to pay a fine of Rs 250 per watt to the amount by which losses at 50% loading and 100% loading increase with respect to the values given in specifications.

IV. During testing at Bidder's works if it is found that the actual measured losses are more than the values quoted by the Bidder, **TPSODL shall have the right to reject the complete lot**.

V. During testing at Bidder's works, if the temperature rise exceeds the specified values, **the entire lot shall be rejected by TPSODL.**

VI. During testing at Bidder's works, if the impedance values differ from the guaranteed values including tolerance, the **entire lot shall be rejected by TPSODL.**

VII. Transformer losses shall be checked on any one of DT from supplied lot at TPSODLworkshop. If it is found that the actual measured losses are more than the values quoted by the Bidder, **TPSODL shall have the right to reject the complete lot.**

VIII. **Bidder shall provide the below details in below table:**

Sl. No.	Description	Unit	To be furnished by bidder
1	No Load losses	Watt	
2	Load losses at 50%loading at 75° C	Watt	
3	Load losses at 100% loading at 75° C	Watt	
4	Total losses at 50%load at 75° C	Watt	

5	Total losses at 100% load at 75° C	Watt	
6	**Efficiency at 75 deg. C**		
7	**Efficiency at Unity P.F.**		
7.1	100% load	%	
7.2	80% load	%	
7.3	60% load	%	
7.4	40% load	%	
7.5	20% load	%	
8	**Efficiency at 0.8 P.F.**		
8.1	100% load	%	
8.2	80% load	%	
8.3	60% load	%	
8.4	40% load	%	
8.5	20% load	%	
9	**Regulation at :**		
9.1	Unity P.F. at 75 deg. C	%	
9.2	0.8 P.F. at 75 deg. C	%	
9.3	% Impedance at 75 deg. C	%	

5.5 TRANSFORMER TANK AND TANK CONSTRUCTION

I. The transformer tank shall be of robust construction, **rectangular in shape** and shall be built up of electrically tested welded mild steel plates.

II. The tank shall be fabricated by welding at corners. No horizontal or vertical joints in tank side walls and its bottom or top cover shall be allowed.

III. All welding operations should be carried by **qualified welders** (performance qualification certificates to the customer) as per the relevant ASME standards and a copy of the **welding procedure** has to be submitted to TPSODL at the time of drawing approval.

IV. The **thickness of tank** should be as below:
For top and bottom : 6 mm (min.)
For Sides : 5 mm (min.)
Tolerance shall be applicable as per IS 1852 as per above thickness band.

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

VI. 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. The top cover shall have no cut at point of lifting lug.

VII. The transformer tank cover shall be bolted with tank rim so as to make a leak proof joint.

VIII. The tank plate and lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle.

IX. The tank cover shall have slight slope (10 mm ± 2mm) towards HV side to drain rain water.

X. There must be sufficient space from the core to the top cover to take care of oil expansion. 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 0.4 kg/sq. cm positive or negative** and the tank shall be of adequate mechanical strength to withstand it.

XI. The transformer should be capable of **withstanding 0.8kg/sq.cm air pressure and a vacuum of 0.7kg/sq.cm**. The permanent deflection of the flat plate, when the tank without oil is subjected to a vacuum of 525 mm of mercury shall not be more than the values specified:

Length of Plate	Deflection
Up to 750 mm	5.0 mm
751 mm to 1250 mm	6.5 mm
1251 mm to 1750 mm	8.0 mm
Above 1750 mm	9.0 mm

XII. **The tank design shall be such that the core and the windings can be lifted freely without dismantling the bushings.**

XIII. All joints of tank and fittings shall be oil tight and no bulging shall occur during service.

XIV. Anti –theft stainless steel fasteners with breakaway nut shall be provided at top cover (minimum 4 nos. at corners) placed in between other bolts without affecting pitch of bolts.

XV. The tightening torque chart to be provided for all bolts used. This shall be submitted along with each rating drawings.

XVI. The transformer shall be provided with four pulling lugs of MS plate of 8mm thick to pull the transformer horizontally.

Lifting lugs:

XVII. The transformer shall be provided with a minimum of four welded heavy duty enclosed lifting lugs of Structural steel E250 or better grade quality A (Minimum quality A) as per IS 2062 plate of minimum 16mm thickness for lower rating and gradually increased for higher rating as per weight suitably reinforced by vertical supporting flat stiffener smooth welded properly on the side walls up to reinforcing angle. They shall be so extended that cutting bend plate is not required. The transformer lifting lug shall be painted with yellow colour.

XVIII. The location of lifting lugs shall be such that the clearance between lifting chain and nearest part of bushing shall be at least 100 mm.

XIX. There shall be facilities for lifting the core coil assembly separately.

XX. The lifting lugs shall be designed in such a way that any two diagonal lugs are capable of lifting two times of the total weight of the transformer. The design of should be such that it should be suitable for 120degree lifting rope angle as per ASME B30.9 and at any point of time the maximum stress allowed on the Lug martial shall be lesser than 82MPa as per ANSI C.57.12.10

XXI. Calculation sheet for Lifting lug design to be submitted by Bidder. The calculation shall include the Stress on lifting lug material and stress on welding both. The Stress on the welding should be less than 840kg/cm2 as per ANSI C.57.12.10. All calculation to be done for considering lifting on any diagonal opposite two lugs conditions.

XXII. The lifting lugs shall be located on the side walls only and conservator on LT box side. Separate drawing to be submitted stating welding thickness, welding length and location on tank along with stiffener support for all rating and all lugs.

XXIII. **Bidder shall provide the transformer size and clearances in below table:**

Sl. No.	**Description**	**Unit**	**To be furnished by bidder**
1	**Transformer overall Length x Height x width**	mm x mm x mm	
2	Only Tank **overall Length x Height x width**	mm x mm x mm	
3	HV Cable box overall LxWxH	mm x mm x mm	
4	LV Cable box overall LxWxH	mm x mm x mm	
5	**Clearances**		
5.1	Core and LV (minimum 5mm)	Mm	
5.2	LV and HV (minimum 8mm)	Mm	
5.3	HV Phase to phase (minimum 10mm)	Mm	
5.4	Between HV winding and Yoke (minimum 20mm)	Mm	
5.5	Between LV winding and Yoke (minimum 5mm)	Mm	
5.6	Between yoke and inside of tank to cover (minimum 100mm)	Mm	
5.7	Between yoke and bottom (minimum 10mm)	Mm	

5.8	Any point of winding to tank (minimum 20mm)	Mm	
6	**Calculated Impedance**	%	
7.1	HV to Earth Creepage distance in oil (minimum 15mm)	Mm	
7.2	LV to Earth Creepage distance in oil (minimum 5mm)	Mm	
8.	Conservator dimension (dia x Length)	Mmxmm	
9.	Size of Pipe used for conservator to Tank	Mm	
10.	Size of Pipe used for Valves	Mm	
11.	Base Channel size	Mmxmm xmm	
12.	No. of Radiators	Nos	
13.	No. of fins per Radiator	Nos	
14	Dimension of radiator fins (L x W)	Mmxmm	
15	Make of Tank material		

5.6 RADIATORS

I. Radiators of pressed steel type conforming to the design requirement suitable for mineral oil and Ester oil (all type) type transformer.
II. The Pressed Steel type should be used in vertical formation without any bending and should be individually tested for leakage and pressure test etc. before welding with the main tank.
III. **Thickness** of sheet for radiators shall be **1.20 mm (min)**.
IV. The **mounting** of the radiators shall be **non-detachable** (i.e., they should be welded permanently with the tank) for DTs up to 1 MVA.
V. The number / cross section / length / fixing arrangement of radiators shall be indicated in the general assembly drawing.
VI. Radiator thickness must be uniform without any dent or damage and also no bulging or concave should occur even after performing pressure/ vacuum test and temperature rise test.
VII. Corrugated designs are not accepted.

