

SECTION-III

TECHNICAL SPECIFICATION

FOR

100 KVA, 11/0.433 KV THREE PHASE ALUMINIUM WOUND

ENERGY EFFICIENT LEVEL-2 (STAR-1 RATING)

DISTRIBUTION TRANSFORMERS

(WITH CRGO/ AMORPHOUS CORE)

AGAINST TN-1248

AJMER VIDYUT VITRAN NIGAM LIMITED, AJMER

TECHNICAL SPECIFICATION FOR SUPPLY OF 11/0.433KV, 100 KVA OUTDOOR THREE PHASE ALUMINIUM WOUND ENERGY EFFICIENT LEVEL-2 (STAR-1 RATING) DISTRIBUTION TRANSFORMERS AGAINST TN-1248.

1. SCOPE:

This specification covers the design, engineering, manufacture, assembly, inspection and testing at manufacturer's works before supply and delivery at site of Oil immersed, Oil Natural Air Natural (ONAN) outdoor type BIS Level-2 (STAR-1 RATING), 11KV/433 V, three phase, 50 Hz, double wound core type, outdoor Type, Aluminium Wound Distribution Transformers of 100 KVA ratings, complete with fittings and accessories for use in Distribution System.

1.1 The Equipment Offered shall be complete with all parts necessary for their effective and trouble free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.

1.1.1 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. In actual practice, notwithstanding any anomalies, discrepancies, omissions, incompleteness, etc. in these specifications and attached drawings, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulation in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E Act and other statutory provisions.

1.2 The Tender / supplier shall bind himself to abide by these considerations to the entire satisfaction of the Purchaser and will be required to adjust such details at no extra cost to the purchaser over and above the tendered rates and prices.

1.3 Tolerances on all the dimensions shall be in accordance with provisions made in the relevant Indian/ IEC standards and in these specifications. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

2. APPLICABLE STANDARDS:

Unless otherwise modified in the specifications, the Distribution Transformer, including various accessories, shall generally comply with the following Indian Standards / REC Specifications. **The standard(s) shall be with latest amendment, if any, from time to time.**

Note: Wherever ISS are mentioned, equivalent or better International standards are also acceptable.

Sr. No.	Specification	Details about	International & internationally recognized standards.
1	IS: 1180 (PART-I)/2014	Specifications for outdoor type oil immersed Distribution Transformer upto and including 2500 KVA, 33 KV Class.	IS: 1180 (PART-I)/2014
2	IS:6600/1978	Guide for loading of oil immersed Transformers	IEC 76
3	IS:335/1983	New insulation oils for Transformers	BS 148, D-1473, D-1533 - 1934, IEC PUB 296
4	IS:3347 (Part-I/ Sec. 1 & 2)	Dimension of Porcelain parts & Metal parts for Transformer bushing (1.1KV).	DIN 42531 to 33
5	IS:3347 (PART-III / Sec-1 & 2) & IS:8603:2008	Dimensions of Porcelain(parts & Metal parts) for Transformer bushing for use in heavily polluted atmosphere 12/17.5 KV,24 KV and 36KV(amalgamating IS 8603(Part1,2 & 3):1977	
6	IS:7421	Porcelain Transformer Bushings for low voltage - upto 1 KV.	
7	IS:2099/1986	Porcelain Transformer bushing for AC volts above 1000 volts.	
8	IS:3639/1966	Fittings & accessories for Transformers	
9	IS:1866/1978	Code of practice for maintenance & supervision of insulating oil in service.	
10	IS:5484	Specifications for Aluminium wire rods.	ASTM B - 233
11	IS:9335	Specifications for insulating kraft paper.	IEC 554
12	IS:1576	Specifications for solid insulating press Boards for electrical purposes.	IEC 641
13	IS:616 (Part I)	Specification for paper covered Aluminium round conductors	
14	IS:6162(Part II)	Specification for paper covered Aluminium rectangular conductors	
15	IS:104	Ready mixed paint, brushing zinc chromate, painting	
16	IS:649	Testing of steel sheets and strips for magnetic circuits.	
17	IS:2362	Determination of water content in oil for porcelain bushing transformers.	
18	IS: 4257	Dimensions for clamping arrangements for bushings.	
19	IS 6160	Rectangular conductor for electrical machines.	
20	IS:10028	Selection, Installation and maintenance of transformers	
21	IS: 3401	Silica gel	
22	- REC Specification No. 2 - REC Specification No. 39/1993 - CEA Specification Chapter 4		
23	IS:2026(Part1,II,III,IV & V)/ 1981	Power Transformers	
24	IS:5/1961:	Color for ready mixed paints	
	IS:8603:2008	Dimensions for porcelain transformers bushings for use in heavily polluted atmospheres 12/17.5 KV, 24 KV and 36 KV (Amalgamating IS 8603 (Part 1, 2 & 3):1977.	

