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Central Electricity Authority
वितरण आयोजन एवं प्रौद्योगिकी प्रभाग
Distribution Planning & Technology Division

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विषय: सिंगल-फेज़ एवं थ्री-फेज़ सी आर जी ओ कोर वितरण ट्रांसफॉर्मरों के लिए तकनीकी विनिर्देशों का मानकीकरण (भाग-I)

SUBJECT: STANDARD TECHNICAL SPECIFICATIONS FOR SINGLE-PHASE AND THREE-PHASE CRGO CORE DISTRIBUTION TRANSFORMERS (PART-I)

A Committee was constituted by All India Discoms Association (AIDA) to standardize specifications and procurement practices of various equipment used in distribution sector including distribution transformers. The Committee is headed by DG, AIDA and has members from CEA, DISCOMs, IEEMA, ISGF etc.

Based on the deliberations, the Standard Technical Specifications for Single-phase and Three-phase CRGO Core Distribution Transformers, which are being used by the Discoms, have been finalised by the cited Committee and the same are attached herewith for kind information of the stake holders in the power sector.

As both the types of Cores i.e CRGO core and Amorphous core are allowed in Distribution Transformers as per India Standards & SBD of RDSS, the Standard Technical Specifications for Single-phase and Three-phase Amorphous Core Distribution Transformers (Part-II) are also under preparation and expected to be placed on CEA website shortly.


14.5.2026
(प्रवीण कमल)
निदेशक



STANDARDIZATION OF TECHNICAL SPECIFICATIONS FOR CRGO CORE DISTRIBUTION TRANSFORMERS (PART I)



2026

INTRODUCTION

Although, electricity being a concurrent subject, Central Government and State Governments act together for providing reliable, quality and affordable power to its citizens, however, it is prime responsibility of respective Distribution Utilities in the States/ UTs to supply 24x7 quality and reliable power to all the consumers in their areas of operations.

The power sector in India has witnessed tremendous growth over the past decade in the areas of Generation, Transmission and Distribution. The country has surplus generation capacity and enhancement of inter-regional transmission capacity has resulted in achieving the One Nation One Grid objective. Government of India has been regularly supplementing resources of the States/ DISCOMs through Central Sector Schemes viz. DDUGJY, IPDS, Saubhagya & Revamped Distribution Sector Scheme (RDSS) for strengthening and augmentation of sub-transmission and distribution network. As a result of these initiatives, the country has achieved 100% village electrification and universal electricity access to all the households with significant improvement in availability of power supply in both rural and urban areas. The recently launched RDSS scheme carries the objective of improving the quality and reliability of power supply to consumers through a financially sustainable and operationally efficient distribution sector. Thus, ensuring uninterrupted power supply (24x7) across the country continues to remain a key focus area of GoI.

Distribution Transformer is a vital equipment near the consumer level through which the power supply is provided to the consumers. Distribution Utilities are installing Distribution transformers as a new or capacity enhancement of existing transformer on a regular basis to meet the growing demand or replacement of faulty transformers. Hence, the proper & efficient working of Distribution transformers is the key factor for maintaining 24x7 reliable power supply to the consumers. The faults in Distribution Transformer can cause not only interruption in power supply to the consumers but also results in revenue losses to the discoms.

As Distribution Transformers (DTs) constitute one of the largest groups of equipment in the electrical network, hence, the losses in the Distribution Transformers also constitute one of the major factor of total technical losses in the network. As per data available in CEA, at present, there are about 1.82 Crore DTs are installed in the country having transformation capacity of over 9.44 Lakh MVA. As Distribution Transformer is an integral part of the Electricity Distribution system, the demand of DTs will keep on increasing on the account of increase in generation capacity of both conventional and non-conventional sources besides the increase in loads of consumers / increase in per capita consumption of electricity and new avenues like electric vehicle charging stations etc. The demand will also increase due to replacement of old transformers with energy efficient transformers.

BIS has issued the Indian Standards for Distribution Transformer (IS 1180) which stipulates the losses of Transformers at various levels. In order to ensure quality procurement along with higher energy efficiency requirements, some of the important points to be considered during procurement of Distribution transformers are highlighted below.

- a) The maximum allowable losses at rated voltage and rated frequency permitted at 75°C for Distribution transformers can be chosen by the utility as per IS 1180 (as amended). The losses are maximum allowable and there would not be any positive tolerance.
- b) As per the Electrical Transformers (Quality Control) Order, 2015 issued by Ministry of Heavy Industries and Public Enterprises, no person shall by himself or through any person on his behalf manufacture or store for sale, sell or distribute any electrical Transformers specified in the Schedule, which do not conform to the specified standards (i.e. IS 1180 Part-1, 2014) and do not bear Standard Mark of the Bureau of Indian Standards, on obtaining certification marks license.

Accordingly, ISI marking on the Distribution transformer is mandatory and the product should be manufactured in compliance with IS 1180. Additionally, Star rating by BEE is also mandatory on Distribution transformers.

Regular inspections and periodic maintenance of Distribution transformers help to identify impending issues at the earlier stages and utilities may take necessary actions to prevent future problems. Distribution transformers must be regularly checked as an O&M practice especially for overloading, damaged connectors, worn-out power cords, burning smell, loose plugs or misaligned parts to minimize system failures and fire hazards. It is paramount that the maintenance crew adheres to applicable standards such as ISO 9001:2015 for quality management and ISO 45001:2018 for occupational health and safety, to ensure a safe and reliable working environment for both the equipment and the maintenance staff.

Recognizing the importance of standardization of specifications of the distribution transformer for procurement of quality transformers, Central Electricity Authority in association with AIDA has formulated the Guidelines for Standardization of Distribution transformers. This document covers the Standard Technical Specifications of Single Phase and Three Phase Distribution Transformers which may be used by the Distribution Utilities. This document will serve as standard technical specifications of distribution transformers for floating of the tenders by AIDA to negotiate rate contract which can be used by all the member DISCOMs for procurement of Distribution Transformers of a common designs / ratings specified in this specification. For the procurements of any other designs & ratings, DISCOMs can float their own tenders using their own technical specifications.

**STANDARD TECHNICAL SPECIFICATIONS
FOR
SINGLE PHASE CRGO CORE
DISTRIBUTION TRANSFORMERS
 $11/\sqrt{3}$ kV/250V or 11kV/250V
(Outdoor, Sealed Type)**

SCOPE:

This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery of oil immersed naturally cooled 11 kV/250 V, $11/\sqrt{3}$ kV/250 V single phase distribution transformers, round tank, sealed type, for outdoor use. The secondary voltage can be 240 V if required by some DISCOMs. The core used in the transformer shall be CRGO & winding shall be aluminum. Standard ratings of single phase transformers shall be 10, 16 and 25 kVA.

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

The equipment shall be manufactured in a dust-free environment with humidity control and equipped with adequate facilities and skilled personnel, as dust and contaminants compromise performance and lifespan, while proper infrastructure ensures quality, mechanical stability, and adherence to industry standards

The manufacturing facility must have a dust-free environment with humidity control and equipped with adequate facilities and skilled personnel having excellent level of knowledge & experience required.

The equipment shall have a design life of min. 25 years & equally long life in actual service under normal operating conditions.

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 the operation and maintenance of equipment. All outdoor apparatus, including bushing insulators with their mountings, shall be designed to have excellent hydrophobic properties to avoid any accumulation of water on the surface.

LIST OF APPLICABLE STANDARDS

Indian Standards	Title	International Standards
IS -2026	Specification for Power Transformers	IEC 60076
IS 1180 (Part-I): 2014	Outdoor Type Oil Immersed Distribution Transformers up to and including 2500 kVA, 33kV- Specification	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS- 7404	Paper covered copper conductor	
IS-335	Specification for Transformer/Mineral Oil	IEC 60296
IS-5	Specification for colors for ready mixed paints	
IS -104	Ready mixed paint, brushing zinc chromate, priming	
IS/IEC 60137	Insulated Bushings for Alternating Voltages above 1000 V	IEC 60137
IS-649	Testing for steel sheets and strips and magnetic circuits	
IS- 3024	Cold rolled grain oriented electrical sheets and strips	
IS - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 60554
IS - 1576	Specification for Insulating Press Board	IEC 60641
IS – 2026 (part 7)	Guide for loading of oil Immersed Transformers	IEC 60076
IS - 2362	Determination of water content in oil for porcelain bushing of transformer	
IS - 6162	Paper covered Aluminum conductor	
IS - 6160	Rectangular Electrical conductor for electrical machines	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical insulating liquids	
IS - 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	

IS - 6792	Determination of electrical strength of insulating oil	
IS- 10028	Installation and maintenance of Transformers.	
IS- 3347	Dimensions for porcelain bushings for Transformer.	
IS- 4253	Cork composition sheets spec.	

STANDARD RATINGS:

The standard ratings for single phase distribution transformer of 11 kV/250 V, $11/\sqrt{3}$ kV/250 V shall be 10, 16 and 25 kVA, continuous operation under the following climatic conditions.

SERVICE CONDITIONS:

The distribution transformers to be supplied against this specification shall be suitable for satisfactory continuous operation under the following climatic conditions.

i)	Location	At various locations in the country
ii)	Max ambient air temperature (0C)	50
iii)	Minimum ambient air Temperature (0C)	-5
iv)	Maximum Average daily ambient Air temperature (0C)	40
v)	Maximum Yearly weighted average (a) Ambient temperature (0C) (b) Humidity (%) (c) Average Rain (d) Max. altitude above mean sea level	32 100 1500 mm 1000 meters
vi)	Maximum altitude above mean sea level (meters)	5000 meters (For HP, J&K, Uttrakhand, Sikkim, Assam, Meghalaya, Manipur ,Nagaland, Tripura, Arunachal Pradesh and Mizoram)

NOTE: The climatic conditions specified above are indicative and may be different for different DISCOMs depending upon their location.

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

1. PRINCIPAL PARAMETERS:

- 1.1.** The transformer shall conform to the following specific parameters. These shall be specified in the GTP by manufacturer for approval from Purchaser.

Sl. No	ITEM	SPECIFICATION
1	No. of Phases	Single
2	Rated primary voltage (HV) Rated secondary voltage LV)	11/ $\sqrt{3}$ kV (P-N) or 11 kV (P-P) 250 V or 240 V
3	System voltage(max)	7kV (P-N) or 12kV (P-P)
4	Fluctuation in supply voltage	+12.5% to -12.5%.
5	Frequency	50 Hz +/- 5%
6	Neutral Earthing	Solid
7	Type of cooling	ONAN

1.2. INSULATION LEVELS

Voltage (Volts)	Impulse Voltage (kV Peak)	Power Frequency (kV rms)
433 or 250 or 240 V	-	3
11000	75	28
11000/ $\sqrt{3}$	60	20

2. TECHNICAL REQUIREMENTS:

2.1. CORE:

Transformer core shall be wound type construction using new & high quality cold rolled grain oriented (CRGO – M3 or higher grade) steel lamination with having low loss and good grain properties, coated with hot oil proof insulation, clamped together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

Core clamping shall be done with top and bottom U- shaped core clamps made of sheet steel clamped. Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to arrest movement of the active part. M.S. core clamps shall be painted with oil-resistant paint. Core shall be clamped with MS Tie rods of suitable size.

- 2.2. The transformer shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions & shall not get saturated. The operating flux density shall be such that there is a clear safe margin over the over fluxing limit of 12.5%.
- 2.3. The nominal flux density in any part of the core shall not exceed 1.69 Wb/Mtr² at 100% rated voltage and frequency and the maximum flux density in any part of the core and yoke at rated voltage and frequency shall be such that the flux density with 112.5 % combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9 Wb/Mtr²
- 2.4. No-load current shall not exceed 3% of full load current and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.
- 2.5. Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

3. WINDING:

- 3.1. For single phase Distribution transformers, the HV and LV windings shall be wound from double paper covered Aluminum conductor.
- 3.2. Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength to be conducted. The inter layer insulation shall be of Nomex/epoxy resin dotted Kraft paper.
- 3.3. The core coil assembly shall be dried in an oven. The type of winding shall be indicated in the tender. Whether LV windings are of conventional type or foil wound shall be indicated.
- 3.4. Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in guaranteed technical particulars (GTP).
- 3.5. The core coil assembly shall be securely held in position to avoid any movement under short circuit conditions. Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce the hot spot of the winding.
- 3.6. Current density in the conductor (Aluminum) shall not be more than 1.30 A/sq.mm. Any joints in the HV/LV winding shall not be allowed.
- 3.7. Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.
- 3.8. For 11 kV (P-P) transformers both ends of primary winding shall be brought out

through HV bushings. For 11/ $\sqrt{3}$ kV (P-N) transformers, neutral end of the primary HV winding shall be brought out for connecting to 'Neutral' supply wire through 1.1 kV bushings. There shall be provision for connecting 'Neutral' terminal, to local 'Earth' by way of a tinned Copper strip of adequate size and dimension. The secondary winding shall be connected to two LV bushings

4. OIL:

- 4.1. The insulating oil shall comply with the requirements of respective IS.
- 4.2. Use of recycled oil is not acceptable.
- 4.3. The oil shall be tested prior to filling in main tank showing BDV of 70KV min. and Moisture content 5ppm max. The oil shall be filled under vacuum.
- 4.4. The design and all materials and processes used in the manufacturing of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

5. LOSSES:

- 5.1. The bidder shall guarantee individually the no-load loss and load loss without any positive tolerance. The bidder shall also guarantee the total losses (no load + load losses at 75 $^{\circ}$ C) at the 50% of rated load and at 100% of rated shall not exceed the maximum total loss values given in Table-9 of IS 1180(Part-1):2014 (latest amendment).
- 5.2. The maximum allowable losses at rated voltage and rated frequency permitted at 75 $^{\circ}$ C for 11/0.433 kV transformers can be chosen by the DISCOM as per Efficiency Level specified in IS 1180 (Part-1): 2014 (latest amendment), table 9, for single phase distribution transformers. The recommended Energy Efficiency level for all the single & three phase distribution transformer below 100kVA shall be level 1.
- 5.3. The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive.