5.7 GASKET

I. **Cork rubber gaskets** conforming to Type C , grade RC70 as per IS 4253 (Part-2) shall be provided for all oil bearing & water ingress resistant requirements for components like HV & LV bushings bottom gasket, HV & LV terminal box, Top Cover, Conservator, Valves etc.

II. **Nitrile/Neoprene rubber gaskets** conforming to Type IV – 4C (heat and oil resistant) as per IS 11149 shall be provided for bushing O ring (oil gaskets).

III. **Only Joint free Gasket to be used. Only in case of top cover gasket and terminal box gasket up to two dove-tail joints with adhesive shall be allowed. The terminal box gasket joint shall come at bottom part.**

IV. Cork sheet, Nitrile/Neoprene rubber gaskets shall be free from cracks, pinholes and shall be capable of being cut or punched without crack or tearing.

5.8 TAPS

I. Rotary/Ring type tap changing mechanism to be mounted on side of the transformer in such way that could be easily operated in smooth way.

II. Tap changing shall be carried out by means of an externally operated self-position switch and when the transformer is in de-energised condition.

III. The taps shall be provided in HV winding and each tap change shall result in voltage variation of 2.5%.

IV. Switch position no.1 shall correspond to the maximum plus tapping (i.e.+5%) and position no.7 shall correspond to minimum tapping (i.e,-10%).

V. Tap no. 3 to be considered as principal tap position.

VI. Provision shall be made for locking the tapping switch handle in position. Suitable plate shall be fixed for tap changing switch to know the position number of tap.

5.9 BUSHINGS AND TERMINAL CONNECTORS

A. HT Bushings (17.5 kV/250 A):

I. The bushings shall be outdoor type, external part shall be made of porcelain material. Rods, nuts and flat washer (Tightening Nut along with Check Nut) shall be made of tinned brass material.

II. IS to be followed: IS 8603(Part- I) for porcelain, IS 3347 part3 section 2 for metal part and Complete bushing shall comply IS 2099.

Option 1: Outdoor Bushing on Top with Bird Guard

III. The HV bushings shall have Hot Dipped Galvanized or Alu-zinc coated or SS material arcing horns with 8mm diameter. The thickness of coating shall be **86 microns** (minimum at any point).

IV. The HV bushing shall be fitted with bird guard on the bushing connector.

V. Complete Tinned Brass jointless connectors shall be provided on HV bushing rods suitable for bare dog conductor connections. The connector should have large contact area. Hardware shall be Hot Dipped Galvanized or Aluzinc coated or SS material

Option 2: Side bushing with Cable box

VI. Transformer shall be with HT cable box on sidewall of tank having porcelain bushing as specified above.

VII. In some situation Plinth mounted transformer may require outdoor bushing arrangement. This shall be decided during tender by user group.

B. LT Bushings(1.1kV/suitable current rating):

I. The bushings shall be of outdoor type made of porcelain material, The rod shall be Tinned copper for all rating along with neutral. The nuts and washers shall be of

(Tightening Nut along with Check Nut) tinned brass material.

II. IS to be followed: IS 3347(Part-I) (Section-1 for porcelain and Section 2 for metal part) and IS 7421(latest amendment of IS).

III. The metal portion of the internal HV & LV bushing inside the tank shall remain dipped in oil in all operating condition.

IV. The LV bushings shall be provided on the side wall of tank along with cable box.

V. The bushing tinned copper stem sizes to be followed are,

Rating	Size of stem
250kVA	M20
400kVA	M20
500kVA	M30
630kVA	M30
800kVA	M42
1000kVA	M42

5.10 CABLE BOXES

I. Cable boxes made up of Mild Steel 2.2mm thickness with suitable handle and front cover to be provided for both HV and LV side.

II. Water should not accumulate on cable boxes and proper slope shall be provided in order to ensure drainage of water.

III. Cable box protection shall be IP 55. Test reports to be submitted from CPRI /ERDA.

IV. Cable box should be painted in same way as that of tank painting with treatment.

V. HV and LV cable boxes shall be fixed on opposite sides on the tank with nuts and bolts (gasket placed in between them) in such a way that they can be completely removed whenever required.

VI. Canopy shall be provided on all gasket joints, the bend edges of cover overlapping gasket to protect from rain and sunlight shall also accepted.

VII. Cable cleating arrangements shall be provided just below terminal box (outside) to keep Cable straight and to support cables to avoid tension on bushings due to cable weight.

VIII. For Cable clamping, **Fire retardant nylon grade material to be used for oval shaped clamping arrangement** with GI nut bolt on both HV & LV Side.

IX. For HV Cable box, Non-magnetic Gland plate shall have thickness of 3mm and shall be in two parts in such a way that HV cable can be easily removed.

X. For LV cable box, Non-magnetic Gland plate shall have thickness of 4mm and shall be in two or more parts in such a way that LV cables can be easily removed by removing the gland plates.

XI. Gland plates shall be mounted separately with nut & bolt arrangement and gasket in between them.

XII. The size of the cable box cover should be moderate so that only one or two people is enough to lift it.

XIII. The bidder shall submit **drawings for the box with internal details** along with the transformer for approval.

HV CABLE BOX (option 2, ref: 5.9.A):

XIV. The HV box shall be designed and fixed on transformer such way that only opening of cover shall facilitate for working on cable termination with ease of accessibility of terminal.

XV. HV box gland plate shall have Single compression gland designed for 11kV, 3C X 150 or 3CX400 sq.mm XLPE Cable as per drawing approved from TPSODL.

XVI. Distance between HV gland plate and HV bushings should be minimum 650 mm.

XVII. Earthing provision (Body earth- outside and for cable earthing- inside of box) shall be provided in the HV box with M12 SS bolt & SS washers.

XVIII. Gland shall be SCG 18 single compression brass gland suitable for diameter of 91mm cable.

XIX. Bolted type terminal cover with M14/M16 HDG bolts (M12 bolts for 250KVA DT) with danger marking

LV CABLE BOX:

XX. Neutral terminal of LV winding shall be brought out on LV phase terminals to form four wire system.

XXI. Epoxy Insulators shall be provided from top side in LV box to support LV busbar.

XXII. LV busbar shall be of AL material & shall have clearances as mentioned in GTP.

XXIII. Lugs shall be of AL material with tin coating & shall comply the IS requirements.

XXIV. Arrangement in the LV box shall be BYRN from left to right when viewed from LV front.

XXV. All Nut bolts shall be as per Clause 5.24 and size selection shall with as per the hole size of the AL lugs to be used.

XXVI. The Neutral to be brought out from box through bushing and shall have same dimension as that of phase bushing.

XXVII. GI earth strip (Size - 50 x 6 mm) shall be provided from neutral bushing to both side of the box and shall be extended up to bottom of the terminal box both sides.

XXVIII. Insulator support to be provided on terminal box both sides for GI earth strip so as to avoid tension on secondary neutral bushing.