Note: - Besides above changes, the technical parameters of the specifications wherever are deviating from the IS: 1180 (Part-I/2014), the same shall be in accordance with IS: 1180 (Part-I/2014) and its latest amendments, if any and the changes where the IS:1180 (Part-I/2014) is silent for technical parameters, same shall be applicable as per Discom specification

Material conforming to other internationally accepted standards, which ensure equal or better quality than the standards mentioned above would also be acceptable. In case the Bidders who wish to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English Translations shall be furnished along with the offer.

3. SERVICE CONDITIONS:

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

- | | |
|--|----------------------------|
| i) Peak ambient temperature | : 50°C |
| ii) Minimum Ambient Temperature in shade | : -5°C |
| iii) Maximum average ambient temp. in a 24 hours period in shade | : 45°C |
| iv) Maximum yearly weighted average ambient temperature | : 35°C |
| v) Maximum temperature attainable by an object exposed to sun | : 60°C |
| vi) Maximum relative humidity | : 100 % |
| vii) Average number of thunder storm days per annum | : 40 |
| viii) Average number of rainy days per annum | : 120 |
| ix) Average annual rainfall | : 15-100 cm |
| x) Number of months of tropical monsoon conditions | : 4 Months |
| xi) Maximum wind pressure | : 195 Kg/mt ² |
| xii) Altitudes | : Not exceeding 1000 mtrs. |

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

4. PRINCIPAL PARAMETERS:

The Transformers shall be suitable for outdoor installation with three phase 50 Hz 11 KV system in which the neutral is effectively earthed and should be suitable for outdoor service as step down transformers under fluctuations in supply voltage upto plus 12.5% to minus (-) 12.5% permissible under Indian Electricity Act and rules there under.

The transformer shall conform to the following specific parameters:

- | | |
|---------------------------------|-----------------------------|
| i) Continuous rated capacity | : 100 KVA |
| ii) System Voltage (Max.) | : 12 KV |
| iii) Rated HT voltage | : 11 KV |
| iv) Rated LT voltage | : 433 V (P-P) / 250 V (P-N) |
| v) Frequency | : 50 Hz \pm 5% |
| vi) No. pf phases | : THREE |
| vii) Primary connection (HT) | : DELTA |
| viii) Secondary connection (LT) | : STAR |
| ix) Vector Group | : Dyn-11 |
| x) Percentage impedance at 75°C | : 4.5 % |
| xi) Taps (off circuits) | : TAPS ARE NOT REQUIRED. |
| xii) Type of cooling | : ON AN |
| xiii) Fault level of the system | : 750 MVA |

Primary winding shall be DELTA connected and the secondary winding shall be STAR connected (vector symbol Dyn-11), so as to produce a positive displacement of 30° from the primary to the secondary vectors of the same phase. The neutral of the secondary winding shall be brought out to a separate insulated terminal. **The transformers shall be Aluminium Wound.**

The transformers shall be designed and constructed to withstand without damage the thermal and dynamic stresses of an external short circuit. The manufacturer / supplier shall furnish all relevant design data and calculations in support of having fulfilled this requirement as stipulated in IS: 2026 (Part-I)

5. **NO LOAD VOLATGE RATIO**: The No load voltage ratio(s) shall be 11000/ 433 Volts.