6. PERCENTAGE IMPEDANCE:

- 6.1. The percentage impedance of single-phase transformers at 75 $^{\circ}$ C for different ratings up to 25 kVA shall be as per Table 9 of IS 1180(Part- 1):2014.

7. TEMPERATURE RISE:

- 7.1. The temperature rise over ambient temperature of 50 deg.C, shall not exceed the limits given below when tested in accordance with IS 2026 (part 2):

Top oil temp.rise measured by thermometer: 35 Deg. C

Winding temp.rise measured by resistance: 40 Deg. C

The permissible temperature rise limits shall be as per IS 1180, part 1 (2014), latest amendment.

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

8. BUSHING:

- 8.1.** The bushings shall be porcelain clad with a creepage of 31mm/kV (min) conforming to the relevant standards specified in the table of applicable standards.
- 8.2.** Porcelain bushings of 12 kV class shall be used for HV and 1.1 kV class for LV bushings shall be used.
- 8.3.** Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section – IX.
- 8.4.** The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.
- 8.5.** The HV bushings shall be fixed to the top cover of the transformer and the LV bushings shall be fixed to transformer on sides and in the same plane.
- 8.6.** The bushing rods and nuts shall be of brass for HV and tinned copper for LV. Arcing horns made of SS shall be provided on the HT bushings.
- 8.7.** Bushings shall be marked with manufacturer's name, voltage grade and month/year of manufacture etc.

9. BUSHING TERMINALS:

- 9.1.** The HV bushings shall be fitted with molded heat shrinkage insulating covers suitable for bare ACSR conductor / AB cable / U/G cable. HV terminal shall be designed / provided with suitable arrangements to directly connect the ACSR conductor/AB cable/UG cable. The LV bushing and HV bushing stems shall be provided with suitable detachable terminal connectors so as to connect the jumper without disturbing the bushing stem. LV terminals shall be suitable for directly receiving LT cables (aluminum) ranging from 25 to 50 sq. mm both in vertical and horizontal position in a cable box. The arrangements should be such as to avoid bimetallic corrosion. Terminal connectors must be type tested as per IS 5561.

10. TANK:

- 10.1.** 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. There must be sufficient space from the core to the top

cover to take care of oil expansion.

- 10.2.** The tank cover shall have plasticized surface at the top to guard against bird faults. Alternately, suitable insulating shrouds shall be provided on the bushing terminals.
- 10.3.** The Transformer tank shall be of robust construction round/rectangular in shape and shall be built up of tested CRCA/Mild Steel Sheet.
- 10.4.** The tank shall be capable of withstanding a pressure of 1 kg/cm² (g) and a vacuum of 760 mm of Hg for 30 minutes without any permanent deflection (Air pressure test shall be conducted as per IS -1180(Part- I):2014.)
- 10.5.** The L - seam joint, C - seam joint and all fittings and accessories shall be oil tight and no deflection / bulging should occur during service.
- 10.6.** Manufacturer should carry out the all the welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the Purchaser.
- 10.7.** The circular bottom plate edges of the tank should be folded upward, for at least 25 mm, to have sufficient overlap with vertical sidewall of the transformer.
- 10.8.** The Transformer tank and the top cover shall be designed in such a manner as to leave no external pockets in which water can lodge. The top cover shall be fixed to the tank through clamping only.
- 10.9.** Tank shall have permanent lugs for lifting the transformer bodily and there shall be facilities for lifting the core coil assembly separately.
- 10.10.** The transformer shall be provided with two mounting lugs suitable for fixing the transformer to a single pole by means of 2 bolts of 20 mm diameter as per ANSI C 57.12.20-1988.
- 10.11.** Both mounting lugs are made with steel of minimum 5 mm thickness. Mounting lug faces shall be in one plane. Jump proof lips shall be provided for upper mounting lug.
- 10.12.** Minimum Oil level mark shall be embossed inside the tank (at 25⁰ C).
- 10.13.** HV bushing pocket shall be embossed to top side of the top cover so as to eliminate ingress of moisture and water.
- 10.14.** The edges of the top cover shall be formed, so as to cover the top end of the tank and gasket.
- 10.15.** Nitrile/ polyurethane /neoprene rubber gaskets' conforming to latest IS 4253 part-II shall be provided between tank and top cover. The gaskets shall be continuous i.e. without any joint.
- 11. TANK SEALING:**

The space on the top of the oil shall be filled with dry air or nitrogen. The nitrogen plus oil volume inside the tank shall be such that even under extreme operating conditions, the pressure generated inside the tank does not exceed 0.4 kg/sq. cm positive or negative. The nitrogen shall conform to commercial grade of the relevant standards.

12. SURFACE PREPARATION AND PAINTING:

12.1. GENERAL

12.1.1. All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

12.1.2. All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations.

12.2. CLEANING AND SURFACE PREPARATION:

12.2.1. 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 SA. 2.5 Of ISO 8501-1 or chemical cleaning by Seven Tank process including phosphating (IS 3618).

12.2.2. The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination to ensure that the cleaning process is not impaired.

12.2.3. Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale and shall only be used where shot blast cleaning is impractical. Manufacturer shall indicate such location, for purchaser's information, in his offer.

12.3. PROTECTIVE COATING:

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

12.4. PAINT MATERIAL:

Following are the types of paint mentioned below that may be suitably used for the items to be painted at shop and supply of matching paint to site:

12.4.1. The painting shall be as per Annexure-Paint which is attached herewith.

12.4.2. For external surfaces one coat of thermosetting paint or 1 coat of epoxy primer followed by 2 coats of polyurethane base paint. These paints can be either air-drying or stoving.

12.4.3. In case of highly polluted area, chemical atmosphere or at a place very near the sea coast, paint as above with one intermediate coat of high build MIO (Micaceous iron oxide) as an intermediate coat may be used to give a total dry film thickness of 150 to 180 microns.

12.5. PAINTING PROCEDURE:

12.5.1. 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.

12.5.2. Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another. In all instances where two or more coats of the same paint are specified, such coatings may or may not be of contrasting colors.

12.6. DAMAGED PAINTWORK:

12.6.1. 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 employed.

12.6.2. Any damaged paint work shall be made good as follows:

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

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

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

12.7. DRY FILM THICKNESS:

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

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

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

12.8. TESTS:

12.8.1. The painted surface shall be tested for paint thickness.

12.8.2. The painted surface shall pass the cross hatch adhesion test and impact test as

routine test, Salt spray and Hardness test as type test as per the relevant ASTM standards.

- 12.9.** The paint shade shall be as per Annexure-Paint which is attached herewith.

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

13. RATING PLATE AND TERMINAL MARKING PLATE:

- 13.1.** Each transformer shall be provided with rating plate made of anodized aluminum/stainless steel material securely fixed on the outer body, easily accessible, showing the information given in Fig.2 of IS 1180(Part-1):2014 for single phase transformers. The entries on the rating plates shall be indelibly marked by engraving.

- 13.2.** Each transformer shall be provided with a terminal marking plate in accordance with Fig.5 of IS 1180(Part-1):2014. The rating and terminal marking plates may be combined into one plate at the option of manufacturer.

- 13.3.** The distribution transformer be marked with the Standard Mark and the use of Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and regulations made thereunder. As per Quality Control Order for Electrical Transformers- 2015, issued by Dept. of Heavy Industries, the Standard / ISI marking on Distribution Transformers is mandatory and the product should be manufactured in compliance with IS 1180 Part-1(2014).

14. PRESSURE AND VACCUM REQUIREMENTS:

Single phase transformers up to 25kVA, the transformer tank shall be of robust construction, round in shape shall be capable of withstanding a pressure of 100kPa and a vacuum of 760 mm of mercury, as per the detailed provided in IS 1180.

15. FITTINGS:

- 15.1.** Two earthing terminals with earthing symbol.
- 15.2.** Lifting lugs for the complete transformer as well as for core and winding assembly.
- 15.3.** HV side neutral grounding strip (where one of the bushing terminal is connected to earth).
- 15.4.** Rating and terminal marking plates. (Non-detachable type).
- 15.5.** Pressure relief device or self-ventilating cover.
- 15.6.** HV bushings -2 nos.
- 15.7.** LV bushings – 2 nos.
- 15.8.** HV and LV terminal connectors.

- 15.9. Top cover fixing clamps.
- 15.10. Mounting lugs - 2 Nos.
- 15.11. Bird guard.
- 15.12. LV earthing arrangement. LV neutral terminal to be brought out for earthing.
- 15.13. Any other fitting required as per IS: 1180 (Part 1)

16. FASTENERS:

- 16.1. All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.
- 16.2. Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.
- 16.3. All nuts and pins shall be adequately locked.
- 16.4. Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.
- 16.5. All bolts/nuts/washers exposed to atmosphere should be as follows.
 - 16.5.1. Size 12 mm or below – Stainless steel
 - 16.5.2. Above 12 mm- steel with suitable finish like electro galvanized with passivation or hot dip galvanized.
- 16.6. Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.
- 16.7. The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.
- 16.8. Taper washers shall be provided where necessary. Protective washers of suitable material shall be provided front and back of the securing screws.

17. OVER LOAD CAPACITY:

- 17.1. The transformer shall be suitable for loading as per latest IS 2026 (part7).
- 17.2. **Transformer Overcurrent Protection** - Appropriate protection device must be installed externally on HV & LV side of the transformer to protect it from overload & short-circuit faults. Protection devices must be installed locally, near to the transformer. MCCB/HRC fuse can be provided on LV side. Drop-out type fuses shall be used on HV side of the transformer.

- 17.3. Transformer Overvoltage Protection** – Appropriate Overvoltage protection must be installed externally on the HV side to protect the transformer from Lightning overvoltage. Gapless metal Oxide lightning arrester conforming to standards IS 3070 part 3 / IEC 60099 – 4 shall be installed locally as close as possible to the transformer.

18. TESTS:

All the equipment offered shall be fully type tested by the bidder as per the relevant standards (IS 1180, IS 2026) including the additional type tests mentioned. The type test must have been conducted on a transformer of same design & rating, during the last five years at the time of bidding. The bidder shall furnish four sets of type test reports along with the offer.

- 18.1.** Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards.
- 18.2.** The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid. However, if the same are not available at the time of bidding, the same may be submitted after order but before commencement of supply.
- 18.3.** The procedure for testing shall be in accordance with IS 1180(Part-1): 2014 / IS 2026 as the case may be except for temperature rise.
- 18.4.** Before dispatch each of the completely assembled transformer shall be subjected to the routine tests at the manufacturer's works.

19. ROUTINE TESTS:

All the equipment offered shall be subjected to routine tests by the bidder in accordance with the relevant applicable Indian Standards, i.e., IS 1180 and/or IS 2026, as applicable.

20. TYPE TESTS:

All the equipment offered shall be subjected to type tests by the bidder in accordance with the relevant applicable Indian Standards, i.e., IS 1180 and/or IS 2026, as applicable.

- 20.1.** Type test certificates for the tests carried out on prototype of same specifications shall be submitted along with the bid.
- 20.2.** The purchaser may select the transformer for type tests randomly.
- 20.3. Additional Requirements for Short Circuit Test and Impulse Voltage Withstand Test:**
- 20.3.1.** The purchaser intends to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against

the order are not exactly as per the tested design, the supplier shall be required to carry out the short circuit test and impulse voltage withstand test at their own cost in the presence of the representative of the purchaser.

20.3.2. 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.

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

20.4. It may also be noted that the purchaser reserved the right to conduct short circuit test and impulse voltage test in accordance with the IS, afresh on each ordered rating at purchaser's cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at their works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's Stores. The findings and conclusions of these tests shall be binding on the supplier. For any failure during the new testing, the purchaser has rights to reject the complete lot.