XXIX. There shall be gland provision in side wall bottom or base plate of the LV box with gland of size suitable for 10core cable for taking out voltage terminal to box. 10 core cable up to box shall also be provided wired up from bus bar to TB.

XXX. For Transformer up to 1 MVA ratings, In LV box, there must be provision for flexible mounting arrangement to fix multiple sized CT.

XXXI. There must be proper provision of connecting voltage wires with closed thimble/lug on LV bus bars (Phases and neutral) with nut bolt size of 6mm &wires to be taken out and connected in the Metering terminal box.

Transformer Rating	Size of cable for Phase & Neutral	Gland Size for LV Box	No. of runs per phase	No. of runs for neutral
315 kVA	1C x 630 sq. mm(1.1 kV Class)	SCG10	1	1
400 kVA			2	2
500 KVA			2	2
630 kVA			2	2
800kVA			3	3
250 kVA	1C x 300 sq.mm (1.1 kV class)	SCG7	2	2

XXXII. Earthing provision (Body earth) shall be provided in the LV box with M12 bolt.

XXXIII. The clearance above bushing shall be 120mm and below busbar cable mounting bolt shall be 450mm up to gland plate.

XXXIV. The no. and size of cables for installation on LV side shall be as follows:

Transformer Rating	Size of cable for Phase & Neutral	No. of runs per phase	No. of runs for neutral

1 MVA	1C x 630 sq. mm (1.1 kV Class)	3	3
1.25MVA		4	4
1.6 MVA		5	5
2 MVA		6	6

XXXV. The LV busbar shall be one continuous conductor strip with current density of 1A/mm^2 and length should be min. 225mm for 250kVA. The support insulator shall be provided at the end of busbar such that cable load shall be on top end support. Neutral busbar shall be of same size of phase. The lug shall be have single hole. Busbar shall be connected on four bolts on brass palm connector.

XXXVI. Bolted type terminal cover with M14/M16 HDG bolts (M12 bolts for 250KVA DT) with danger marking

5.11TERMINAL CONNECTORS

HT TERMINAL CONNECTOR:

I. Tinned Brass connectors shall be provided connected with HV bushing rods for bare top plate bushings .
II. UV resistant polymeric insulating shrouds shall be provided on the HV bare bushing terminals.
III. For 250 kVA and above ratings Aluminium lugs (with minimum of 2 hole) suitable for 3CX300 sq.mm XLPE shall be provided at HT side for cable connection.

LT TERMINAL CONNECTOR:

IV. Tinned Brass palm connector (with current rating w.r.t Load current), and Aluminium busbar (current density: not more than1 A/mm^2) shall be provided.
V. Busbar shall be supported with insulator at the top portion of terminal box.
VI. Aluminum lugs (with minimum of two holes) shall be provided with suitable size (no. of lugs as per clause 5.10 and size of lugs as per IS 8309) for the LV cables. (Can be share our drawing or specs)

5.12 METERING CURRENT TRANSFORMERS (This shall be decided during tender by user group.)

I. Cast Resin Type CTs shall be provided for transformers on the LT side for metering purpose.
II. The CTs shall be Resin Casted ring type and a thickness of min 2mm of resin above the coil of the CT to be ensured.
III. The core of the CT shall be of high grade non-ageing electrical silicon CRGO Steel or better grade of first quality having low hysteresis loss and high permeability to ensure accuracy at both terminal and over current/ voltage.
IV. The grade of the Core shall be M4 or better
V. The Resin Casted CTs shall be embossed as ‘P1’ and other side as ‘P2’. Lock side pole of coupler shall have S1 terminal and other pole shall have S2 terminal.
VI. The Coil shall be insulated with electrical grade Polyester Tape and the insulation shall be of high insulation grade, excellent mechanical strength (tensile, tear, and stretch), high purity, chemical stability, and heat resistance.
VII. The Copper wire used shall be super enameled as per the IS 4800 Part IX/ IEC 317.

VIII. The wiring shall be enclosed in such a way that it can't be disturbed during maintenance activities.
IX. The CT shall be mounted outside the tank with suitable clamping arrangement (fiber glass material).
X. The position of secondary terminals shall be such that, it will face towards outside after installation on bushing or bus bar of transformer.
XI. Mounting arrangement should be such that the CT shall be replaceable at site.
XII. The terminals shall have shorting facility and it should not get saturated up to 200% of rated current.
XIII. The weight of the Ring type CTs shall not exceed approx. 2.5 Kg +/- 10%.
XIV. The CTs shall have following parameters.

Accuracy class	0.5s
Burden	20 VA
Application	Metering
ISF	5
CT ratio for	As mentioned in clause 4.28

5.13 AUXILIARY TERMINAL BOX

Note: Aux. Terminal Box shall be required for 250kVA to 1MVA and ratings above 1MVA marshalling box shall be required.

I. Aux. terminal box of suitable size made up of **Mild Steel** and with **theft proof locking arrangement** for box.
II. Box shall be provided with Stud Type terminal blocks with 2 spare terminals. shorting links required for CT connections.
III. 10 core multi stranded PVC armored cable (2.5 sq.mm Cu FRLS PVC stranded panel wires) shall be used to terminate connections from CT and voltage terminals (6 CT wires and 4 voltage wires) at LV side to the CT terminal box.
IV. PVC ferrules engraved with black letters shall be used to mark the wires coming from LV box for CT and volatge.
V. **PVC ferrules** engraved with black letters shall be used to mark the wires in the terminal box.
VI. Holes with PVC glands to be provided on bottom side of this box as incoming (01nos.) and outgoing (02Nos.) for 10CX2.5 sq.mm cable and for Auxiliary cables of magnetic float switch, PRV contacts, OTI aux. cable.
VII. Terminal and cable entry for secondary wiring of Magnetic Float switch in conservator, OTI aux cable, PRV cable (for plinth mount DT) to be provided as required.
VIII. Terminal box shall have IP 55 protection with rubber gasket and bend cover canopy over joints.
IX. Terminal box must have provision for connecting I-type or U-type pin arrangement without spring arrangement.

5.14 EQUILISING/ EQUIPOTENTIAL STRIP

I. The Transformer top cover shall be connected with main tank using **tinned copper strip (30mm wide, 0.7mm thick)** at two places (diagonally opposite with each other).
II. The strip should touch bare surface of tank in order to ensure proper electrical connection of tank body with top cover with the strip.
III. All the covers like inspection cover, LV box cover, HV box cover, Conservator cover must be electrically connected using **tinned copper strip (30mm wide, 0.7mm thick).**
IV. Separate arrangement to be made and cover tightening bolt not to be used for equipotential strips.

5.15 EARTHING CONNECTIONS

NEUTRAL EARTHING:

I. Separate LV neutral bushing to be provided on top of LV box for neutral earthing.
II. For connecting LV neutral bushing shall be provided with 2 Nos of 50x6 mm GI strip, one on each side of terminal box (The thickness of GI coating of neutral earthing strip shall be **86 microns** (minimum at any point).
III. At the bottom of the GI strips two concentric holes of 12 mm diameter shall be made and M12 size SS nuts, bolts and SS washer shall be provided for them.

BODY EARTHING:

I. Two body earthing terminals pads boss arrangement (up to 500sq.mm) shall be provided on Transformer tank with M12 SS Bolt with 70 sq. mm lug. with SS plain washer and spring washer.
II. It shall be located on the lower side of the transformer, diagonally opposite to each other.
III. Each Earthing terminal pad on DT shall be provided with two SS M12 bolts on each pad on each side with two 70 sq.mm AL Lugs and washers.