6. **THE LOSSES:**

The max. Allowable losses at rated voltage and frequency and at 75 Deg. C. shall be as under:

RATING (KVA)	Total losses (watts) at 75 Deg. C at 50% loading (Max.)	Total losses (watts) at 75 Deg. C at 100% loading (Max.)
100	475	1650

The above specified loss values are maximum guaranteed, without any positive tolerance. In case the actual loss values exceed the above guaranteed values, the transformers shall be rejected at the risk, cost and responsibility of the supplier.

7. **TEMPERATURE RISE:**

Each transformer shall be capable of operating continuously at its normal rating without exceeding following temperature rise with the above service conditions given in clause-3.

- i) 35 Deg. C in oil by thermometer.
- ii) 40 Deg. C in winding by resistance

Temperature rise test shall be conducted on Maximum measured total losses (No load at rated excitation + Load loss at max. current tap at 75oC) at 100% loading shall be supplied during temperature rise test.

The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. **Bids not meeting the above limits of temperature rise will be treated as non responsive.**

The Hot spot temperature at annual weighted average ambient temperature of 35°C shall not exceed 98°C, when calculated as per IS: 2026 (Part-II)

However, the transformer shall be designed for class 'A' insulation

8. **UNBALANCE CURRENT:**

The maximum value of unbalance current in transformers shall not exceed 2% of full load current.

9. IMPEDANCE:

The percentage impedance at rated current and at 75°C shall be **4.5%** with plus/minus (+/-) 10% tolerance.

10. TAPPINGS: No taps are to be provided in these transformers.

11. FREQUENCY:

Transformers shall be designed for normal frequency of 50 Hz, but shall be capable of giving the rated output with the variation of plus/minus (+/-) 5% from the rated frequency.

12. ELECTRICAL CLEARANCES:

(A) EXTERNAL (IN AIR)

Minimum external electrical clearances after mounting the bimetallic terminal connectors in position shall be maintained, as under, however positive tolerance shall be acceptable without any ceiling.

Voltage	Medium	Clearance	
		Phase to phase	Phase to earth
11000 Volt	A I R	255 mm	140 mm
433 Volt	A I R	75 mm	40 mm

B) INTERNAL (IN OIL): The following minimum internal clearances shall be maintained as per details given hereunder:

PARTICULARS	100 KVA
a) On width side (non bushing side)	25 mm
b) On length side (bushing side HV & LV both)	40 mm
c) Between HV windings & yokes (end insulation)	20 mm
d) Between LV windings to core (Bare conductor)	3.5 mm
e) From top of yoke to inside of top cover of tank (with gasket)	75 mm
f) Between LT/HT winding (Radial bare conductor Clearance)	11 mm
g) Phase to Phase Clearance between HV limbs	10 mm

The aforesaid external and internal clearances are minimum clearances and no negative tolerance on these clearances shall be allowed.

13. TEST VOLTAGE: Transformers shall be capable of withstanding the power frequency and impulse test voltage prescribed below:

Nominal system Voltage (RMS)	Highest system voltage (RMS)	Impulse withstand voltage	Power frequency test voltage in (RMS)
11 KV	12 KV	75 KV (PEAK) (Minimum)	28 KV
0.433 KV	----	----	3 KV

The Transformer shall have fully insulated windings designed for the above impulse level.

14. HEAT DISSIPATION (COOLING) / RADIATOR CALCULATIONS & E T R / PSR (ELLIPTICAL TUBE RADIATORS/ PRESS STEEL RADIATOR) PLACEMENT:

The transformers shall be capable of giving a continuous output without exceeding the specified temperature rise. **Elliptical tube radiators/ Press steel radiator of section 57 of gauge 18 (with tolerance as per relevant ISS) shall be acceptable on the transformers.**

The radiator tubes shall be arranged in two equal banks fixed at two opposite non bushing sides. The header pipe connecting radiator bank to the tank shall be rectangular in shape with approximate size of 100x20 mm. alternatively round pipe of dia 32 mm can also be used for connecting the radiator bank to the tank. The placement of top header pipe to the tank body shall be above the top of yoke, to facilitate cooling for hot oil sump over top yoke.

Cooling area of the tank/radiators should be sufficient to dissipate the guaranteed losses satisfactorily. Necessary calculations in this regard shall be furnished by the Bidder with their tender. For the purpose of heat dissipation calculations, the following criteria shall be adopted:

- i) Plain surface of tank – **500 W / m²**

(Note: The area of top/bottom tank surface, headers, HV/LV bushing pocket and conservator shall not be considered for purpose of above calculations).