21. ADDITIONAL TESTS:

In addition to the tests mentioned above following tests shall be conducted as per IS 1180, IS 2026 and other applicable standards:

21.1. Noise level measurement.

21.2. Permissible flux density and over fluxing withstand test.

21.3. Oil samples (post short circuit and temperature rise test) - Only DGA & BDV test shall be conducted.

22. TESTS AT SITE / STORE:

22.1. The purchaser reserves the right to conduct all tests on transformer after arrival at site and the manufacturer shall guarantee test certificate figures under actual service conditions. For any failure during the new testing, the purchaser has rights to reject the complete lot.

23. ACCEPTANCE TESTS:

23.1. At least 10% transformers of the offered lot (min. 1) shall be subjected to the acceptance tests (all the test specified in clause 18 (routine tests) & temperature rise test) in the presence of purchaser's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS 1180, Part-1 (2014), IS 2026 and other applicable standards. Checking of mass, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish

and workmanship as per GTP/QA plan and contract drawings.

- 23.2.** Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP and contract drawings on one transformer of each type in every inspection.
- 23.3.** Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report.
- 23.4.** Temperature rise test shall be carried out on minimum 1 unit of total ordered quantity as acceptance test.

24. INSPECTION:

- 24.1.** In respect of raw material such as core stampings, winding conductors, insulating paper and oil, the manufacturer shall use materials of pre-approved make from reputed manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from the manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect to the raw materials:

- 24.1.1.** Invoice of supplier.

- 24.1.2.** Mill's certificate.

- 24.1.3.** Packing List.

- 24.1.4.** Bill of landing.

- 24.1.5.** Bill of entry certificate by custom.

Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure. It is mandatory to follow the procedure given in the Annexure A.

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

- 24.2.1.** Online anytime during receipt of raw material and manufacture/ assembly whenever the purchaser desires.

- 24.2.2.** When the raw material is received, and the assembly is in process in the shop floor.

- 24.2.3.** At finished stage i.e. transformers are fully assembled and are ready for dispatch.

- 24.3.** After the main raw-materials i.e. core and coil materials and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm 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 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, as and when the transformers are ready for dispatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS and as in clauses above, shall be sent by the firm 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.

- 24.4.** In case of any defect/defective workmanship observed at any stage by the purchaser's inspecting officer; the same shall be pointed out to the firm in writing for taking remedial measures. Further processing should only be done after clearance from the Inspecting officer/purchaser.
- 24.5.** 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 inspection during manufacturing stage as well as active part inspection during acceptance tests.
- 24.6.** The manufacturer 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.
- 24.7.** Along with the bid the manufacturer shall prepare Quality Assurance Plan (QAP) identifying the various stages of manufacture, quality checks performed at each stage and the customer hold points. The document shall also furnish details of method of checking, inspection and acceptance standards/values and get the approval of purchaser or his representative before proceeding with manufacturing. However, purchaser or his representative shall have the right to review the inspection reports, quality checks and results of manufacturer's in house inspection department which are not customer hold points and the manufacturer shall comply with the remarks made by purchaser or his representative on such reviews with regards to further testing, rectification or rejection etc. Manufacturer should submit the list of equipment for testing along with latest calibration certificates to the purchaser.
- 24.8.** Purchaser shall have every right to appoint a third party inspection to carry out the inspection process. The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality of supply. 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 has every right to reject the entire lot or penalise the manufacturer, which may lead to blacklisting among other things.

25. QUALITY ASSURANCE PLAN:

- 25.1.** The bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of material offered.
- 25.2.** Statement giving list of important raw materials, names of sub- suppliers for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials in presence of bidder's representative and copies of test certificates.
- 25.3.** Information and copies of test certificates as above in respect of bought out accessories.
- 25.4.** List of manufacturing facilities available.
- 25.5.** Level of automation achieved and list of areas where manual processing exists.
- 25.6.** List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- 25.7.** List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports shall be furnished with the bid. Manufacturer shall possess 0.1 accuracy class instruments for measurement of losses.
- 25.8.** Quality assurance plan with hold points for purchaser's inspection.
- 25.9.** The successful bidder shall within 30 days of placement of order, submit following information to the purchaser.
 - 25.9.1.** List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
 - 25.9.2.** Type test certificates of the raw materials and bought out accessories.
- 25.10.** 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.
- 25.11.** ISI marking on the transformer is mandatory. As per Quality Control Order for Electrical Transformers- 2015, issued by Dept. of Heavy Industries, the Standard / ISI marking on Distribution Transformers is mandatory and the product should be manufactured in compliance with IS 1180 Part-1:(2014).

26. DOCUMENTATION:

- 26.1.** Completely dimensioned drawings indicating general arrangement and details of fittings, clearances and winding details shall accompany the tender.
- 26.2.** Drawings of internal constructional details and fixing details of coils should also be indicated. Tank dimensions, position of fittings, clearances between leads within the

transformer, core grade of laminations, distance of core centers, area of conductor bare and with insulation. No. of coils, No. of turns per coil material of bushing metal parts etc., shall also be furnished with tender.

27. PACKING AND FORWARDING:

27.1. The packing shall be done as per the manufacturer's standard practice. However, he should ensure the packing is such that, the material should not get damaged during transit by rail/road.

27.2. The marking on each package shall be as per the relevant IS.

28. GUARANTEE:

28.1. The manufacturers of the transformer shall provide a guarantee of 60 months from the date of receipt of equipment at purchaser's store/site. In case the transformer fails within the guarantee period, the supplier will depute his representative within 15 days from date of intimation by utility for joint inspection. In case, the failure is due to the reasons attributed to supplier, the transformer will be replaced/repared by the supplier within 2 months from date of joint inspection.

28.2. 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.

28.3. In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier, which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

Annexure – Paint

Painting-Transformer Main tank, pipes, Conservator Tank, Radiator etc.

	Surface Preparation	primer coat	Intermediate under coat	finish coat	Total Time	Color shade
Main tank, pipes, conservator tank, (External surfaces)	Blast cleaning Sa2½	Epoxy base	Epoxy base Zinc primer 30-40 micron	Aliphatic Polyurethane (PU Paint) (min)50 micron	Min 110 micron	541/631/632/108 shade of IS:5
Main tank, pipes (above 80 NB), Conservator	Blast cleaning Sa2½	Hot	--	--	Min 30 micron	Glossy white

tank, etc. (Internal surfaces)						
Radiator (External surfaces)	Chemical / blast cleaning (Sa2½)	Epoxy base zinc primer 30- 40 micron	Epoxy base Zinc primer Min 30-40 micron	Aliphatic Polyurethane (PU Paint) (min)50 micron	Min 110 micron	541/631/ 632/108 shade of IS:5
Radiator	Chemical cleaning if required	Hot oil proof low viscosity varnish or hot oil resistant non corrosive paint	--	--	--	Glossy White for paint
	Surface Preparation	prier coat	intermediate under coat	finish coat	Total DFT	Color shade

GUARANTEED TECHNICAL PARTICULARS FOR SINGLE PHASE DISTRIBUTION TRANSFORMERS

Sr. No.	GTP parameter	Value/Unit	Bidders Offer
1	Name of manufacturer		
2	Place of Manufacturing		
3	Transformer continuous rating	KVA	
4	Voltage ratio	11/√3 kV / 250V or 11 kV / 250V	
	(a) Rated voltage HV	11KV	
	(b) Highest System voltage HV	12KV	
5	No. of Phases	1	
6	Type of Cooling	ONAN	

7	Type of Transformer	Sealed	
	(a) Power frequency withstand voltage HV	28 KV rms	
	(b) Impulse withstand voltage HV	75 KV rms	
8	BIS Energy Efficiency Level	Level 1	
9	Losses		
	(i) No load loss	Watts	
	(a) At Normal Voltage	Watts	
	(b) At Maximum Voltage	Watts	
	(ii) Full Load losses at 75 deg.C.	Watts	
	(iii) Total losses at 50 % load at 75 deg.C.	Watts	
	(iv) Total losses at 100 % load at 75 deg.C.	Watts	
10	Percentage Impedance at 75 deg.C. (as per IS 1180)	%	
11	Maximum temperature rise		
	(a) Windings by resistance method	40 deg C	
	(b) Top oil by Thermometer	35 deg C	
12	Clearances		
	(a) Core & LV	mm	
	(b) LV & HV	mm	
	(c) HV Phase to Phase	mm	
	(d) End insulation clearance to Earth	mm	
	(e) Any point of winding to tank	mm	
	(f) HV to earth creepage distance	mm	
	(g) LV to earth creepage distance	mm	
13	Efficiency at 75 deg.C.		
	a) Unity P.F.		
	(a) 125% load	%	
	(b) 100% load	%	
	(c) 75% load	%	
	(d) 50% load	%	
	(e) 25% load	%	
	b) 0.8 P.F.		
	(a) 125% load	%	
	(b) 100% load	%	
	(c) % load	%	
	(d) 50% load	%	
	(e) 25% load	%	

14	Regulation at		
	(a) Unity P.F.		
	(b) 0.8 P.F. at 75 deg.C.		
15	CORE	CRGO Core	
	(i) Core grade	M3 or better	
	(ii) Core diameter	mm	
	(iii) Gross Core area	Mtr ²	
	(iv) Net Core area	Mtr ²	
	(v) Flux density at 100% / 112.5% voltage	Wb/Mtr ²	
	(vi) Wt. of Core	Kg	
	(vii) Loss per kg. of Core at the specified Flux density	Watts	
	(viii) Core window height	mm	
	(ix) Centre to center distance of the core	mm	
	(x) The nominal flux density at		
	(a) 100% rated voltage	$\leq 1.69 \text{ Wb/Mtr}^2$	
	(b) 112.5 % of rated voltage	$\leq 1.9 \text{ Wb/Mtr}^2$	
	(xi) % No load current of full load current at rated voltage and frequency on the secondary and Increase of voltage by 112.5%	$\leq 3\%$ and $\leq 6\%$	
	(xii) Neutral Unbalance Current	$\leq 2\%$	
16	WINDINGS	Aluminum	
	(i) No. of L.V. Turns	No.	
	(ii) No. of H V turns	No.	
	(iii) Diameter of LV Conductor bare/ DPC covered	mm	
	(iv) Diameter of HV conductor bare/DPC covered	mm	
	(v) No. of parallels	No.	
	(vi) Resistance of HV winding at 20 deg.C	Ohm	
	(vii) Resistance of LV winding at 20 deg.C	Ohm	
	(viii) Current density of LV winding	1.3 Amps/sq.mm. for Aluminum	
	(ix) Current density of HV winding	1.3 Amps/sq.mm. for Aluminum	
	(x) Wt. of the LV winding for Transformer	Kg.	

	(xi) Wt. of the HV winding for Transformer	Kg.	
	(xii) No. of LV Coils/phase	No.	
	(xiii) No. of HV coils / phase	No.	
	(xiv) Height of LV Windings	mm	
	(xv) Height of HV winding	mm	
	(xvi) ID/OD of LV winding	mm	
	(xvii) ID/OD of HV winding	mm	
	(xviii) Size of the duct in LV winding	mm	
	(xix) Size of the duct in HV winding	mm	
	(xx) Size of the duct between HV & LV	mm	
	(xxi) Inter layer insulation provided in design for		
	(a) Top & bottom layer		
	(b) In between all layer		
	(c) Details of end insulation		
	(d) Whether wedges are provided at 50% turns of the HV coil		
	(xxii) Insulation materials provided		
	(a) For winding conductors		
	1. HV		
	2. LV		
	(b) For Core		
	(xxiii) Material and Size of the wire used		
	(a) HV		
	1. SWG	No.	
	2. Diameter	mm	
	(b) LV		
	1. Strip size	mm X mm	
	2. No. of Conductors in parallel	No	
	3. Total area of cross section	sq.mm.	
17	Weight content of		
	(a) Core lamination (min)	KG	
	(b) Windings (min) Aluminum	KG	
	(c) Tank & Fittings	KG	
	(d) Oil	KG	
	(e) Oil qty (min)	Liter	
	(f) Total weight	KG	
18	Oil Data		

	(a) Qty for first filling (min)	Liter	
	(b) Grade of oil used		
	(c) Maker's name		
	(d) BDV at the time of filling	KV	
19	Transformer		
	(a) Overall length x breadth x height	mm X mm X mm	
	(b) Shape of Tank		
	(c) Tank length x breadth x height	mm X mm X mm	
	(d) Thickness of plates for		
	1. Side plate (min)	mm	
	2. Top & Bottom plate (min)	mm	
	(e) Conservator Dimensions	mm X mm	
	(f) Tank base channel dimensions	mm X mm X mm	
20	HV Bushings & Terminals		
	(a) Make of HV bushing		
	(b) Rating in KV	KV	
	(c) Turret Height	mm	
	(d) Material of HV terminal	Brass/Copper	
	(e) Current Density of HV terminal	Amps/sq.mm.	
21	LV Bushings & Terminals		
	(a) Make of LV bushing		
	(b) Rating in KV	KV	
	(c) Turret Height	mm	
	(d) Material of LV terminal	Brass/Copper	
	(e) Current Density of LV terminal	Amps/sq.mm.	
22	Radiation		
	(a) Heat dissipation by tank walls exclusive top & bottom		
	(b) Heat dissipation by cooling tube		
	(c) Diameter & thickness of cooling tube		
	(d) Whether calculation sheet for selecting cooling area to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise is enclosed.	Yes/No	
23	Whether the name plate gives all particulars as required in Tender	Yes/No	