5.16 OIL

Note: Default Oil shall be Mineral oil only if not specified / asked for other oil.

Mineral Oil: In case of Mineral Oil below are the requirements to be fulfilled:

1. All transformers shall be filled with new, unused, clean, standard mineral oil in compliance with IS 335-2018 / IEC 296 type-II and shall be free from all traces of polychlorinated biphenyl (PCB) compounds.
2. The use of recycled oil is not acceptable.
3. Oil shall be filled under vacuum before filling it shall be filtered and tested (as per IS 6103).
4. The test parameters should be as per the table below:

Test parameters	Values
Break Down Voltage (min)	60 kV
Water content ppm, (max.)	20 ppm
Specific resistance (min.) (at 27˚C)	2.5×10^{12} ohm-cm

Bidder has to provide the oil data in below table:

Sl. No.	Description	Unit	To be furnished by bidder
1	**Type of oil**		
2	**Oil Qty. for first filling**	Ltr.	
3	Grade of Oil		
4	Maker's name		
5	BDV at the time of first filling	kV	

5.17 CONSERVATOR

I. The conservator shall be supported / fixed on the main body of the transformer tank.

II. The capacity of the conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain **10% quantity of the oil used in transformer**. Normally, at least **30% volume of conservator** shall be filled with Oil.

III. The connecting pipe of the conservator shall be so fitted to transformer tank that the pipe can be detached from the tank.

IV. Jointless pipe shall be used which shall be connected with round flanges.

V. The inside diameter of the pipe connecting the conservator to the main tank shall be within 25 to 50 mm and it should be projected into the conservator so that its end is approximately 20mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level corresponding to -5°C should be above the sump level.

VI. The conservator oil filling cap/hole shall be of 32mm diameter & female type cap to be provided.

VII. For DT up to 1600kVA, the conservator to be fitted with float switches such that it shall operate/open contact when the oil level in conservator goes below -5 degree C /Minimum mark. The float switch shall be with normally closed type. This contact shall be wired up in auxiliary terminal box.

VIII. Buchholz relay: The pipe should not contain any right angle elbows. Its diameter should correspond to the diameter of the hole for the passage of oil of the relay. The pipe must be arranged to slope upwards towards the conservator at an angle of about 2 to 4 degrees to the horizontal (max 5 degrees). The part of the pipe preceding the relay should be straight for a length equal to at least five pipe diameters; the part of the pipe leading to the conservator immediately adjacent to the relay should be straight for a length equal to at least three pipe diameters.

IX. The Oil conservator shall be provided with:

a. **Oil level indicator** (as per clause no. 5.18).
b. **Dehydrating breather** (as per clause no. 5.22).
c. **Drain plug**
d. **Oil filling hole** (1.25 inch/32mm with thread size of BSP 1.25inch, 11TPI) with cover.
e. **Detachable end plate** on one side (the side on which the gauge glass is fitted), to enable the maintenance staff to periodically clean the inside of the conservator tank

Center of Gravity

The transformer should be designed in such a way that the centre of gravity of complete transformer with oil and with all accessories shall fall at the vertical centre at lower height such that the transformer should be stable on flat surface ground and while lifting at lifting hooks.

5.18 OIL LEVEL INDICATOR

I. Oil level indicator with **prismatic glass and red colour background** shall be provided.
II. The oil gauge glass shall be removable and so embodied in the end plate so as to prevent oil leakage.
III. The Oil level indicator should indicate oil level at minimum, normal and maximum as -5˚C, 30˚C and 90˚C respectively.

5.19 PRESSURE RELEASE DEVICE

I. All DTs, 250 kVA and above shall be provided with PRV/PRD with auxiliary contacts. The contact to be wired up in the auxiliary terminal box.
II. PRV shall be provided to operate before reaching the test pressure as specified in the above class.
III. PRV shall not have air release arrangement.
IV. The PRV shall seal-off after the excess pressure has been released and it shall have mechanical flag arrangement.
V. The PRV shall have NO, NC contacts wired up in auxiliary terminal box.

5.20 AIR RELEASE PLUG

The cover of the main tank shall be provided with an **air release plug on all ratings.**

5.21 DRAIN VALVE AND FILTER VALVE

I. The drain valve and filter valve shall be of Brass with gate valve.
II. The drain valve and filter valve shall have double round flanges. One side shall be fixed with tank and other side should be left open for oil filling/filtration purpose.
III. The drain valve and filter valve shall be provided with embossed name plate stating drain valve and filter valve.
IV. The drain valve shall be located on the bottom and filter valve shall be provided at side top of tank.
V. Locking arrangement shall be provided to stop movement of hand wheel.
VI. The valves shall be covered with a MS box of 2mm thickness by welding on tank. The paint thickness shall be min. 80 micron on the box.

5.22 DEHYDRATING BREATHER

I. The breather pipe shall enter the conservator from the upper side of the conservator.
II. The breather shall contain 1 kg of silica gel for 250/315/400/500/630 kVA/800kVA & 1MVA DTs and 2kg for above 1 MVA rating.
III. The silica gel shall be blue colored as per IS: 3401 – 1992. The granules size should be 3-5 mesh (4 to 6.73mm) up to 2kg capacity breather.
IV. The body of the breather shall be unbreakable, transparent, UV stabilized seamless polycarbonate tube of minimum thickness 3mm
V. The top cover shall be of pressure die cast aluminum and powder coated.
VI. The oil cup shall be of UV protected polycarbonate.
VII. Oil cup shall have marking of oil filling level
VIII. The breather shall be supplied as per approved make and as per specifications.

IX. The gasket should be of Class 3B, Type III as per IS 11149 Nitrile rubber (Oil resistant gaskets)
X. All tie rods and all hardware should be of stainless steel material (SS 304)
XI. Breather mounting arrangement,
   a. Up to 2 kg capacity of Silicagel breather shall have top threaded mounting arrangement with 1/2''pipe having BSP threading.
   b. 2kg and above capacity shall have flange mounting with 4 holes of 12mm diameter on 83 PCD.
XII. While fixing of breather on transformer Teflon tape should be used to make it air tight & water tight. This shall be checked during inspection and after receipt at our stores on each transformer.
XIII. The breather should have passed air pressured test as per our specification i.e. Breather shall be tested at an air pressure of 0.35kg/cm2 (5 PSI) for period of 30 minutes. NABL lab test report to be submitted from OEM. For further details please refer our specifications of breathers.

5.23 OIL TEMPERATURE INDICATOR

I. Dial Type Oil temperature indicator shall be provided on the top cover of the transformer. It should be suitable for outdoor mounting with maximum indicator pointer. Fixing union shall be of female thread.
II. Range: 0- 120 ˚C, Accuracy: $\pm$ 4 ˚C.
III. The OTI shall have auxiliary contacts for alarm and trip contacts at preset temperatures, both the contacts should be wired up in the auxiliary terminal box.
IV. The IP65 gland should be used for dial for taking out auxiliary wires.
V. The OTI shall be IP55 tested.