- ii) Elliptical tube of section 57 / **Press steel radiator (PSR)** -- **55 watts/meter length.**

Note- The provision of radiator is essential in distribution transformers to be supplied against this tender.

15. WINDING AND INSULATION:

i) MATERIALS:

Super enameled/Double paper covered aluminium conductors shall be used for 11 KV class transformers of 100 KVA rating. The covering shall conform to IS: 6162 (part I & II).

ii) CONSTRUCTION:

The High-tension windings shall be concentric with the Low-tension windings. The Arrangement of the windings shall be robust in electrical and mechanical construction and shall permit free circulation of oil and avoid hot spots. The LT conductor shall be rectangular in shape. Two layer of electrical grade insulation kraft paper of 2 mil thickness or one layer of min. 4 mil thickness shall be used for interlayer insulation both for HV and LV Coils. Insulation cylinder made from electric grade pre-compressed board(s) having minimum total thickness of 1.5 mm shall be used between

HV and LV windings. Alternatively 20 mil pressphan paper making thickness of the cylinder 1.5 mm having similar electrical properties may also be used.

For phase barrier, 2 Nos. of 1 mm thick press board shall be used for overing the tie rods. Besides, tie rods shall be covered by SRBP tubes of suitable size.

2 mm press board shall be used for base support insulation and core clamping channel insulation.

For bottom and top yoke insulation, only PC Board of min. 2 mm thickness will be used.

Also, vertical spacers between HV and LV coils and radial spacers (tickleys)/ blocks etc. shall be of PC Board only.

Top layer of all HV coil shall be given one coat of air drying insulation varnish.

A tolerance of upto plus minus 1% shall be permissible on ID and OD and axial length of HV and LV coils. However, the above tolerances are subject to maintaining the min. required clearances. The material and thickness of various insulation provided for phase barrier, foot plate insulation, yoke insulation and core clamp insulation shall be clearly indicated in the drawing and in any case shall not be inferior to those used in type tested transformers.

Min. number of coils on HV side shall be 4 (four) per phase for 100 KVA rating transformers. Dovetailed shaped radial spacers shall be placed between HV coil sections, suitably – locked with vertical spacers around the circumference of the coils.

The number of such spacers shall be minimum 4(four).

Current Density

The current density for HV and LV conductor shall not exceed the value given hereunder:

Rating	Current density in Amp/mm .sq.	
	HV winding	LV winding
100 KVA	1.6	1.6

iii) INSULATION MATERIAL :

Electrical grade insulating Kraft paper of only Triveni / Ballarpur / Padamjee shall be used. Press Board used shall be of senapathy whitely / Raman make. Perma wood or haldu wood blocks shall be used for Top and Bottom yoke insulation.

iv) CONNECTIONS AND TERMINATIONS:

A) HV Winding: The following method shall be adopted for taking out HV connections-

a) The coil series connections shall be made by soldering / brazing only, after completely removing the insulation from the ends.

b) Starting and finishing leads of HT coils shall be covered with empire sleeve(s) of proper size. These leads should be clamped with the body of the winding with the help of cotton twine during manufacture of the coils.

- c) All delta leads from the HT coils as well as HT line leads shall be taken out through **multiple paper covered** (MPC) copper wires of sufficient cross section area to impart the desired mechanical strength. The current density in HV lead wire shall not exceed 0.8 A/mm^2 . These lead wires shall be provided with multi layer paper insulation of minimum 1.0 mm thickness i.e. minimum increase in diameter due to paper insulation shall not be less than 2 mm. The layer of glass sleeves/ glass tape shall also be provided on the delta MPC wire and it should be further covered with minimum 12 mm dia SRBP tube. **The MPC should also be varnish dipped.** The SRBP tube shall be extended in such a way that it is entered upto 50% of bushing height.
- d) All the above leads shall then be clamped tightly with cotton twine directly on to the special frame/bracket making **"Pie"** shape connection. This structure could be made up of Bakelite/ Permalli wood/ laminated PC board flats, having minimum thickness of 6 mm. Line leads leading to the HV bushing terminals shall be directly clamped to the horizontal support bar of the **"Pie"** structure so that any tension which may develop in the HT leads due to jerks or at the time of making the connection, is not passed to the HT coils.
- e) Delta joint and lead from delta joint to bushing rod shall be made by brazing only.