24	Whether the transformer offered is already type tested for the design and test reports enclosed	Yes/No	
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ADDITIONAL DETAILS

Sl. No	Description	
1.	Core grade	
2.	Core dimensions	mm
3.	Gross core area	cm ²
4.	Net Core area	cm ²
5.	Flux density	Tesla
6.	Mass of Core	kg
7.	Loss per kg of core at the specified flux density	watt
8.	Core window height	mm
9.	Center to center distance of the core	mm
10.	No. of LV Turns	
11.	No. of HV turns	
12.	Size of LV Conductor bare/ covered (dia)	mm
13.	Size of HV conductor bare/covered (dia)	mm
14.	No. of parallels	
15.	Current density of LV winding	A/sq. mm
16.	Current density of HV winding	A/sq. mm
17.	Mass of the LV winding for Transformer	kg
18.	Mass of the HV winding for Transformer	kg
19.	No. of LV Coils/phase	
20.	No. of HV coils phase	
21.	Height of LV Windings	mm
22.	Height of HV winding	mm
23.	ID/OD of LV winding HV	mm
24.	ID/OD of LV winding	mm

25.	Size of the duct in LV winding	mm
26.	Size of the duct in HV winding	mm
27.	Size of the duct between HV and LV	mm
28.	HV winding to LV clearance	mm
29.	HV winding to tank clearance	mm
30.	Calculated impedance	%
31.	HV to earth creepage distance	mm
32.	LV to earth creepage distance	mm

SOURCE OF MATERIALS/PLACES OF MANUFACTURE, TESTING AND INSPECTION

Sl. No.	Item	Source of material	Place of Manufacture	Place of testing and inspection
1.	Laminations			
2.	Aluminum /Copper			
3.	Insulated winding wires			
4.	Oil			
5.	Press boards			
6.	Kraft paper			
7.	MS plates/Angles/Channels			
8.	Gaskets			
9.	Bushing HV/LV			
10.	Paints			

ANNEXURE – A

Check-list for Inspection of Prime quality CRGO for Transformers

During inspection of PRIME CRGO, the following points needs to be checked by the Transformer manufacturer. Utility shall verify all these points during inspection:

In case PRIME CRGO cutting is at works of Transformer Manufacturer:

Review of documents

Purchase Order (unpriced) to PRIME CRGO supplier/Authorized Agency Manufacturer's test certificate

Invoice of the Supplier Packing List

Bill of Lading

Bill of Entry Certificate by Customs Dept.

Reconciliation Statement as per format below Certificate of Origin

BIS Certification

Format for Reconciliation/Traceability records

Packing List No. /date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate no. /date

Serial No.	Details of Package /Job	Drawing reference	Quantity Involved	Cumulative Quantity Consumed	Balance Stock
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Inspection of PRIME CRGO Coils

PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

ISI logo sticker on packed mother coil and ISI logo in Material TC

During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

Inspection of PRIME CRGO laminations:

Transformer manufacturer will maintain records for traceability of laminations to prime

CRGO coils and burr/bow on laminations shall be measured. Utility can review these records on surveillance basis.

Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/ rusting/discoloration, samples may be taken for testing on surveillance basis for tests mentioned in A.2.2 above.

Above tests shall be witnessed by Utility. In case testing facilities are not available at Manufacturer's work, the sample(s) sealed by Utility to be sent to approved labs for testing.

Inspection Clearance Report would be issued after this inspection

In case PRIME CRGO cutting is at Sub-vendor of Transformer manufacturer

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/ Authorized Agency Purchase Order (unpriced) to Core Cutter

Manufacturer test certificate Invoice of the Supplier Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below Certificate of origin

BIS Certification

Format for Traceability records as below:

Packing List No. /date /Quantity of PRIME CRGO received

Sl. No.	Name of consumer	Details of Package/ Job	Drawing reference	Quantity Involved	Cumulative Quantity Consumed	Balance Stock	Dispatch

Inspection of PRIME CRGO Coils

PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

ISI logo sticker on packed mother coil and ISI logo in Material TC

During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla, thickness depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

Inspection of PRIME CRGO laminations

Transformer manufacturer representative will inspect laminations and issue their internal Inspection Clearance Report. Inspection will comprise of review of traceability to prime CRGO coils, visual Inspection of PRIME CRGO laminations and record of burr/bow. After clearance given by transformer manufacturer, Utility will issue an Inspection Clearance Report after record review. If so desired by Utility, their representative may also join transformer manufacturer representative during this inspection.

Inspection Clearance Report would be issued after this inspection

Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/rusting/discoloration, samples may be taken for testing on surveillance basis for tests mentioned in

Inspection Clearance Report would be issued after this inspection

NOTE: Transformer Manufacturer to ensure that PRIME CRGO is procured from POWERGRID approved vendors and CRGO manufacturer should have valid BIS Certificate for respective offered Grade.

Transformer Manufacturer should also involve themselves for ensuring the quality of CRGO laminations at their Core Cutter's works. They should visit the works of their Core cutter and carry out necessary checks.

General

If a surveillance sample is drawn and sent to TPL (if testing facility not available with the manufacturer), the Transformer manufacturer can continue manufacturing at their own risk and cost pending TPL test report on PRIME CRGO sample drawn. Decision for acceptance of PRIME CRGO shall be based upon report of the sample drawn.

These checks shall be read in-conjunction with approved Quality Plan, specification as a whole and conditions of contract.

Sampling Plan (PRIME CRGO)

33 / 11 kV -1st transformer and subsequently at random 10% of Transformers (min. 1) offered for inspection. DTs and other ratings -1st transformer and subsequently at random 2% of Transformers (min. 1) offered for inspection.

**STANDARD TECHNICAL SPECIFICATIONS
FOR
THREE PHASE CRGO CORE
DISTRIBUTION TRANSFORMERS
11kV/433-250V
(Outdoor, Non-sealed Type)**

1. SCOPE:

- 1.1.** This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed, naturally cooled 3-phase 11 kV/433 - 250 V distribution transformers for outdoor use. The secondary voltage can be 415-250 volt if required by some DISCOMs.
- 1.2.** The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.
- 1.3.** 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.
- 1.4.** All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

2. LIST OF APPLICABLE STANDARDS

Indian Standards	Title	International Standards
IS -2026	Specification for Power Transformers	IEC 60076
IS 1180 (Part-I): 2014	Outdoor Type Oil Immersed Distribution Transformers up to and including 2500 kVA, 33kV- Specification	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS- 7404	Paper covered copper conductor	
IS-335	Specification for Transformer/mineral Oil	IEC 60296
IS-5	Specification for colors for ready mixed paints	
IS -104	Ready mixed paint, brushing zinc chromate, priming	

IS/IEC 60137	Insulated Bushings for Alternating Voltages above 1 000 V	IEC 60137
IS-649	Testing for steel sheets and strips and magnetic circuits	
IS- 3024	Cold rolled grain oriented electrical sheets and strips	
IS - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 60554
IS - 1576	Specification for Insulating Press Board	IEC 60641
IS – 2026 (part 7)	Guide for loading of oil Immersed Transformers	IEC 60076
IS - 2362	Determination of water content in oil for porcelain bushing of transformer	
IS - 6162	Paper covered Aluminum conductor	
IS - 6160	Rectangular Electrical conductor for electrical machines	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical insulating liquids	
IS - 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS - 6792	Determination of electrical strength of insulating oil	
IS- 10028	Installation and maintenance of transformers	
IS- 4253	Cork composition sheets spec.	

3. STANDARD RATINGS:

- 3.1.** The standard ratings for 11KV, 3 Phase Distribution Transformer with CRGO core & Aluminum winding shall be 16, 25, 63, 100 kVA.
- 3.2.** The standard ratings for 11KV, 3 Phase Distribution Transformer with CRGO core & Copper winding shall be 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000 and 2500 kVA.

4. SERVICE CONDITIONS:

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

i)	Location	At various locations in the country
ii)	Max ambient air temperature ($^{\circ}\text{C}$)	50
iii)	Minimum ambient air temperature ($^{\circ}\text{C}$)	-5
iv)	Maximum Average daily ambient air temperature ($^{\circ}\text{C}$)	40
v)	Maximum Yearly weighted average (a) Ambient temperature ($^{\circ}\text{C}$) (b) Humidity (%) (c) Average Rain (d) Max. altitude above mean sea level	32 100 1500 1000 meter
vi)	Maximum altitude above mean sea level (meters)	5000 meters (For HP, J&K, Uttrakhand, Sikkim, Assam, Meghalaya, Manipur, Nagaland, Tripura, Arunachal Pradesh and Mizoram)

NOTE:

- a) The climatic conditions specified above are indicative and can be changed by the user as per requirements.
- b) The equipment shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

5. PRINCIPAL PARAMETERS:

- 5.1.** The transformers shall conform to the following specific parameters. These shall be specified in the GTP by manufacturer for approval from purchaser.

Sl. No	ITEM	SPECIFICATION
1	No. of Phases	Three
	Rated primary voltage (HV)	11 kV
2	Rated secondary voltage LV)	433-250 V or 415-240 V
3	System voltage(max)	12kV
4	Fluctuation in supply voltage	+12.5% to -12.5%.
5	Frequency	50 Hz +/- 5%
	Connection HV	Delta
	Connection LV	Star (Neutral brought out)
	Vector Group	Dyn11
6	Neutral Earthing	Solid
7	Type of cooling	ONAN

Voltage (Volts)	Impulse Voltage (kV Peak)	Power Frequency (kV rms)
433 or 250 or 240 V	-	3
11000	75	28

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

kVA rating	Audible sound levels (decibels)
0-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

6. TECHNICAL REQUIREMENTS:

6.1. CORE

Transformer core shall be stack / wound type construction using new & high quality cold rolled grain oriented (CRGO – M3 or higher grade) steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. All core clamping bolts shall be effectively insulated. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

6.2. For wound type core the core clamping shall be done with top and bottom U- shaped core clamps made of sheet steel clamped. Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to arrest movement of the active part. M.S. core clamps shall be painted with oil-resistant paint. Core shall be clamped with MS Tie rods of suitable size.

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

6.4. The nominal flux density in any part of the core shall not exceed 1.69 Wb/Mtr^2 at 100% rated voltage and frequency and the maximum flux density in any part of the core and yoke at rated voltage and frequency shall be such that the flux density with 112.5 % combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9 Wb/Mtr^2 .

6.5. No-load current of DTR up to 200kVA shall not exceed 3% of full load current and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% max. of full load current. No-load current of DTR above 200kVA and up to 2500kVA shall not exceed 2% of full load current and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% max. of full load current.

6.6. Please refer to “Check-list for Inspection of Prime quality CRGO for Transformers” attached at Annexure-A. It is mandatory to follow the procedure given in the Annexure-A.

7. WINDINGS:

7.1. HV & LV windings of distribution transformer of rating up to 100kVA, shall be wound

from double paper covered Aluminum conductor. Distribution transformer of rating above 100kVA shall have HV & LV winding, wound with double paper covered copper conductor.

- 7.2. LV winding shall be such that neutral formation will be at top. The winding construction of single HV coil wound over LV coil is preferable.
- 7.3. Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted. The inter layer insulation shall be of Nomex / epoxy resin dotted Kraft paper.
- 7.4. Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP schedule I).
- 7.5. The core coil assembly shall be dried in an oven. The type of winding shall be indicated in the tender. Whether LV windings are of conventional type or foil wound shall be indicated.
- 7.6. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions. Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce the hot spot of the winding.
- 7.7. The unbalanced current shall not be more than 2% of the full load current when measured during unbalance current test.
- 7.8. Current density in the Aluminum winding conductor shall not be more than 1.3 A/sq.mm. Current density in the copper winding conductor shall not be more than 2.5 A/sq.mm.
- 7.9. Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

8. TAPPING RANGES AND METHODS:

- 8.1. No tapping shall be provided for distribution transformers up to 100 kVA rating.
- 8.2. Off Load Tap Changer with 4 taps shall be provided on the DT above 100kVA and 7 taps on the DT above 200kVA.
- 8.3. Tap changing shall be carried out by means of an externally operated self-position switch when the transformer is in de-energized condition. Each tap change shall result in variation of 2.5% in voltage. Arrangement for pad locking shall be provided. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

9. OIL:

- 9.1. The insulating oil shall comply with the requirements of respective IS.
- 9.2. Use of recycled oil is not acceptable.
- 9.3. Oil shall be tested prior to filling in main tank showing BDV of 70KV min. and Moisture content 5ppm max. The oil shall be filled under vacuum.
- 9.4. The design and all materials and processes used in the manufacturing of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

10. LOSSES:

- 10.1. The bidder shall guarantee individually the no-load loss and load loss without any positive tolerance. The bidder shall also guarantee that the total losses (no load + load losses at 75 °C) at the 50% of rated load and at 100% of rated load shall not exceed the maximum total loss values given in Table-3 up to 200kVA & Table-6 for ratings above 200kVA of IS 1180(Part-1):2014 (latest amendment).
- 10.2. The maximum allowable losses (Energy Efficiency level) at rated voltage and rated frequency permitted at 75 °C for 11/0.433 kV transformers can be chosen by the DISCOM as per Table-3 for rating up to 200kVA and Table-6 for ratings above 200kVA as per Energy Efficiency Level specified in IS 1180 (Part-1):2014. The recommended Energy Efficiency level for all the distribution transformer below 100kVA shall be level 1. The recommended Energy Efficiency level for all the distribution transformer of 100kVA and above shall be level 2.