5.24 FASTENERS

I. All the bolts or studs shall be **at least 6 mm in diameter** except when used for small wiring terminals. **All bolts shall be of grade 8.8.**
II. All nuts/bolts/washers exposed to atmosphere shall be as follows:

Size 12mm (or below)	Stainless Steel
Above 12mm	Steel with antirust coating (aluzinc coated) ,Hot dip galvanized

III. All ferrous bolts, nuts and washers placed in outdoor positions shall be hot dip galvanized to prevent corrosion (except high tensile steel bolts and spring washers which shall have electrolytic action between dissimilar metals).
IV. In case the galvanization is removed due to welding or manufacturing, the parts should be properly cleaned and painted to avoid exposure to atmosphere.
V. The cup type washers to be used as spring washers, cut spring washers are not accepted.
VI. Taper washers shall be provided where necessary. Protective washers of suitable material shall be provided on front and back of the securing screws.
VII. Each bolt shall project at least one thread but more than three threads through the nut. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided. The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.
VIII. Core bolts shall be black colored high tensile grade-8.8

5.25 SURFACE PREPARATION AND PAINTING

I. The paint shall be applied by airless spray.

II. Steel surfaces shall be prepared by **shot blast cleaning** (IS-9954) to grade Sq.2.5 of ISO 8501-1 or **chemical cleaning** including phosphating of the appropriate quality (IS 3618).

III. **Heat resistant (Hot oil proof) paint** shall be used for the **inside surface** and whereas for **external surface one coat of thermosetting powder paint or one coat of epoxy primer (zinc chromate/Zinc Phosphate) followed by two coats of polyurethane (P.U.) base pain**t. as per table given below

S.No.	Paint type (should be UV restraint, non-fading)	Area to be painted	No of coats	Total dry film thickness (min); micron
1.	Thermosetting **powder paint**	Inside Outside	01 01	30 60
2.	**Liquid Paint**			
a.	Epoxy (primer)	Outside	01	30
b.	P.U. Paint (finish paint)	Outside	02	25 (each)
c.	Hot oil resistant paint	Inside	01	35

The two coats shall be of oil and weather-resistant nature with final coat as flossy and non-fading paint of shade 631 as per IS 5.

IV. The dry film thickness shall not exceed the specified minimum dry film thickens by more than 25%.

V. Any damaged part shall be cleaned to bare metal with an area extending 25 mm around its boundary. A priming coat shall be immediately applied followed by full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage. The repainted surface shall present a smooth surface which shall be obtained by carefully chamfering the paint edges before and after priming.

VI. Painting shall not affect by weather changes & performance against pilling out or fading etc. to be guaranteed for 5 Years.

5.26 RADIO INTEREFENCE

When operated at voltages up to **12.5%** in excess of the normal system rating, transformers shall be substantially free from partial discharges (i.e. corona discharges in either internal or external insulation) which are likely to cause interference with radio or telephone communication.

5.27 OVERLOAD CAPACITY

The transformer shall be suitable for loading as per IS 2026 part 7

5.28 FITTINGS

The following standard fittings shall be provided:

I. Two earthing terminal pads/ boss with earthing symbol ⏚ for body earthing on opposite sides with 70sq.mm AL lug and M12 SS bolt and washers.
II. Air Release Device.
III. Thermometer Pocket with cap.
IV. 1MVA and above with Inspection Cover.
V. Drain cum Sampling Valve & filter valve (Double Flanged for 630kVA and above & Up to 500kVA with T type drain valve without filter valve) and (0.75 inch nominal size thread, IS 554) with locking arrangement and a valve cover made of M.S. steel painted with minimum 70 micron layer.
VI. Pressure relief device with auxiliary contacts for DT up to 250 kVA and above.
VII. Welded fixed type Radiators upto 1MVA.
VIII. LV cable box for all DT. For HV side, cable box or Bare bushings can be provided. **User group shall decide this during tender.**
IX. For HV bare bushing DT- bird guard on bushings terminals connectors
X. Terminal Connectors for HV (Tinned brass for pole mounted DT) /LV side (tinned brass palm connector, Al busbar with support insulator on top and Al lugs) up to 500kVA DT.
XI. 1000kVA and above DT, epoxy bushing in HV and LV with tinned copper busbar shall be accepted for compact designs with top cover terminal & cable box.
XII. HV and LV two part Gland plates (Non-Magnetic and with Single compression Brass glands).
XIII. Conservator with Dehydrating Breather on LV side.
XIV. Prismatic Oil level Gauge and magnetic float switch in conservator.
XV. Lifting lugs (enclosed type) for the top cover, complete transformer and core and winding assembly.
XVI. Pulling Lugs.
XVII. Jacking Pads
XVIII. Stiffener Angle.
XIX. 2 Base channels all DT
XX. Marking Plates as asked in clause 6.1
XXI. Oil Temperature indicator with alarm & trip contact (>= 250KVA rating)
XXII. Magnetic float switch for 250kVA to 1600kVA DT on conservator tank.
XXIII. Two GI earth strip of Size 50x6 mm for neutral earthing from both side of LV box with minimum GI coating thickness of 86 microns. With SS nut bolts and washer.
XXIV. Magnetic Oil level Gauge (>1600kVA), Winding Temperature Indicator (>1600kVA), Magnetic Reed type Buchholz relay (for ratings above 1MVA) in line with IS 1180.
XXV. Marshalling Box with stud type terminals (for ratings above 1000kVA).

5.29 WINDING TEMPERATURE INDICATOR (WTI)

I. WTI shall be provided in one winding of each phase.
II. WTI shall be **indicating type**, responsive to the combination of top oil temperature and winding current, calibrated to follow the hottest spot temperature of the transformer winding.
III. WTI shall operate a remote alarm and trip in the event of attaining the predefined temperature.

5.30 BUCHHOLZ RELAY

I. Only for >1MVA DT.
II. Magnetic Reed type Buchholz relay shall be provided with alarm and tripping contacts to detect accumulation of gas.
III. The installation shall be fixed and weather proof to avoid any water seepage inside the relay.
IV. Round flange of nominal pipe bore of **50mm diameter** shall be used.
V. In addition, pocket with heater coil along with Resistance Temperature Indicator (RTD) shall be provided for WTI and OTI. CT for RTD for winding hot spots shall be provided.

5.31 MARSHALLING BOX AND PROTECTION

I. Marshalling Box of suitable size, made up of **Mild Steel** and with **theft proof locking arrangement** shall be provided.
II. Marshalling box shall have IP 55 protection.
III. Above 1MVA DT - Marshalling Box shall have provision for wiring the **WTI, OTI, MOG, PRV, Buchholz relay and LT CT terminals.** The terminals shall be provided as per table below:

Element	Alarm	Trip
Oil Temperature Indicator	NO,NC,COM	NO,NC,COM
Winding Temperature Indicator HT Side	NO,NC,COM	NO,NC,COM
Winding Temperature Indicator LT Side	NO,NC,COM	NO,NC,COM
Buchholz	NO,NC,COM	NO,NC,COM
Magnetic Oil Level Gauge	NO,NC,COM	
PRV	NO,NC,COM	
LT Neutral CT Secondary Terminal	N	
LT Phase CT Secondary Terminal	RYB	
LT Voltage terminals	RYBN	
Spare TB	4 No.	

IV. WTI meter shall be wired/ installed in the marshalling box.
V. 10 core PVC wire (4 sq.mm Cu FRLS PVC stranded panel wires) shall be used to terminate connections from CTs at LV side to the Marshalling box.
VI. Plastic ferrules engraved with black letters shall be used to mark the wires in the marshalling box.
VII. Wiring in Marshalling box shall be done by 2.5 sq.mm Cu FRLS PVC stranded panel wires.
VIII. For TPSODL, The equipments connected into marshalling box shall be compatible with power pack relay as per attached specification for 1MVA & above ratings.