B) LV Winding:

- a) The LV connection shall be taken out by cut on the top yoke channel duly reinforced to compensate for the mechanical strength.
- b) The layers in LT Coil may be either even or odd in numbers but minimum layers shall be two.
- c) LV star point shall be formed of aluminium flat of sufficient strength. Leads from winding shall be connected to the flat by brazing.
- d) Firm connection of LT winding to bushing shall be made of adequate size of "L" shape flat". Connection of LT coils to "L" shape flat shall be by brazing only.
- e) "L" shape Flat shall be clamped to LV Bushing metal part(s) by using nut, lock nut and washer.
- f) Neutral of the Secondary winding (LV) shall be brought out to a separate insulated bushing.
- g) For Aluminium windings, L&T, ALKAPEE Aluminium brazing rods with suitable flux will be used.

16. CORE CONSTRUCTION & CORE COIL ASSEMBLY DETAILS:

A. CRGO CORE

(i) The core shall be **stack/ wound type** of high grade cold rolled grain oriented annealed steel laminations, having low loss and good grain properties, coated with hot oil proof insulation, bolted together to the frames firmly to prevent vibration or noise. All core clamping bolts shall be effectively insulated. The complete design of core must ensure the permanency of the core losses with continuous working of the transformers. The value of the flux density allowed in the designs and grade of laminations used shall be clearly stated in the offer, along with the curves. The transformer core shall be

constructed out of the prime class of materials. CRGO Lamination used shall be of prime grade and not second grade steel laminations.

(ii) It will be mandatory for all the transformer manufacturers to use only **PRIME grade CRGO Laminations** with specific loss of 0.89 watt per kg. at 1.5 Tesla or any other combination of better grades with any thickness subject to maximum specific loss of 0.89 watt per kg. at 1.5 Tesla will also be acceptable. The bidder shall furnish the core loss (watt/Kg.) and power (VA/Kg) curves of the laminations used. The core shall be properly stress relieved by annealing in inert atmosphere. The transformer shall be suitable for over fluxing (due to combined effect of voltage and frequency) upto 12.5% without injurious heating. The operating flux density shall be such that there is a clear safe margin over the fluxing limit of 12.5%.

(iii) Full mitred core construction technique shall be adopted. Top yoke & bottom yoke pieces shall all be in one single piece and no cut pieces shall be acceptable. The cross sectional area of yoke & limb shall be approximately same.

(iv) The transformer core shall not get saturated for any value of V/f ratio to the extent of 115% of the rated value of V/f ratio (i.e. 11000/ 50) due to combined effect of voltage and frequency without injurious heating at full load conditions. The bidder shall furnish necessary design data in support of this situation.

(v) Flux density at rated voltage and frequency of core and yoke shall not be more than **1.60 Tesla. The Over fluxing shall be limited to 12.5% of rated value and flux density at 112.5% of rated voltage does not exceed by 1.9 Tesla.**

The No Load Current (magnetising current) at rated voltage and at 112.5% of rated voltage shall not exceed the values given below:

Maximum permissible magnetising current in percentage of rated full load current		
	At 100% rated voltage	At 112.5% rated voltage
100 KVA	3%	6%

The tolerance on magnetizing current shall be +30% on declared value of magnetizing current as per IS: 2026.

vi) Core clamping:

- a) MS Channel of 100 X 50 mm min. size shall be used on top and bottom (for stacked core transformers).
- b) 2 x 12 mm high tensile bolts to be used in parallel at each end.
- c) Channel on LV side to be reinforced at equidistance, if holes/cutting is done for LT lead in order to avoid bending of channel.
- d) MS channel shall be painted with varnish or oil-resistant paint.
- e) Tie-rods: 4 Nos. of M12 M.S steel rods shall be effectively insulated.
- f) All top and bottom yoke nuts & bolts and tie rods shall be painted with oil and corrosion-resistant paint and phosphate coated paint for tie rods before use.
- g) Only prime quality CRGO sheets should be used in the transformers and no Second/Defective/ Scrap CRGO finds way into transformers.