11. TOLERANCES:

- 11.1. The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive.

12. PERCENTAGE IMPEDANCE:

- 12.1. The percentage impedance of transformers at 75 °C for different ratings upto 200 kVA shall be as per Table 3 and for ratings beyond 200 kVA shall be as per Table 6 of IS 1180(Part-1):2014.

13. TEMPERATURE RISE:

- 13.1. The temperature rise over ambient temperature of 50 deg.C, shall not exceed the limits given below when tested in accordance with IS 2026 (part 2):

For distribution transformer up to & including 200kVA

Top oil temp.rise measured by thermometer: 35 Deg. C

Winding temp.rise measured by resistance: 40 Deg. C

For distribution transformer above 200kVA

Top oil temp.rise measured by thermometer: 40 Deg. C

Winding temp.rise measured by resistance: 45 Deg. C

The permissible temperature rise limits shall be as per IS 1180, part 1 (2014), and its latest amendment.

- 13.2.** Bids not conforming to the above limits of temperature rise will be treated as non-responsive.
- 13.3.** The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

14. INSULATION MATERIAL:

- 14.1.** Electrical grade insulation epoxy dotted Kraft Paper/Nomex and pressboard of standard make or any other superior material subject to approval of the purchaser shall be used.
- 14.2.** All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 60641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

15. TANK:

- 15.1.** Transformer tank construction shall conform in all respect to clause 15 of IS 1180(Part- 1):2014.
 - 15.1.1.** 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.
 - 15.1.2.** All joints of tank and fittings shall be oil tight and no bulging should occur during service.
 - 15.1.3.** Inside of tank shall be painted with varnish/hot oil resistant paint.
 - 15.1.4.** The top cover of the tank shall be slightly sloping to drain rain water.
 - 15.1.5.** 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/hook Type.
 - 15.1.6.** Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the customer.

15.2. PLAIN TANK:

- 15.2.1.** The transformer tank shall be of robust construction rectangular in shape and shall be built up of electrically tested welded mild steel plates of thickness of 3.15 mm for the bottom and top and not less than 2.5 mm for the sides for distribution transformers up to and including 25 kVA, 5.0 mm and 3.15 mm respectively for transformers of more than 25 kVA and up to and including 100 kVA and 6 mm and 4 mm respectively above 100 kVA. Tolerances as per IS1852 shall be applicable.
- 15.2.2.** The tank shall be fitted with radiator fins (1.5mm thick) / rounded or elliptical cooling tubes or made of corrugated panels. The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.
- 15.2.3.** In case of rectangular tanks above 100 kVA the corners shall be fully welded at the corners from inside and outside of the tank to withstand a pressure of 0.8 kg/cm^2 for 30 minutes. In case of transformers of 100 kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.
- 15.2.4.** Under operating conditions, the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747 for DT up to 63 KVA. For DT of 63 KVA and above rating, conservator shall be provided.
- 15.2.5.** The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.
- 15.2.6.** For DTR Up to 200 KVA, the tank shall be design for a pressure of 80 kPa above atmosphere pressure, measured inside the tank for 30 minutes and vacuum of 250 mm of mercury for 30 minutes. While for 500 KVA transformers, the tank shall be design for a pressure of 80 kPa above atmosphere pressure, measured inside the tank for 30 minutes and vacuum of 500 mm of mercury for 30 minutes. There should be no air leakage at any point.
- 15.2.7.** Permanent deflection: The permanent deflection, when the tank without oil is subjected to a vacuum of 525 mm of mercury for rectangular tank and 760 mm of mercury for round tank, shall not be more than the values as given below:

All figures are in mm)

Horizontal length of flat plate	Permanent deflection
Up to and including 750	5.0

751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

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

15.3. CORRUGATED TANK:

15.3.1. The bidder may offer corrugated tanks for transformer ratings up to 100kVA.

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

15.3.3. Corrugation panel shall be used for cooling. The corrugation sheets thickness shall be of minimum 1.6 mm. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

15.3.4. Tanks with corrugations shall be tested for leakage test at a pressure of 0.25kg/ sq cm measured at the top of the tank.

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

16. CONSERVATOR:

16.1. Transformers of rating 63 kVA and above with plain tank construction, the provision of conservator is mandatory. For corrugated tank and sealed type transformers with or without inert gas cushion, conservator is not required.

16.2. When a conservator is provided, oil gauge and the plain or dehydrating breathing device shall be fitted to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1¼")] normal size thread with cover. In addition, the cover of the main tank shall be provided with an air release plug.

16.3. The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the color of the silica gel crystals which should be easily visible from a distance. Volume of breather shall be suitable for 500g of silica gel conforming to IS 3401 for transformers up to 200 kVA and 1 kg for transformers above 200 kVA.

16.4. The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain 10% quantity of the oil. Normally 3% quantity the oil shall be contained in the conservator.

16.5. The cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

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

17. SURFACE PREPARATION AND PAINTING:

17.1. All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

17.2. All primers shall be well marked into the surface, particularly in areas where painting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, where ever airless spray is not possible, conventional spray be used with prior approval of purchaser.

17.3. CLEANING AND SURFACE PREPARATION:

17.3.1. 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.

17.3.2. 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).

17.3.3. Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical. Manufacturer to clearly explain such areas in his technical offer.

17.4. PROTECTIVE COATING:

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

17.5. PAINT MATERIAL:

17.5.1. Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site: Heat resistant paint (Hot oil proof) for inside surface.

17.5.2. For external surfaces one coat of thermos setting powder paint or one coat of

epoxy primer followed by two coats of synthetic enamel/polyurethane base paint. These paints can be either air drying or stoving.

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

17.6. PAINTING PROCEDURE:

- 17.6.1.** 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.
- 17.6.2.** Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.

17.7. DAMAGED PAINTWORK:

- 17.7.1.** 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.
- 17.7.2.** Any damaged paint work shall be made good as follows:
- (a) The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.
 - (b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.
 - (c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.
 - (d) The paint shade shall be as per Annexure-Paint which is attached herewith.

17.8. DRY FILM THICKNESS:

- 17.8.1.** To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same color.
- 17.8.2.** Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.
- 17.8.3.** Particular attention must be paid to full film thickness at the edges.
- 17.8.4.** The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

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

17.9. TESTS FOR PAINTED SURFACE:

17.9.1. The painted surface shall be tested for paint thickness.

17.9.2. The painted surface shall pass the cross hatch adhesion test and impact test as acceptance tests and Salt spray test and Hardness test as type test as per the relevant ASTM standards.

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

18. BUSHINGS:

18.1. The bushings shall be porcelain clad with a creepage of 31mm/kV (min) conforming to the relevant standards. The bushings arrangement shall be decided by utility during detailed engineering.

18.2. For HV, 12 kV class bushings shall be used and for 0.433 kV- 1.1 kV class bushings shall be used.

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

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

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

For DTs of 200 KVA and above, the clearances of cable box shall be as below:

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

- 18.5.** Arcing horns shall be provided on HV bushings.
- 18.6.** Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section – IX.
- 18.7.** The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.
- 18.8.** The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.
- 19. TERMINAL CONNECTORS:**
- 19.1.** The LV and HV bushing stems shall be provided with suitable terminal connectors as per IS 5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.
- 20. CABLE BOX:**
- 20.1.** Cable box is not required on HV side for distribution transformer rating up to 200kVA. For the transformer rating above 200kVA, the cable box can be provided for if required specifically by any DISCOM. The transformer shall be fitted with suitably designed HV cable box to terminate 11kV, three core XLPE, aluminum cable up of suitable rating.
- 20.2.** The bidder shall ensure the arrangement of HV Cable box so as to prevent the ingress of moisture into the box due to rain water directly falling on the box. The cable box on HT side shall be of the split type with faces plain and machined and fitted with Neo-k-Tex or similar quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut-bolt arrangement and MS earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. On the HV side the terminal rod shall have a diameter of not less than 12 mm. The material of connecting rod shall be copper. HT Cable support clamp should be provided to avoid tension due to cable weight.

- 20.3.** The transformer shall be fitted with suitably designed LV cable box for each rating having non-magnetic material gland plate with appropriate sized single compression brass glands to terminate 1.1 kV, single core aluminum cable, multiple runs. (Size as per requirement).

21. RATING PLATE & TERMINAL MARKING PLATE:

- 21.1.** Each transformer shall be provided with rating plate made of anodized aluminum/stainless steel material securely fixed on the outer body, easily accessible, showing the information given in Fig. 1 of IS 1180(Part-1):2014 for single phase transformers. The entries on the rating plates shall be indelibly marked by engraving.
- 21.2.** Each transformer shall be provided with a terminal marking plate in accordance with Fig. 3/4 of IS 1180(Part-1):2014. The rating and terminal marking plates may be combined into one plate at the option of manufacturer.
- 21.3.** The distribution transformer be marked with the Standard Mark and the use of Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and regulations made thereunder. As per Quality Control Order for Electrical Transformers- 2015, issued by Dept. of Heavy Industries, the Standard / ISI marking on Distribution Transformers is mandatory and the product should be manufactured in compliance with IS 1180 Part-1(2014).

22. FITTINGS

The following standard fittings shall be provided:

- 22.1.** Rating and terminal marking plates, non-detachable.
- 22.2.** Earthing terminals with lugs - 2 Nos.
- 22.3.** Lifting lugs for main tank and top cover
- 22.4.** Terminal connectors on the HV/LV bushings (For bare terminations only).
- 22.5.** Thermometer pocket with cap - 1 no.
- 22.6.** Air release device (for non-sealed transformer).
- 22.7.** HV bushings - 3 Nos.
- 22.8.** LV bushings - 4 Nos.
- 22.9.** Pulling lugs.
- 22.10.** Stiffener.
- 22.11.** Radiators (1.5 mm thick) - No. and length may be mentioned (as per heat dissipation calculations)/ corrugations.
- 22.12.** Arcing horns on HT side - 3 No., Only clamps for lightning arrestor shall be provided.

- 22.13.** Prismatic oil level gauge.
- 22.14.** Drain cum sampling valve.
- 22.15.** One filter valve on upper side of the transformer (For transformers above 200 kVA)
- 22.16.** Oil filling hole having p. 1- ¼ " thread with plug and drain plug on the conservator.
- 22.17.** Silica gel breather. Base channel 75x40 mm for up to 100 kVA and 100 mmx50 mm for up to 250kVA & 150x75mm above 250 kVA. Base channel shall have appropriate length with holes to make them suitable for fixing on a platform or plinth.
- 22.18.** 4 No. rollers for transformers of 200 kVA and above.
- 22.19.** Pressure relief device or explosion vent (above 200 kVA).
- 22.20.** Oil level gauge:
 - 22.20.1.** -5 °C and 90°C marking for non-sealed type Transformers.
 - 22.20.2.** 30°C marking for sealed type transformers
- 22.21.** Nitrogen / air filling device/ pipe with welded cover Capable of reuse (for sealed type transformers).
- 22.22.** Inspection hole for transformers above 200 kVA.
- 22.23.** Pressure gauge for sealed type transformers above 200 kVA.
- 22.24.** Buchholz relay for transformers above 1000 KVA.
- 23. FASTENERS:**
 - 23.1.** All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.
 - 23.2.** Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.
 - 23.3.** All nuts and pins shall be adequately locked.
 - 23.4.** Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.
 - 23.5.** All bolts/nuts/washers exposed to atmosphere should be as follows.
 - 23.5.1.** Size 12 mm or below – Stainless steel.
 - 23.5.2.** Above 12 mm- steel with suitable finish like electro galvanized with passivation or hot dip galvanized.
 - 23.6.** Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay

stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

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

23.8. Taper washers shall be provided where necessary.

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

24. OVERLOAD CAPACITY:

24.1. The transformers shall be suitable for loading as per IS 2026 (part7).

24.2. Transformer Overcurrent Protection - Appropriate protection device must be installed externally on HV & LV side of the transformer to protect it from overload & short-circuit faults. Protection devices must be installed locally, near to the transformer. MCCB/HRC fuse can be provided on LV side. Drop-out type fuses shall be used on HV side of the transformer.