IX. All the cables and conduits between the transformer and control cabinet shall be included in the scope of supply by the bidder.

5.32 MAKE OF MAJOR COMPONENTS & RAW MATERIALS

The BA shall procure the following constituent items from the designated vendors as follows:

S.no	RAW MATERIAL/EQUIPMENT	MAKE
a)	Copper	M/S Sterlite, M/S Hindustan Copper, M/S Hindalco.
b)	Core	M/S AK Steels, POSCO, Kawasaki/ JFE, Nippon Steel.
c)	Insulation paper and Pressboards	ITC paper, ABB, Raman Boards-Mysore, Senapathy Whiteley – Bangalore
d)	Transformer Oil (Mineral oil)	Savita, Apar, Gandhar
e)	Gaskets & Corks	Nu Cork, Anchor Corks
f)	Steel For Tank	M/s, TATA Steel, M/s SAIL, M/s. JSW Steel, M/s. IISCO, M/s. RINL/Vizag Steel, M/s. Jindal Steel,
g)	Dehydrating Breather	Yogya, Anushree, Electrical engineers
h)	Bushings HV & LV	GE,Hindustan Chemicals, Rashtriya Electricals,LAMCO
i)	Bucholz, PRD, SPR, OTI , WTI, and other devices	Reputed make to be approved by TPSODL during detailed engineering.

Also, Bidder has to provide all test certificates from original manufacturers & relevant sourcing documents. BA shall also have shot blasting facility.

6. MARKING:

6.1 MARKING PLATES

I. Name Plate (Rating) Plate : SS material

A rating plate shall be fitted to each transformer in a visible position and shall carry all the information as **specified in clause no. 6.2**

II. Terminal Marking Plate : on same name plate also accepted

- The terminal marking plate shall be provided which shall be strictly in accordance with **figure 4 of IS 1180-Part 1: 2014**. This plate may be combined with the rating plate or can be provided separately.
- Value of short circuit impedance on extreme tapping and on principal tapping and indication of winding to which impedance is related has to be displayed additionally.

III. Details Plate : MS sheet of 2.5mm with punched details and welded on tank.

A separate plate of **size 125 mm x 125 mm** shall be provided having following details:

- Name of the firm.
- Serial No.
- Rating of transformer.
- Order no. and date.
- Date of dispatch.

IV. Guarantee Plate :

A separate warranty plate made of **Stainless Steel** with following clause written on it.

"THE EQUIPMENT GUARANTEED UPTO A PERIOD OF 48 MONTHS FROM THE DATE OF COMMISSIONING OR 60 MONTHS FROM THE DATE OF LAST SUPPLY"

All the plates described above (clause 1 to 4) should be as followings:

Material	Stainless Steel
Thickness	1 mm
Engraving	The letters on the rating plate shall be engraved black on the white/silver back ground.
Fixing	Fixing screws shall be of stainless steel.

V. Danger Plate: On all cable boxes

Danger notice shall have red lettering on a white background on a plate as specified in **IS: 2551 – 1982.**

VI. BIS Certification Mark: On main name plate

The Bidder is required to get approval from BIS and display BIS mark on the name plate.

VII. BEE LABEL (up to 200 kVA transformers only):

A label shall be affixed on the front of the distribution transformer near the name plate, so as to be prominently visible. The label shall be non-detachable weather proof type with the following particulars shall be displayed on its label, namely:

a. the logo of the Bureau of Energy Efficiency
b. that the equipment is a distribution transformer
c. that it is an oil filled, naturally cooled type
d. name of the manufacturer and brand
e. Capacity in KVA as tested
f. Voltage is up to 11 KV

g. Total losses at 50% loading in watts
h. Total losses at 100% loading in watts
i. Star level
j. Model and year of manufacturing.
k. Bureau's authorisation number

VIII. Control Circuit drawing Plates:

- Engraved drawing for control circuit unit shall be available on Marshalling box.

6.2 NAME PLATE DETAILS

The name plate shall be strictly as per **IS 1180: 2014 (figure 1)**. Additionally, following points shall be displayed :

I. **Actual no load losses of transformer.**
II. **Actual total losses of transformer at 50% load and 100% load.**
III. Standard mark (BIS certification).
IV. "**PROPERTY OF TPSODL**" shall be written in bold letters.
V. PO number with date has to be mentioned.
VI. Overall dimensions of the transformer

6.3 MARKING

I. All transformers shall have HV phase windings marked in both, the terminal boards inside the tank and outside with capital letter 1U, 1V, 1W.
II. The LV winding for the same phase shall be marked by corresponding small letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n.
III. The markings shall be done by steel strips in which marks had been engraved in black colour.
IV. Colour marking of the bushings shall be done.
V. On the top cover of tank and the core channel, Manufacturer's name and Manufacturer's serial no. shall be engraved.
VI. On the body of tank, Manufacturer's name, rating, serial no. and year of manufacturing shall be written with black paint on yellow base. It should be written in suitable place in approved format that it is readable from ground after installation on pole.
VII. Durable QR code Sticker with name plate details and warranty details to be fixed on two accessible places i.e one on side wall of LV terminal box and other one is on conservator.

7. TESTS:

I. All routine, acceptance & type tests shall be carried out in accordance with the IS 2026 and IS 1180: Part-1 (2014).
II. All routine & acceptance tests shall be witnessed by the TPSODL/his authorized representative.
III. All the components shall also be type tested as per the relevant standards.

Following tests shall be necessarily conducted on the Distribution Transformers in addition to others specified in IS/IEC standards.

7.1 TYPE TESTS

I. Lightning Impulse Test [As per IS 2026 (Part 3) Clause no. 12].

II. Temperature Rise Test [As per IS 2026 (Part 2) Clause no.4].
NOTE: Maximum measured total loss (No load at Rated excitation load loss at maximum current tap converted to 75°C reference temperature) at 100 percent loading shall be supplied during temperature rise test.

III. Short Circuit Withstand test [As per IS 2026 (Part 5)].
NOTE: Routine tests before and after short circuit test shall be conducted as per IS 2026(Part 1).