B. AMORPHOUS METAL:

a) The core shall be high quality amorphous ribbons having very low loss formed into wound cores of rectangular shape, bolted together to the frames firmly to prevent vibration or noise. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the flux density allowed in the design shall be clearly stated in the offer. Curve showing the properties of the metal shall be attached with the offer.

b) Core Clamping – Amorphous Metal and CRGO wound core Transformers

1. Core clamping shall be with top and bottom U-shaped core clamps made of sheet steel clamped with MS tie rods for efficient clamping.

2. MS core clamps shall be painted with varnish or hot oil resistant paint

3. Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to Arrest movement of the active part.

c) The transformer core shall be suitable for over fluxing due to combined effect of voltage and frequency upto 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.

d) Flux density should not be more than 1.6 Tesla for Amorphous core. No load current shall not exceed 3% of full load current and will be measured by energizing the transformer at 433 volts 50 c/s on the secondary. Increase of voltage of 433 volts by 12.5% shall not increase the no load current disproportionately high and shall not exceed i.e., 6%. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of an, bn, cn voltage will be carried out.

NOTE : Equal Weightage shall be given to the transformers with Amorphous metal core and CRGO.

C. CORE-COIL ASSEMBLY:

The core joints shall be interleaved and with full mitre design, as mentioned above. Ample provision for free circulation of oil in the radial gap between the core & LV coils shall be made. Eyes or lugs of sufficient size shall be provided for lifting core and winding assembly out of the tank. The core shall be effectively earthed through **tinned copper earthing plate** bolted on core frame channels, after removing the channel paint.

For top yoke channels, if cut or holes are made for taking LV connections, suitable reinforcement to channels shall be made by providing adequate size of MS Flat of the thickness not less than 6 mm.

On the core-coil assembly, core clamping channels, tie rods, core studs, spacers, assembly base supports, etc. shall be provided as per details given hereunder:

Sr. No.	Item	Particulars
a)	Tie rods	Minimum 4 Nos. of 12/16 mm each properly insulated and covered with SRBP tubes. Tie rods shall also be provided with lock nuts.
b)	Core studs	Minimum 4 Nos. of 2X12/16 mm each properly insulated and covered with SRBP tubes. The core studs shall also be provided with lock nuts.

c)	Spacers	Minimum 4 Nos. dovetail type with min. peripheral coverage of 30%
d)	Support of core assembly base	2 Nos. MS channels OF 75 X 40 MM (100 KVA) , with minimum peripheral coverage of 40%.
e)	Channels for clamping core coil assembly	4 MS Channels of 75 X 40 MM (100 KVA) , size (applicable for CRGO transformers)

Guides on all the four sides shall be provided to prevent shifting of the active parts and thereby accidental touching the tank. Alternatively boss nut arrangement at the top of core coil assembly to lock the same with the transformer tank be provided.

The assembly fixing boss nut(s) are to be welded, 20-30 mm off the center line (and diagonally) of the tanks, so that assembly shifting during transport etc. is prevented. M S Channel, **Tie Rods** etc should be painted with hot oil and corrosion resistant paint before use.

All core-coil assembly shall be indelibly marked / punched on core channel / an identity plate welded on core channel with following details:

1. Name of Supplier:
2. Order / TN No:
3. Rating:
4. Sr. No. of Transformer:

In case if above marking is not found on the core assembly of physically opened transformer selected for physical verification during final inspection then no further inspection shall be carried out and re-inspection charges shall be payable by the supplier.