24.3. Transformer Overvoltage Protection – Appropriate Overvoltage protection must be installed externally on the HV side to protect the transformer from Lightning overvoltage. Gapless metal Oxide lightning arrester conforming to standards IS 3070 part 3 / IEC 60099 – 4 shall be installed locally as close as possible to the transformer.

25. TESTS:

All the equipment offered shall be fully type tested by the bidder or his collaborator as per the relevant standards (IS 1180, IS 2026) including the additional type tests. The type test must have been conducted on a transformer of same design during the last five years at the time of bidding. The bidder shall furnish four sets of type test reports along with the offer.

25.1. Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards.

25.2. The requirements of site tests are also given in this clause.

25.3. The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid.

25.4. The procedure for testing shall be in accordance with IS1180 (Part-1): 2014 /IS 2026 as the case may be except for temperature rise test.

25.5. Before dispatch each of the completely assembled transformers shall be subjected to the routine tests at the manufacturer's works.

26. ROUTINE TESTS:

All the equipment offered shall be subjected to routine tests by the bidder in accordance with the relevant applicable Indian Standards, i.e., IS 1180 and/or IS 2026, as applicable.

- 26.1.** The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted after the receipt of order.

27. TYPE TESTS :

All the equipment offered shall be subjected to type tests by the bidder in accordance with the relevant applicable Indian Standards, i.e., IS 1180 and/or IS 2026, as applicable.

- 27.1.** Type test certificates for the tests carried out on prototype of same specifications shall be submitted along with the bid.

- 27.2.** The purchaser may select the transformer for type tests randomly.

27.3. Additional Requirement's for Short Circuit Test and Impulse Voltage Withstand Tests:

- 27.3.1.** The purchaser intends to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against the order are not exactly as per the tested design, the supplier shall be required to carry out the short circuit test and impulse voltage withstand test at their own cost in the presence of the representative of the purchaser.

- 27.3.2.** 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.

- 27.3.3.** 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.

28. ADDITIONAL TESTS:

- 28.1.** Phase sequence and vector group.

- 28.2.** Impedance voltage test.

- 28.3.** Neutral current measurement-The value of zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.

- 28.4.** Oil samples (one sample per lot) to comply with IS 1866.

- 28.5.** Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 110% rated voltage.

- 28.6.** Impulse voltage test: with chopped wave of IS 2026 part-III. BIL for 11 kV shall be

75 kV peak.

- 28.7.** Magnetic Balance Test.
- 28.8.** Noise-level measurement.
- 28.9.** Measurement of zero-phase sequence impedance.
- 28.10.** Measurement of Harmonics of no-load current.
- 28.11.** Un-balanced current test: The value of unbalanced current indicated by the ammeter shall not be more than 2% of the full load current.
- 28.12.** Transformer tank together with its radiator and other fittings shall be subjected to pressure corresponding to twice the normal pressure or 0.35 kg / sq.cm whichever is lower, measured at the base of the tank and maintained for an hour. The permanent deflection of the flat plates after the excess pressure has been released, shall not exceed the figures for vacuum test.
- 28.13.** Pressure relief device test: The pressure relief device shall be subject to increasing fluid pressure. It shall operate before reaching the test pressure as specified in the above class. The operating pressure shall be recorded. The device shall seal-off after the excess pressure has been released.
- 28.14.** It may also be noted that the purchaser reserves the right to conduct short circuit test and impulse voltage withstand test in accordance with the IS, afresh on each ordered rating at purchaser cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's stores. The findings and conclusions of these tests shall be binding on the supplier.

29. ACCEPTANCE TESTS:

- 29.1.** At least 10% transformers of the offered lot (min. 1) shall be subjected to the acceptance tests (all the test specified in clause 30 (routine tests) & temperature rise test) in the presence of purchaser's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS 1180, Part-1 (2014), IS 2026 and other applicable standards.
- 29.2.** Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP and contract drawings on one transformer of each type in every inspection.
- 29.3.** Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report.
- 29.4.** Temperature rise test on minimum 1 unit of total ordered quantity.

30. TESTS AT SITE:

30.1. The purchaser will conduct the following test on receipt of transformers in their store. The utility shall arrange all equipment, tools & tackle and manpower for the testing. The bidder will depute his representative to witness the same. All such test shall be conducted by utility not later than 10 days from receipt of transformers.

30.1.1. Megger Test

30.1.2. Ratio test

31. INSPECTION:

31.1. In respect of raw material such as core stampings, winding conductors, insulating paper and oil, supplier 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 purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

31.1.1. Invoice of supplier.

31.1.2. Mill's certificate.

31.1.3. Packing list.

31.1.4. Bill of landing.

31.1.5. Bill of entry certificate by custom.

Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

32. INSPECTION AND TESTING OF TRANSFORMER OIL:

32.1. To ascertain the quality of the transformer oil, the original manufacturer's tests report should be submitted at the time of inspection. Arrangements should also be made for testing of transformer oil as per IS: 335, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.

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

32.3. Anytime during receipt of raw material and manufacture/ assembly whenever the purchaser desires.

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

32.5. The stage inspection shall be carried out in accordance with the procedure given at **Annexure** given below.

- 32.6.** After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on shop floor and a few assemblies have been completed, the firm 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 stage inspection a few assembled core shall be dismantled to ensure that the laminations used are of good quality. Further, as and when the transformers are ready for dispatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS shall be sent by the firm 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. The proforma for pre delivery inspection of Distribution transformers is placed at **Annex**.
- 32.7.** In case of any defect/defective workmanship observed at any stage by the purchaser's Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial measures. Further processing should only be done after clearance from the Inspecting Officer/ purchaser.
- 32.8.** 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 Inspection during manufacturing stage as well as Active Part Inspection during Acceptance Tests.
- 32.9.** The manufacturer shall provide all services to establish and maintain quality of workman ship 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.
- 32.10.** Purchaser shall have every right to appoint a third party inspection to carry out the inspection process.
- 32.11.** The purchaser has the right to have the test carried out at his own cost 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 manufacturer, which may lead to blacklisting, among other things.
- 33. QUALITY ASSURANCE PLAN:**
- 33.1.** The bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for

individual type of equipment offered.

- 33.2.** Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in the presence of bidder's representative, copies of test certificates.
- 33.3.** Information and copies of test certificates as above in respect of bought out accessories.
- 33.4.** List of manufacturing facilities available.
- 33.5.** Level of automation achieved and list of areas where manual processing exists.
- 33.6.** List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- 33.7.** List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports. These shall be furnished with the bid. Manufacturer shall possess 0.1 accuracy class instruments for measurement of losses.
- 33.8.** Quality Assurance Plan (QAP) withhold points for purchaser's inspection.
- 33.9.** The successful bidder shall within 30 days of placement of order, submit following information to the purchaser :
- 33.10.** List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
- 33.11.** Type test certificates of the raw materials and bought out accessories.
- 33.12.** 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.
- 33.13.** ISI marking on the transformer is mandatory. As per Quality Control Order for Electrical Transformers- 2015, issued by Department of Heavy Industries, Government of India, the Standard / ISI marking on Distribution Transformers is mandatory and the product should be manufactured in compliance with IS 1180 Part-1: (2014).
- 34. DOCUMENTATION:**
 - 34.1.** The bidder shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings.
 - 34.2.** Dimensional tolerances.
 - 34.3.** Weight of individual components and total weight.
 - 34.4.** An outline drawing front (both primary and secondary sides) and end-elevation and plan of the tank and terminal gear, wherein the principal dimensions shall be given.
 - 34.5.** Typical general arrangement drawings of the windings with the details of the

insulation at each point and core construction of transformer.

- 34.6.** Typical general arrangement drawing showing both primary and secondary sides and end- elevation and plan of the transformer.

35. PACKING AND FORWARDING:

- 35.1.** The packing shall be done as per the manufacturer's standard practice. However, it should be ensured that the packing is such that, the material would not get damaged during transit by Rail / Road / Sea.
- 35.2.** The marking on each package shall be as per the relevant IS.

36. GUARANTEE:

- 36.1.** The manufacturers of the transformer shall provide a guarantee of 60 months from the date of receipt of transformer at the stores of the Utility. In case the transformer fails within the guarantee period, the supplier will depute his representative within 15 days from date of intimation by utility for joint inspection. In case, the failure is due to the reasons attributed to supplier, the transformer will be replaced/repared by the supplier within 2 months from date of joint inspection.
- 36.2.** 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.
- 36.3.** In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

37. SCHEDULES:

- 37.1.** The bidder shall fill in the following schedule which will be part of the offer. If the schedule are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule-A : Guaranteed Technical Particulars

Schedule-B : Schedule of Deviations

38. DEVIATIONS:

- 38.1.** The bidders are not allowed to deviate from the principal requirements of the Specifications. However, the bidder is required to submit with his bid in the relevant schedule a detailed list of all deviations without any ambiguity. In the absence of a deviation list in the deviation schedules, it is understood that such bid conforms to the bid specifications and no post-bid negotiations shall take place in this regard.
- 38.2.** The discrepancies, if any, between the specification and the catalogues and / or literatures submitted as part of the offer by the bidders, shall not be considered and representations in this regard shall not be entertained.

38.3. If it is observed that there are deviations in the offer in guaranteed technical particulars other than those specified in the deviation schedules then such deviations shall be treated as deviations.

38.4. All the schedules shall be prepared by vendor and are to be enclosed with the bid.

Annexure-Paint

Painting-Transformer Main tank, pipes, Conservator Tank, Radiator etc.-

	Surface Preparation	primer coat	intermediate under coat	finish coat	total DFT	Color shade
Main tank, pipes, conservator tank, etc. (External surfaces)	Blast cleaning Sa2½	Epoxy Base Zinc primer 30-40 micron	Epoxy base Zinc primer 30-40 micron	Aliphatic Polyurethane (PU Paint) (min 50 micron	Min 110 micron	541/631/632 /108 shade of IS:5
Main tank, pipes (above 80 NB), Conservator tank, etc. (Internal surfaces)	Blast cleaning Sa2½	Hot oil resistant, non- corrosive varnish or paint	--	--	Min 30 micron	Glossy White for paint
Radiator (External surfaces)	Chemical / blast cleaning (Sa2½)	Epoxy base zinc primer 30-40 micron	Epoxy base Zinc primer Min30-40 micron	Aliphatic Polyurethane (PU Paint) (min) 50 micron	Min 110 micron	541/631/632 /108 shade of IS:5
Radiator and pipes up to 80 NB (Internal surfaces)	Chemical cleaning if required	Hot oil proof low viscosity varnish or hot oil resistant non corrosive paint	--	--	--	Glossy White for paint

GUARANTEED TECHNICAL PARTICULARS FOR THREE PHASE DISTRIBUTION TRANSFORMER

Sr. No.	GTP parameter	Value/Unit	Bidders Offer
1	Name of manufacturer		
2	Place of Manufacturing		
3	Transformer continuous rating	KVA	
4	Voltage ratio	11/0.433-0.250 KV	
	(a) Rated voltage HV	11KV	
	(b) Highest System voltage HV	12KV	
5	No. of Phases	3	
6	Connection / Vector Group	DY-11	
7	Type of Cooling	ONAN	
8	Type of Transformer	Non-sealed	
	(a) Power frequency withstand voltage HV	28 KV rms	
	(b) Impulse withstand voltage HV	75 KV rms	
9	For transformer above 100 KVA		
	(a) No. of tap positions in HV winding	4 or 7	
	(b) Voltage variation		
10	BIS Energy Efficiency Level	Level 1/Level 2	
11	Losses		
	(i) No load loss	Watts	
	(a) At Normal Voltage	Watts	
	(b) At Maximum Voltage	Watts	
	(ii) Full Load losses at 75 deg.C.	Watts	
	(iii) Total losses at 50 % load at 75 deg.C.	Watts	
	(iv) Total losses at 100 % load at 75 deg.C.	Watts	
12	Percentage Impedance at 75 deg.C. (as per IS 1180)	%	
13	Maximum temperature rise		
	(a) Windings by resistance method	40 deg C/ 45 deg C	
	(b) Top oil by Thermometer	35 deg C/ 40 deg C	
14	Clearances		
	(a) Core & LV	mm	
	(b) LV & HV	mm	
	(c) HV Phase to Phase	mm	