IV. Pressure Test [As per IS 1180: Part 1 (2014)].

V. Determination of sound levels [IS 2026 (part 10)].

VI. No load current at 112.5% voltage

VII. BDV and moisture content of oil in transformer (IS 335).

VIII. Magnetic balance test.

IX. Measurement of Zero-phase sequence impedance.

X. Measurement of Harmonics of no-load current.

XI. Test to verify IP 55 for CT terminal Box and cable boxes.

Note: - Out of the above mention type test, the tests under sl. No. 1, 2 ,3 and 4 shall be conducted at CPRI/ERDA labs and the balance tests to be conducted at TPSODL recommended NABL lab.**In-house test labs are accepted if in-house lab is NABL accredited for these tests.**

7.2 ROUTINE TESTS

Sr. No.	Test to be done	Reference BIS	Clause no.
1	Measurement of Winding Resistance on each tap.	IS 2026 (Part 1)	16.2.1 & 16.2.3
2	Measurement of voltage ratio, check of voltage displacement, polarity, phase sequence and vector group	IS 2026 (Part 1)	16.3
3	Measurement of short circuit impedance (principal tapping, when applicable) and load loss at 50% and 100% load	IS 2026 (Part 1)	16.4
4	Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 112.5% of rated voltage	IS 2026 (Part 1)	16.5
5	Measurement of insulation resistance	IS 2026 (Part 1)	16.6
6	Induced over voltage withstand test	IS 2026 (Part 3)	11
7	Separate Source voltage withstand test	IS 2026 (Part 3)	10
8	Oil leakage test	IS 1180 (Part 1)	21.5.1.3
9	Neutral current measurement	IS 1180	7.9.2
10	BDV and moisture content of oil in transformer (Type-2 oil)	For mineral oil : IS 335 (2018) For Ester oil : IEC 60247 & IEC61099	For mineral oil : IS 335 Table 2

7.3 ACCEPTANCE TESTS

I. Temperature Rise test on one unit of first lot against every release order / PO for each rating. For further lots, TPSODL reserves the right to perform Temperature rise if required. [As per IS 2026 (Part 2) Clause no.4]
II. Oil leakage test for acceptance shall be conducted at pressure of 0.35kg/sq.cm for one hour. (IS 1180 (Part 1) clause 21.5.1.3)
III. The painted surface shall pass the Cross Adhesion Test (IS1180 part 1 clause no. 21.4.d).
IV. Calibration of WTI and OTI.
V. Magnetic Balance Test.
VI. OEM test reports for CT if used.
VII. OEM test reports for breather for air pressure test.
VIII. At stage inspection -Checking of weight, dimensions, fitting and accessories, tank sheet thickness, oil quantity, material finish and workmanship, physical verification of core coil assembly and measurement of flux density on one unit of each rating of the offered lot with reference to the GTP and contract drawings. Oil BDV of all offered lot.
IX. At least 10% transformer of the offered lot (minimum of one) shall be subjected to all the tests mentioned under the section 'ROUTINE Test" in presence of TPSODL's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS: 1180 and IS: 2026.
X. Device trails & test for 1MVA & above (Buchholz trip, Buchholz alarm, PRV trip, WTI alarm, WTI trip and OTI alarm.
XI. At Stage and Final inspection, the incoming raw material and its movement/consumption record in the related jobs of TPSODLwill be verified by inspecting officer. In case of any deviation or non-availability of such records, the offered lot may get rejected.

8. TYPE TEST CERTIFICATES:

I. The Bidder shall furnish the type test certificates of the offered rating and design of transformer for the tests as mentioned above as per the corresponding standards.
II. All the tests shall be conducted at CPRI / ERDA or as defined in 7.1 as per the relevant standards.
III. In the event of any discrepancy in the test reports, i.e. any test report not acceptable or any/all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication to TPSODL.
IV. Type tests should have been conducted in CPRI/ERDA during the period not exceeding 5 years from the date of opening the bid.

9. PRE-DISPATCH INSPECTION:

I. Bidder to raise the inspection calls for stage inspection and only after getting clearance from TPSODL shall proceed for further manufacturing. The bidder shall raise the inspection call for Final Inspection or prototype Inspection in TPSODL format.
II. If the prototype inspections asked for during drawing approval then bidder to make one unit of transformer and raise for inspection call for stage and final for prototype inspection.
III. Equipment shall be subject to inspection by a duly authorized representative of the TPSODL.
IV. Inspection may be made at any stage of manufacture at the option of the purchaser and the equipment if found unsatisfactory as to workmanship or material, the same is liable to rejection.
V. Bidder shall grant free access to the places of manufacture to TPSODL's

representatives at all times when the work is in progress.

VI. Inspection by the TPSODL or its authorized representatives shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications.

VII. The BA shall ensure that 100% of the lot must be ready for inspection and atleast 10% must be ready with all mounting and accessories during inspection.

VIII. Material shall be dispatched only after getting MDCC (Material Dispatch Clearance Certificate) from TPSODL.

IX. Following documents shall be sent along with material:

a) Test reports
b) MDCC issued by TPSODL
c) Invoice in duplicate
d) Packing list
e) Drawings & catalogue
f) Guarantee / Warrantee card
g) Delivery Challan.
h) Other Documents (as applicable)

X. To ascertain the quality of the transformer oil, the original manufacturer's tests report shall be submitted at the time of inspection.

XI. Arrangements shall also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of TPSODL's representative.

XII. In respect of raw material such as core stampings, winding conductors, insulating paper and oil, bidder shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the TPSODL.

XIII. The bidder shall furnish following documents along with their offer in respect of the raw materials:

a) Invoice of supplier.
b) Mill's certificate
c) Packing List.
d) Bill of Landing
e) Bill of entry certificate by custom.

XIV. To ensure about the quality of transformers, the inspection shall be carried out by the TPSODL's representative at following two stages:

a) Online anytime during receipt of raw material and during manufacturing/assembly Stage.
b) At finished stage i.e. transformers are fully assembled and ready for dispatch.

XV. Advance intimation of 7Days (Within Odisha)/12 Day (Outside Odisha) is required for both Stage and final inspections.

XVI. All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and TPSODL at the time of purchase.

XVII. The manufacturer shall offer the inspector representing the TPSODL all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as Active Inspection during Acceptance Tests.

XVIII. During the stage inspection a few assembled core coil and assembled Tanked transformer shall be dismantled (only in case of CRGO material) to ensure that the CRGO laminations, Windings and workmanship are of good quality. TPSODL also reserves the right to review any document or certificates related to material, manufacturing process, quality checks at any point of stage inspection.

XIX. TPSODL also reserves the right to inspect the tank of transformer before surface preparation and painting. The same shall be informed to TPSODL accordingly.

XX. Final inspection Call for carrying out acceptance tests as per relevant IS/IECs shall be sent by the Bidder along with routine test certificates.

XXI. The bidder shall provide all services to establish and maintain quality of workmanship in his works and that of his sub-contractors to ensure the mechanical / electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

XXII. The TPSODL has the right to have the test carried out at his own by an independent agency wherever there is a dispute regarding the quality supplied. **AIso TPSODL has right to test 1% of the supply selected either from the stores or field** to check the quality of the product. In case of any deviation TPSODL have every right to reject the entire lot or penalize the bidder, which may lead to blacklisting, among other things.

XXIII. At the time of inspection the material should be ready as specified, In case of material non-readiness or material failure in acceptance, Cost of re-inspection shall be borne by bidder.

10. INSPECTION AFTER RECEIPT AT STORE:

I. The material received at the TPSODL store shall be inspected for acceptance and shall be liable for rejection, if found different from the reports of the pre-dispatch inspection.

II. In case the transformers proposed for supply against the order are not exactly as per the tested design, the Bidder shall be required to carry out the short circuit test and impulse voltage withstand test at its own cost in the presence of the representative of TPSODL.

III. The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

IV. Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations

V. TPSODL reserves the right to conduct all tests on Transformer after arrival at site / stores and the manufacturer shall guarantee test certificate figures under actual service conditions.

VI. TPSODL reserves the right to conduct short circuit test and impulse voltage withstand test in accordance to IS, afresh on each ordered rating at purchaser cost, even if the transformer of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by TPSODL either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to TPSODL stores. The findings and conclusions of these tests shall be binding on the bidder.