17. TRANSFORMER TANK:

(a) Transformer tank shall be rectangular in shape, robust in construction and with adequate strength to withstand the pressures developed at the time of severe fault conditions. **The tank body shall be suitably stiffened with stiffener of size 50x50x6 mm angle. The edge of the angle shall be continuously welded full length with the tank cover body as per drawing enclosed at Annexure-A.** The tank sheet shall be electrically welded both from inside and outside to impart proper mechanical strength and to plug leakage of oil. All joints of tank and fittings shall be oil tight and no bulging shall occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plates shall be of such strength that the complete transformer when filled with oil may be lifted bodily by means of lifting lugs provided. All the welding shall be continuous. The top cover plate shall be sloping down by **more than 15 mm**, opposite LV bushings side. **The top cover edge shall be bent in such a manner which covers the gasket.** Accordingly length of the lifting hooks shall be extended. The top cover shall have no cut at point of lifting lug. **No negative tolerance in the tank dimensions is acceptable in actual supply. There should be no welding on corners (two 'C' shape sections be welded in such a way that the joint of the cover should be at the centre of the tank on non-bushing side). The bottom plate shall be extended at least by 5 mm outside on all sides to facilitate proper welding with the vertical tank walls as per drawing enclosed at Annexure-A.** No joints in its bottom and top cover will be allowed.

(b) (i) Minimum size of MS Sections to be used in construction of transformer tanks shall be as under:

S.N.	I T E M S	100 KVA
1	Tank Cover plate thickness (mm)	5.0 t
2	Tank Sides wall thickness (mm)	3.15 t
3	Tank bottom plate thickness (mm)	5.0 t
4	Conservator body (mm)	2.0 t
5	Detachable Conservator side Cover	N.A.
6	No. of stiffeners (To be welded on four side of the tank in the angle forms inverted "L")	1
7	Size of M. S. stiffener (mm)	50x50x 6 angle
8	Tank Top flange size (mm)	50 x 6 t Flat
9	Cover Bolt Size	As per IS 1180:part1 (2014)**
10	Cover Bolt spacings (Maximum)	75 mm
11	Lifting lugs	2 Nos. 8t mm flat
12	Tank Base Channel (ISMC Type)	2 (75 x 40 mm)

**All nuts , bolts/washers/Fastener used in transformers of stainless steel up to 12mm and above 12mm-steel with suitable finish like electro-galvanized with passivation or hot dip galvanized as IS:1180Part 1/2014

NOTE: Each cover bolt shall be complete with two flat washers, one nut and one spring washer.

The 12 Nos. Nut Bolts (4 Nos. each on length side and 2 Nos. each on width sides of the tank body) to be tag welded on the top cover/ tank body of the transformer.

The 04 Nos. Anti Theft Fasteners shall be provided - one each on all four sides in centre of body of transformer.

Two holes shall be provided – one on top cover and other on collar of transformer to facilitate providing of 2 Nos. poly-carbonate seals on longitudinal side.

The supplier shall provide additional 8 Nos. stainless steel anti theft fasteners (nuts and bolts) for fixing the base channel on structure.

The above mentioned M S sections shall be subject to tolerance as per ISS.

(b) (ii) MEASUREMENT OF SHEET THICKNESS OF TRANSFORMER TANK

The following measurements shall be carried out at respective Central Testing Lab (CTL) of the Discom(s) on the supplies of distribution transformers:

Measurement of Transformer Tank Thickness shall be done as follows:-

1.	Top Cover	At 2 places to be measured & average is to be taken.
2.	Bottom Cover	-do-
3.	Side Wall(s)	On all four sides (average is to be taken)

For transformer tank sheet thickness verification, the average of top and bottom cover be taken collectively and not individually to decide acceptance/rejection of transformers.

The nominal value of sheet thickness will be considered as mentioned in the Specification.

Rolling tolerance will be as per ISS:1852-1985 with latest amendment and no penalty will be charged on such measured thickness till tolerance limit of ISS.

Sheet thickness of transformer tank as per relevant tender specification is as under for ready reference:

Sr. No.	Rating	Top Cover (mm)	Bottom Cover (mm)	Side of Tank (mm)
1	100 KVA Three Phase	5.0	5.0	3.15

Further it is also intimated that 5% variation beyond tolerance limit in measurement of sheet thickness on negative side shall be acceptable by the Discom with levy of penalty. The rate of penalty will be Rs.80.00 per Kg.

For example:

Weight of 25 KVA Transformer Tank	120 Kg. (approx.)
Variation in thickness of tank	5% (beyond tolerance limit)
Then penalty levied will be	120x80x5 = Rs.480.00 ----- 100

In case any dimension in transformer tank sheet thickness found beyond aforesaid limit of **(-) 5%** will not be acceptable to the Discom and the relevant sub-lot shall stand rejected and the lot of such transformers will have to be replaced by the firm.