	(d) End insulation clearance to Earth	mm	
	(e) Any point of winding to tank	mm	
	(f) HV to earth creepage distance	mm	
	(g) LV to earth creepage distance	mm	
15	Efficiency at 75 deg.C.		
	a) Unity P.F.		
	(a) 125% load	%	
	(b) 100% load	%	
	(c) 75% load	%	
	(d) 50% load	%	
	(e) 25% load	%	
	b) 0.8 P.F.		
	(a) 125% load	%	
	(b) 100% load	%	
	(c) 75% load	%	
	(d) 50% load	%	
	(e) 25% load	%	
16	Regulation at		
	(a) Unity P.F.		
	(b) 0.8 P.F. at 75 deg.C.		
17	CORE	CRGO Core	
	(i) Core grade	M3 / Better	
	(ii) Core diameter	mm	
	(iii) Gross Core area	Mtr ²	
	(iv) Net Core area	Mtr ²	
	(v) Flux density at 100% / 112.5% voltage	Wb/Mtr ²	
	(vi) Wt. of Core	Kg	
	(vii) Loss per kg. of Core at the specified Flux density	Watts	
	(ix) Core window height	mm	
	(x) Centre to center distance of the core	mm	
	(xi) The nominal flux density at		
	(a) 100% rated voltage	$\leq 1.69 \text{ Wb/Mtr}^2$	
	(b) 112.5 % of rated voltage	$\leq 1.9 \text{ Wb/Mtr}^2$	
	(xii) % No load current of full load current at rated voltage and frequency on the secondary and Increase of voltage by		

	112.5%		
	(a) Up to 200 KVA Transformer	$\leq 3\%$ and $\leq 6\%$	
	(b) Above 200 KVA Transformer	$\leq 2\%$ and $\leq 5\%$	
	(xiii) Neutral Unbalance Current	$\leq 2\%$	
18	WINDINGS	Aluminum / Copper	
	(i) No. of L.V. Turns	No.	
	(ii) No. of H V turns	No.	
	(iii) Diameter of LV Conductor bare/ DPC covered	mm	
	(iv) Diameter of HV conductor bare/DPC covered	mm	
	(v) No. of parallels	No.	
	(vi) Resistance of HV winding at 20 deg.C	Ohm	
	(vii) Resistance of LV winding at 20 deg.C	Ohm	
	(viii) Current density of LV winding	1.3 Amps/sq.mm. for Aluminum & 2.5 for copper winding	
	(ix) Current density of HV winding	1.3 Amps/sq.mm. for Aluminum & 2.5 for copper winding	
	(x) Wt. of the LV winding for Transformer	Kg.	
	(xi) Wt. of the HV winding for Transformer	Kg.	
	(xii) No. of LV Coils/phase	No.	
	(xiii) No. of HV coils / phase	No.	
	(xiv) Height of LV Windings	mm	
	(xv) Height of HV winding	mm	
	(xvi) ID/OD of LV winding	mm	
	(xvii) ID/OD of HV winding	mm	
	(xviii) Size of the duct in LV winding	mm	
	(xix) Size of the duct in HV winding	mm	
	(xx) Size of the duct between HV & LV	mm	
	(xxi) Inter layer insulation provided in design for		
	(a) Top & bottom layer		
	(b) In between all layer		
	(c) Details of end insulation		
	(d) Whether wedges are provided at 50% turns of the HV coil		
	(xxii) Insulation materials provided		

	(a) For winding conductors		
	1. HV		
	2. LV		
	(b) For Core		
	(xxiii) Material and Size of the wire used		
	(a) HV		
	1. SWG	No.	
	2. Diameter	mm	
	(b) LV		
	1. Strip size	mm X mm	
	2. No. of Conductors in parallel	No	
	3. Total area of cross section	sq.mm.	
19	Weight content of		
	(a) Core lamination (min)	KG	
	(b) Windings (min) Aluminum/Copper	KG	
	(c) Tank & Fittings	KG	
	(d) Oil	KG	
	(e) Oil qty (min)	Liter	
	(f) Total weight	KG	
20	Oil Data		
	(a) 1. Qty for first filling (min)	Liter	
	(b) 2. Grade of oil used		
	(c) 3. Maker's name		
	(d) 4. BDV at the time of filling	KV	
21	Transformer		
	(a) Overall length x breadth x height	mm X mm X mm	
	(b) Shape of Tank		
	(c) Tank length x breadth x height	mm X mm X mm	
	(d) Thickness of plates for		
	1. Side plate (min)	mm	
	2. Top & Bottom plate (min)	mm	
	(e) Conservator Dimensions	mm X mm	
	(f) Tank base channel dimensions	mm X mm X mm	
22	HV Bushings & Terminals		
	(a) Make of HV bushing		
	(b) Rating in KV	KV	
	(c) Turret Height	mm	

	(d) Material of HV terminal	Brass/Copper	
	(e) Current Density of HV terminal	Amps/sq.mm.	
23	LV Bushings & Terminals		
	(a) Make of LV bushing		
	(b) Rating in KV	KV	
	(c) Turret Height	mm	
	(d) Material of LV terminal	Brass/Copper	
	(e) Current Density of LV terminal	Amps/sq.mm.	
24	Radiation		
	(a) Heat dissipation by tank walls exclusive top & bottom		
	(b) Heat dissipation by cooling tube		
	(c) Diameter & thickness of cooling tube		
	(d) Whether calculation sheet for selecting cooling area to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise is enclosed.	Yes/No	
25	Whether the name plate gives all particulars as required in Tender	Yes/No	
26	Whether the transformer offered is already type tested for the design and test reports enclosed	Yes/No	

Name Plate Details

Digit / letter No.	Details	Remark
1	Name of Discoms	DISCOM name
2	KVA rating	
3	Type of Core Material	
4	Core construction	
5	Supplier Name Code	
6	Month of manufacturing	
7	Year of manufacturing	
8	Tender No.	
9	Sr. No. of transformer given by the Supplier	

ADDITIONAL DETAILS

Sl. No.	Description	
1.	Core Grade	
2.	Core diameter	mm
3.	Gross core area	sq. cm
4.	Net core area	sq. cm
5.	Flux density	Tesla
6.	Mass of core	kg
7.	Loss per kg of core at the specified flux density	watt
8.	Core window height	mm
9.	Center to center distance of the core	mm
10.	No. of LV Turns	
11.	No. of H V turns	
12.	Size of LV conductor bare/covered	mm
13.	Size of HV conductor bare/covered	mm
14.	No. of parallels	
15.	Current density of LV winding	A/sq. mm.
16.	Current density of HV winding	A/sq. mm
17.	Wt. of the LV winding for Transformer	kg
18.	Wt. of the HV winding for Transformer	kg
19.	No. of LV Coils/phase	
20.	No. of HV coils / phase	
21.	Height of LV Windings	mm
22.	Height of HV winding	mm
23.	ID/OD of HV winding	mm
24.	ID/OD of LV winding	mm
25.	Size of the duct in LV winding	mm
26.	Size of the duct in HV winding	mm

27.	Size of the duct between HV and LV	mm
28.	HV winding to LV winding clearance	mm
29.	HV winding to tank clearance	mm
30.	Calculated impedance	%
31.	HV to earth creepage distance	mm
32.	LV to earth creepage distance	mm

PROFORMA FOR STAGE INSPECTION OF DISTRIBUTION TRANSFORMERS

(A) GENERAL INFORMATION:	
1. Name of firm	: M/s.
2. Order No. and Date	:
3. Rating-wise quantity offered	:
4. Details of offer	
a) Rating	
b) Quantity	
c) Serial Numbers	
5. Details of last stage inspected lot:	
a) Total quantity inspected	
b) Serial Numbers	
c) Date of stage inspection	
d) Quantity offered for final inspection of	
a) Above with date	
(B) Availability of material for offered quantity:	
Details to be filled in	
(C) Position of manufacturing stage of the offered quantity:	
a) Complete tanked assembly	
b) Core and coil assembly ready	
c) Core assembled	
d) Coils ready for assembly	

• HV Coils													
• LV Coils													
Note:													
(I) A quantity of more than 100 Nos. shall not be entertained for stage inspection.													
(II) The stage inspection shall be carried out in case:-													
At least 25% quantity offered has been tanked and core coil assembly of further at least 30% of the quantity offered has been completed.													
(III) Quantity offered for stage inspection should be offered for final Inspection within 15 days from the date of issuance of clearance for stage inspection, otherwise stage inspection already cleared shall be liable for cancellation.													
Sl. No	Particulars					As offered		As observed			Deviation and Remarks		
(D)	Inspection of Core :												
	(I) Core Material												
	(1) Manufacturer's Characteristic Certificate in respect of grade of lamination used. (Please furnish test certificate).												
	(2) Remarks regarding Rusting and smoothness of core.												
	(3) Whether laminations used for top and bottom yoke are in one piece.												
	(II) Core Construction :												
	(1) No. of Steps												
	(2) Dimension of Steps												
	Step No.	1	2	3	4	5	6	7	8	9	10	11	12
	As offered:												
	W mm												
	T mm												
	As found:												
	W mm												
	T mm												
	(3) Core Diameter (mm)												
	(4) Total cross Section area of core												

	(5) Effective cross Sectional area of core			
	(6) Clamping arrangement			
	(i) Channel Size			
	(ii) Bolt size and No.			
	(iii) Tie Rods size and No.			
	(iv) Painting			
	(a) Channels			
	(b) Tie Rods			
	(c) Bolts			
	(7) Whether top yoke is cut for LV connection.			
	(8) If yes, at 7 above, whether Reinforcement is done.			
	(9) Size of Support Channels provided for Core base and bottom yoke (Single piece of channels are only acceptable)			
	(10) Thickness of insulation provided between core base and support channel.			
	(11) core length (leg center to leg center)			
	(12) Window height			
	(13) Core height			
	(14) Core weight only (without channels etc.)			
(E)	INSPECTION OF WINDING			
	(I) Winding material			
	(1) Material used for			
	(a) HV winding			
	(b) LV winding			
	(2) Grade of material for			
	(a) HV winding			
	(b) LV winding			
	3) Test certificate of manufacturer (enclose copy) for winding material of:			

	(a) HV			
	(b) LV			
	(II) CONSTRUCTIONAL DETAILS			
	(1) Size of Cross Sectional area of conductor for :			
	(a) HV winding			
	(b) LV winding			
	(2) Type of insulation for conductor of :			
	a) HV winding			
	(b) LV winding			
	(3) Diameter of wire used for delta formation (mm)			
	(4) Diameter of coils in:			
	a) LV winding			
	i) Internal diameter (mm)			
	ii) Outer diameter (mm)			
	b) HV winding			
	i) Internal diameter (mm)			
	ii) Outer diameter (mm)			
	(5) Current Density of winding material used for :			
	(a) HV			
	(b) LV			
	(6) Whether neutral formation on top.			
	(7) HV Coils/ Phase			
	a) Number			
	b) Turns / coil			
	c) Total turns			
	(8) LV Coils/ Phase			
	a) Number			
	b) Turns / coil			
	c) Total turns			
	(9) Method of HV Coil Joints			
	(10) Total weight of coils of			
	a) LV winding (kg)			
	b) HV winding (kg)			

(F)	INSULATION MATERIALS :			
	(I) MATERIAL :			
	1) Craft paper			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy).			
	2) Press Board			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy).			
	3) Material used for top and bottom yoke and insulation			
	(II) Type and thickness of material used : (mm)			
	a) Between core and LV			
	b) Spacers			
	c) Inter layer			
	d) Between HV and LV winding			
	e) Between phases			
	f) End insulation			
(G)	CLEARANCES : (mm)			
	(I) Related to core and Windings			
	1) LV to Core (Radial)			
	2) Between HV and LV (Radial)			
	3) (i) Phase to phase between HV Conductor			
	(ii) Whether two Nos. Press Board each of minimum 1 mm thick provided to cover the tie rods.			
	4) Thickness of locking spacers between LV coils (mm)			
	5) Axial wedges between HV and LV coils / phase (Nos.)			
	6) No. of radial spacers per phase between HV coils			

	7) Size of duct between LV and HV winding (mm)			
	(II) Between core - coil assembly and tank : (mm)			
	1) Between winding and body:			
	a) Tank lengthwise			
	b) Tank Breadth wise			
	2) Clearance between top cover and top yoke up to 100 kVA and between top cover and top most live part of tap changing switch for 200 kVA and above.			
(H)	TANK :			
	(I) Constructional details:			
	1) Rectangular shape			
	2) Thickness of side wall (mm)			
	3) Thickness of top and bottom plate (mm)			
	4) Provision of slopping top cover towards HV bushing.			
	5) Tank internal dimensions (mm)			
	a) Length			
	b) Breadth			
	c) Height			
	(i) On LV side			
	(ii) On LV side			
	(II) General details :			
	1) Inside painted by varnish/ oil corrosion resistant paint (please specify which type of coating done).			
	2) Gasket between top cover and tank			
	i) Material			
	ii) Thickness (mm)			
	iii) Jointing over laps (mm)			
	3). Reinforcement of welded angle (specify size and No. of angle provided) on side walls of tank.			