11. GUARANTEE:

I. Bidder shall stand guarantee towards design, materials, workmanship & quality of process/ manufacturing of items under the contract for due and intended performance of the same, as an integrated product delivered under this contract. In the event any defect is found by the Purchaser up to a period of 48 months from the date of commissioning or 60 months from the date of last supplies made under the contract, whichever is earlier.

II. Bidder shall be liable to undertake to replace/rectify such defects at his own costs within mutually agreed timeframe and to the entire satisfaction of the TPSODL, failing which the TPSODL will be at liberty to get it replaced/rectified at Bidder's risks and costs and recover all such expenses plus the TPSODL's own charges (@ 20% of expenses incurred), from the Bidder or from the "Security cum Performance Deposit" as the case may be.

III. In case of Distribution transformer fails within the guarantee period TPSODL will immediately inform the Bidder who shall take back the failed Distribution Transformer within 15 days from the date of intimation at his own cost and replace / repair the transformer within forty five days of date of intimation with a roll over guarantee. The outage period i.e. period from the date of failure till unit is repaired / replaced shall not be counted for arriving at the guarantee period.

IV. Bidder shall further be responsible for 'free replacement' for another period of THREE years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Purchaser.

12. PACKING AND TRANSPORT:

I. Bidder shall ensure that all the equipment covered under this specification shall be prepared for rail/road transport in a manner so as to protect the equipment from damage in transit.

II. Transformers shall be delivered filled with oil and supplied with all accessories mounted. Screws and bolts shall be thoroughly tightened to ensure no leakage of oil.

Note: One use plastic not to be used for packing of the material.

13. TENDER SAMPLE:

All offered transformer detailed documents to be submitted as per clause no.18. The sample shall be not applicable

14. QUALITY CONTROL:

The bidder shall submit with the offer Quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. TPSODL's engineer or its nominated representative shall have free access to the manufacturer's/sub-supplier's works to carry out inspections.

The following information shall necessarily be submitted with the bid:

I. List of important raw materials, names of sub-suppliers for raw materials, standards to which raw material is tested and the copies of test reports of the tests carried out on raw materials in presence of Bidder's representatives.

II. List of manufacturing facilities available, level of automation achieved and the areas where manual process exists.

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

IV. List of testing equipment for final testing with valid calibration reports. Manufacturer shall possess 0.1 class instruments for measurement of losses.

V. QAP withhold points for TPSODL inspection.

15. TESTING FACILITIES:

Bidder shall have adequate in house testing facilities for carrying out all routine tests, acceptance tests and pre-dispatch inspection as per relevant International / Indian standards.

16. MANUFACTURING FACILITIES:

The successful bidder will have to submit (after placement of RC) technical compliance document and drawing of each part along with CCA, breather, bushings, terminal box etc. as per RC line items to be submitted for getting approval before mass manufacturing.

The first time supplier will have to make one prototype sample of each line tem of RC as per CAT-B approved drawing within 30 days of drawing approval. Inspection call to be raised by bidder before 7 days of date of proposed inspection. TPSODL shall arrange inspectors and intimate or confirm the date. Any observation during inspection shall have to be addressed within 7 days and revised improved drawing & technical details to be shared to TPSODL for final approval.

Manufacturing mass quantity to start only after getting CAT-A approved drawings or as per intimation from TPSODL

17. SPARES, ACCESSORIES AND TOOLS

Bidder shall give an assurance that the reparability of transformer is ensured by using standard spare parts and accessories available in market in India.

18. DRAWINGS AND DOCUMENTS:

Following drawings and documents shall be prepared based on TPSODL specifications and statutory requirements and shall be submitted with the bid:

a. Completely filled in compliance to each clause of Technical Specification and any Additional Details and Fittings.
b. Description of the transformer and all components drawings.
c. General arrangement for Transformer.
d. LV terminal box drawing along with CT if applicable and cleat arrangement and gland plate drawing.
e. Bill of material.
f. Design calculation details of transformer losses, cooling, efficiency and current density, weight of coils and components
g. Experience Certificate and list
h. Type test certificates.
i. List of makes of major components as listed above.

Drawings / documents to be submitted for approval after the award of the order within 7 days before mass manufacturing are as under:

List of Drawings/Parameters to be submitted:

a. Technical Parameters as asked in Specification (General Technical Particulars, General Technical Requirements, Additional Details, Fittings, Type test Reports and Routine test certificates of bought out accessories).
b. General Arrangement Drawing of the Transformer (Front view, Top view and both sides view. Complete list of fittings to be displayed and quantities to be mentioned with the drawing).
c. Internal Core arrangement drawing.
d. Internal Core-coil assembly drawing.
e. Foundation Plan drawing.
f. Marking plates and Markings (as mentioned in clause 6)
g. HV and LV bushings drawing (with internal view and metal parts)
h. HT connector, LT connector (palm connector), Aluminum Busbar
i. HV and LV Box drawing.
j. Gland Plate for HV/LV box.
k. Conservator drawing.
l. Prismatic oil level gauge drawing.
m. Silica Gel Breather drawing.
n. Auxiliary Terminal Box drawing with internal wiring arrangement.
o. Gland plate of drawing
p. BH curve & Loss/Kg graph of core material offered.
q. The tightening torque chart to be provided for all bolts used in specific rating.
r. Type Test Certificates.
s. Installation/ Mounting Instructions/Drawing.
t. Efficiency vs Load curve of the offered design.
u. Quality Assurance plan.

List of Calculations to be submitted:

a. All the calculations shall be step by step showing the use of formulas and other practical considerations. **Concise calculations in table or excel sheet shall not be accepted.** Also, the reference (only standard sources as IS, IEC or any such standard is acceptable) of the formulas shall be mentioned.
b. Resistance Calculation (75 deg. C)
c. Load Losses Calculation (at 75 deg. C)
d. No load Losses.
e. Stray Losses.
f. Weight of Copper (Bare and with Insulation also).
g. Weight of Core.
h. Flux Density calculations.
i. Current Density Calculations.
j. Short Circuit withstand.
k. Temperature Rise Calculations.
l. Conservator Volume calculations
m. Cooling Calculations showing cooling with tank and radiators separately with no. of radiators and fins mentioned specifically (For both Mineral oil and Ester oil)
n. Calculation sheet for Lifting lug design and mounting lug design to be submitted by Bidder.

Additional Documents to be submitted :

a. List of raw materials as well as bought out accessories and name of sub-suppliers selected from those furnished along with offer.
b. Type test certificates of the raw materials and bought out accessories.

c. The successful Bidder shall submit the **routine test certificates of bought out accessories** and central excise passes for raw material at the time of routine testing.

All the documents & drawings shall be in English language. After the receipt of the order, the successful bidder will be required to furnish all relevant drawings/parameters/calculation to TPSODL for approval.

Instruction Manuals:

Bidder shall furnish softcopies of nicely bound manuals (In English language) covering erection and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices.

19. SCHEDULE- "A" GUARANTEED TECHNICAL PARTICULARS:

All clauses and points in the Specification to be complied for along with GTR and offered design details.

20. SCHEDULE "B" DEVIATIONS:

(TO BE ENCLOSED WITH TECHNICAL BID)

All deviations from this specification shall be set out by the Bidders, clause by Clause in this schedule. Unless specifically mentioned in this Schedule, the tender shall be deemed to confirm the purchaser's specifications:

SL. No	Clause No.	Details of deviation with justifications

We confirm that there are no deviations apart from those detailed above.

Seal of the Company:

Signature

Designation