	4) Provision of lifting lugs:			
	a) Numbers			
	b) Whether lugs of 8 mm thick MS Plate provided			
	c) Whether reinforced by welded plates edge wise below the lug up to re-enforcing angle of the tank done.			
	5) Pulling lug of MS Plate			
	a) Nos.			
	b) Thickness (mm)			
	c) Whether provided on breadth side or length side			
	6) Provision of air release plug			
	7) Provision of galvanized GI Nuts Bolts with 1 No. Plain and 1 No. spring washer.			
	8) Deformation of length wise side wall of tank when subject to:			
	a) Vacuum of (-) 0.7 kg/sq. cm for 30 minutes.			
	b) Pressure of 0.8 kg/sq. cm for 30 minutes.			
(I)	RAIDATORS :			
	1. Fin Radiators of 1.25 mm thick sheet			
	a) Dimension of each fin (LxBxT)			
	b) Fins per radiator			
	c) Total No. of radiators			
	2. Verification of manufacturer's test certificate regarding Heat dissipation (excluding Top and Bottom) in w/sq. m			
	3. Verification of position of radiator with respect to bushing.			
(J)	CONSERVATOR :			
	1. Dimensions (L x D) (in mm)			
	2. Volume (m ³)			
	3. Inside diameter of Conservator			

	tank pipe (mm)			
	4. Whether conservator outlet pipe is projected approx. 20 mm inside the conservator tank.			
	5. Whether arrangement made so that oil does not fall on the active parts.			
	6. Whether die cast metal oil level gauge indicator having three positions at (- 5 ⁰ C, 30 ⁰ C and 98 ⁰ C) is provided.			
	7. Whether drain plug and filling hole with cover is provided.			
	8. Inner side of the conservator Tank painted with-			
(K)	BREATHER :			
	1. Whether Die cast Aluminum body breather for silica gel provided.			
	2. Make			
	3. Capacity			
(L)	TERMINALS :			
	1. Material whether of Brass Rods/ Tinned Copper.			
	a) HV			
	b) LV			
	2. Size (diameter in mm)			
	a) HV			
	b) LV			
	3. Method of Star connection formed on LV side of 6mm thick (Should use Al./Cu. Flat bolted/ brazed with crimped lugs on winding alternatively for 63 and 100 kVA ratings brazing is done covered with tubular sleeve duly crimped). - Please state dimensions of Al/ Cu flat or tubular sleeve used.(mm)			
	4. Method of Connection of LV			

	winding to LV Bushing (end of winding should be crimped with lugs (Al/Cu) and bolted with bushing stud).			
	5. Method of Connection of HV winding to HV bushing (Copper joint should be done by using silver brazing alloy and for Aluminum, brazing rod or with tubular connector crimped at three spots).			
	6. Whether SRB Ptube/insulated paper used for formation of Delta on HV.			
	7. Whether Empire sleeves used on the portion of HV winding joining to HV bushing.			
	8. Whether neutral formation is covered with cotton tape			
(M)	BUSHINGS :			
	1. Whether HV bushings mounted on side walls.			
	2. Whether sheet metal pocket used for mounting bushing (pipe are not acceptable)			
	a) HV			
	b) LV			
	3. Whether arrangement for studs for fitting of HV Bushing are in diamond shape (so that Arcing Horns are placed vertically).			
	4. Position of mounting of LV bushings.			
	5. Bushing Clearance: (mm)			
	a) LV to Earth			
	b) HV to Earth			
	c) Between LV Bushings			
	d) Between HV Bushings			
(N)	TANK BASE CHANNEL / ROLLERS :			
	1. Size of channel (mm)			

	2. Whether channels welded across the length of the tank			
	3. Size and type of roller (mm)			
(O)	OIL :			
	1. Name of supplier			
	2. Break down voltage of oil: (kV)			
	i) Filled in tanked transformer			
	ii) In storage tank (to be tested by Inspecting Officer).			
	3. Supplier's test certificate (enclose copy)			
(P)	ENGRAVING :			
	1. Engraving of Sl. No. and name of firm.			
	i) On bottom of clamping channel of core-coil assembly.			
	ii) On side wall and top cover of tank along with date of dispatch.			
(Q)	i) MS plate of size 125x125 mm welded on width side of stiffener			
	ii) Following details engraved (as per approved GTP):			
	(a) Serial Number			
	(b) Name of firm			
	(c) Order No. and Date			
	(d) Rating			
	(e) Name of Inspecting Officer			
	(f) Designation			
	(g) Date of dispatch			
(R)	NAME PLATE DETAILS :			
	Whether Name Plate is as per approved drawing			
(S)	Color of Transformer			
	1. Tank body with dark Green color			
	2. Conservator with white color			
(T)	CHECKING OF TESTING FACILITIES:			
	(Calibration certificate also to be			

	checked for its validity)			
	TESTS :			
	1. No Load Current			
	2. No Load Loss			
	3. % Impedance			
	4. Load Losses			
	5. Insulation Resistance Test			
	6. Vector Group Test (phase relationship)			
	7. Ratio and Polarity test relationship			
	8. Transformer Oil Test (Break Down Voltage)			
	9. Magnetic Balance			
	10. Measurement of winding resistance (HV and LV both)			
	11. Induced over voltage withstand test (Double voltage and Double frequency)			
	12. Separate source power frequency withstand test at 28 kV for HV and 3 kV for LV (one minute).			
	13. Air pressure/ Oil leakage Test			
	14. Vacuum test			
	15. Unbalanced current test			
	16. Temperature rise (Heat Run) test.			
(U)	We have specifically checked the following and found the same as per G.T.P./deviations observed as mentioned against each:			
	i) Restlessness of CRGO laminations used			
	ii) Core steps			
	iii) Core area			
	iv) Core weight			
	v) Winding cross sectional area			
	a) LV			
	b) HV			
	vi) Weight of windings			

	vii) Clearance between winding and wall of tank (mm)			
	a) Length-wise			
	b) Breadth-wise			
	viii) Clearance between top of yoke/ top most live part of tap changer to tank cover.			
	ix) Details of Neutral formation			
	x) Connections to bushings:			
	a) LV			
	b) HV			
	xi) Slope of tank top			
	xii) Position of mounting of bushings			

COMPANY'S INSPECTING OFFICER

FIRM'S REPRESENTATIVE

DATE OF INSPECTION:

PROFORMA FOR PRE-DELIVERY INSPECTION OF DISTRIBUTION TRANSFORMERS

1.	Name of the firm	:	
2.	Details of offer made	:	
	(i) Order No. and Date	:	
	(ii) Rating	:	
	(iii) Quantity	:	
	(iv) Sl. No. of transformers	:	
3.	Date of stage inspection of the lot	:	
4.	Reference of stage inspection clearance	:	
5.	Quantity offered and inspected against the order prior to this lot		

(A) ACCEPTANCE TESTS TO BE CARRIED OUT

Sl. No.	PARTICULARS	OBSERVATIONS
1.	(a) Ratio Test	AB/an
		BC/bn
		CA/Cn
	(b) Polarity Test	
2.	No load loss measurement	
		W1
		W2
		W3
	TOTAL	
	Multiplying Factor	
	CT	
	Watt meter	
	Total x MF	
	NET LOSS	
3.	Load loss measurement	
		W1
		W2
		W3
	Total	
	Multiplying Factors:-	

	CT	
	Watt meter	
	PT	
	Total x MF	
	Loss at ambient temperature (watt)	
	Loss at 75 ⁰ C (with calculation sheet) (watt)	
4.	Winding Resistance :	
	H.V. (In Ohms)	
	(a) At ambient temperature of _____ ⁰ C.	A-B
		B-C
		C-A
	(b) Resistance at 75 ⁰ C.	A-B
		B-C
		C-A
	L.V. (In Ohm)	
	(a) At ambient temperature of _____ ⁰ C.	a-b
		b-c
		c-a
	(b) Per Phase resistance at 75 ⁰ C.	a-n
		b-n
		c-n
5.	Insulation Resistance (M ohm)	HV-LV
		HV-E
		LV-E
6.	Separate Source Voltage withstand test voltage:	
	HV	28 kV for 60 secs.
	LV	3 kV for 60 secs.
7.	Induced over-voltage withstand test at double voltage and double frequency	100 Hz, 866 volts for 60 seconds.
8.	No load current at	
	90% volts	
	110% volts	
9.	Unbalance current	
10.	Vector group test	Diagram and readings be shown in separate sheets

11.	Percentage Impedance at 75°C (Please furnish calculation sheet)		
12.	Transformer oil test (Break down voltage)		
13.	Oil leakage test		
14.	Heat run test	To be carried out once against the order	
15.	Bushing clearance (mm)	HV	LV
	(a) Phase to Phase		
	(b) Phase to Earth		
16.	Comments on compliance by the firm on the modifications done as per stage inspection clearance letter issued		
17.	Whether fittings of the order have been verified.		
18.	Whether aluminum die cast silica gel breather with tin container is fitted on the transformers offered.		
19.	Whether engraving of Sl. No. and Name of firm on clamping channel, side wall and top cover of tank has been verified.		
20.	Whether MS Plate of size 125 x 125 mm welded on with side of stiffener.		
21.	Whether engraving of name of firm, Sl. No. and Rating of transformer, Order No. and date and Date of Dispatch on MS Plate.		
22.	Copy of calibration certificates of metering equipment's be enclosed.		

PARTICULARS TO BE CHECKED AT THE TIME OF DISMANTLING OF TRANSFORMER

Sl. No.	PARTICULARS	OBSERVATIONS
1.	Details of the transformer dismantled for physical verification	
	(a) Rating (kVA)	
	(b) Sl. No.	
2.	Whether GI Nut Bolts with one spring one plain washer provided for tightening the tank cover.	
3	Details of gasket used between top cover and tank Material :	
	(i) Thickness (mm)	
	(ii) Type of joints	

4	Whether core is earthed properly with copper strip (one end should be tightened in between the core laminations and other end bolted on core clamping channel).	
5	Connections from winding to bushings (describe the manner in which it has been done)	
	(a) HV	
	(b) LV	
	(c) Formation of Star connection on LV side.	
6	Winding wire dia and cross sectional area :	
	(a) HV	
	(i) Dia (mm)	
	(ii) Area (sq. mm)	
	(b) LV	
	(i) L x W x Nos. of layer	
	(ii) Area (sq. mm)	
7.	Thickness of press board (s) provided between HV coils to cover the tie rods	
8.	Whether painted with oil and corrosion resistant paint / varnish	
	(a) Inside of the tank	
	(b) Inside of the conservator tank	
	(c) Core clamping and core base channels	
	(d) Tie rods	
	(e) Core bolts	
9.	Whether tie rods and core bolts insulated, if yes, material of insulation.	
10.	Whether flap on inner side of top cover provided to prevent direct falling of oil on core- coil assembly.	
11.	Method of joints	
	(a) Between HV Coils	

	(b) Between tap coils	
	(c) For tap changer	
12.	Whether engraving of Sl. No. and name of firm done on bottom channel of core coil assembly.	
13.	Diameter of copper wire, used for formation of delta (should not be less than 1.5 times the dia of conductor). (mm)	
14.	Whether empire sleeves provided up to the end portion of HV winding joining to bushing	
15.	HV Coils :	
	(a) Inner dia (mm)	
	(b) Outer dia (mm)	
16.	LV Coils :	
	(a) Inner dia (mm)	
	(b) Outer dia (mm)	
17.	Core dia	
18.	Core height including base channel and insulation in between (mm)	
19.	Leg Center of core	
20.	Clearances between	
	(a) Core and LV (mm)	
	(b) HV and LV (mm)	
	(c) Phase to phase of HV coils (mm)	
	(d) Core coil assembly and tank body (mm)	
	(i) Length-wise	
	(ii) Width-wise	
	(e) Top of yoke and top cover (mm)	
	(f) Top most live part of tap changer and top cover.	
21.	Weight of core only (kg)	
22.	Weight of windings (kg)	

	(a) LV	
	(b) HV	
23.	Whether core laminations are in one piece, used for	
	(a) Bottom yoke	
	(b) Top yoke	
24.	Specific remarks regarding smoothness and rusting of core used.	
25	Volume of oil filled (to be done once against the order)	
	(a) In conservator tank	
	(b) In tank of the transformer	
26	Weight of transformer (inclusive of all fittings, accessories, oil etc. complete)	
27	Inner dimensions of the tank	
	(a) Length	
	(b) Width	
	(c) Height	
	(i) LV side	
	(ii) HV side	
28	Remarks, if any :	

NOTE: Please ensure that complete details have been filled in the proforma and no column has been left blank.

SIGNATURE OF INSPECTING OFFICER

(With name and designation)

(With name and designation)

SIGNATURE OF FIRM'S

REPRESENTATIVE

DATE OF INSPECTION:

SOURCE OF MATERIALS/PLACES OF MANUFACTURE, TESTING AND INSPECTION

Sl. No.	Item	Source of Material	Place of Manufacture	Place of testing and inspection
1.	Laminations (CRGO) for Core material			
2.	Copper / Aluminum Conductor			
3.	Insulated winding wires			
4.	Oil (Mineral)			
5.	Press boards			
6.	Kraft paper /Epoxy dotted Paper			
7.	MS Plates/Angles/Channels			
8.	Gaskets			
9.	Bushing HV/LV			
10.	Paints			
11	Hardware's (particularly exposed to external weather)			
	Remarks : (must follow BIS QC manual)			