Transformer having thickness even more than 5% after allowing rolling tolerance shall be acceptable.

The highest percentage variation on negative side in respect of measurement of sheet thickness of any part of tank will be applicable on the entire dimensions for levy of penalty.

The sheet thickness measurements will be carried out on all those sample transformers which are tested in CTL and test results will be applicable to the respective sub-lot or part thereof from which the sample is drawn.

(c) Lifting Lugs: Two Nos. welded heavy duty lifting lugs of MS plate of 8 mm thickness, suitably reinforced by vertical supporting flat welded edge wise below the lug on side wall shall be provided, these shall be so extended that cutting of bent plate is not required

(d) Top cover gasket & Bolt:

- i) The gasket provided in between top cover plate and tank shall be of min. 6 mm thick neoprene rubberized oil resistant cork sheets conforming to type B or C as per IS 4253 part II
- ii) G.I. Nut bolts shall be of size M 10 x 40 mm / 3/8x1.5" long with two flat washers, suitably spaced (as specified) to press the cover.
- iii) Height of the tank shall be such that minimum clear height of 75 mm is achieved between top of yoke and under side of the tank cover (with gasket in place).
- iv) All the nuts/ bolts / washers – As per latest amended IS:1180 (Part-I):2014.**
- v) All sealing washers / gaskets shall be made of oil and heat resistant neoprene or nitrile rubber. Gaskets made of natural rubber sheet are not permissible. The minimum thickness of gaskets shall not be less than 6 mm for tank cover and 4mm for HT/LT gasket washers.
- vi) New cork/ Talbros make neoprene/nitrile based rubberized cork sheet – grade RC-70-C shall only be used as gasket material. Alternatively, other makes of gaskets having type designations as under can also be used, if 'Talbro's' make gasket is not available:

S. N.	Name of the firm	Commercial name of gasket manufactured by the firm.
1.	M/s. Nu-Cork Products P. Ltd. Gurgaon	Nu-Cork (Neoprene) Nu-Cork 999 RC-70-C
2.	M/s. Bharat Corrub Ind. Vadodara	Chetak (Neoprene) RC-70-C
3.	M/s. Grindbeck. Gujarat	Zebra (Neoprene) RC-70-C
4.	M/s Goodwill Rubber Ind. (P) Ltd., Calcutta.	Mayur (Neoprene) RC-70C

(e) Tank shall be reinforced by continuously welded angle on all the four sides of the walls, on the edge of tank, as specified above. The permanent deflection shall not be more than 5 mm upto 750 mm length and 6.5 mm upto 1250 mm length when transformer tank without oil is subjected to the vacuum of 250 mm of Mercury.

f). PAINTING & FINISHING:

Steel surface shall be prepared by sand / shot blast or chemical cleaning including phosphating, as per IS: 3618. **Inside of the tank shall be painted with Varnish or oil resistance paint . For external surface , one coat of thermo-setting powder paint or one coat of epoxy primer followed by 2 coats of polyurethane base paint of olive green colour confirming to Shade No. 220 of IS:5-1961 to be applied in order to distinguish of Star label Transformer. The paint thickness for normal to medium corrosive atmosphere is as per IS-1180(Part-I/2014).**

The requirement for the dry type 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.)
1.	Thermosetting Paint	Inside	01	30 microns
		Outside	01	2 icrons
2.	Liquid Paint a)Epoxy(Primer) b)Polyurethane base (Finish coat) c)Heat resistance paint (Hot oil proof Paint)	Outside	01	30 microns
		Outside	02	25 microns each
		Inside	01	35/10 microns

g) The TN No., Sr. No. of the transformer and name of the manufacturer should be punched/ embossed on top cover/ bottom cover/ sides of tank body (size of letter 10x5 mm).

18. FITTINGS & ACCESSORIES:

- a) Earthing terminals of M10/ 3/8x1.5" with tinned lugs and symbol - (2 Nos.)
- b) Lifting lugs - (2 Nos. for main tank).
- c) **Rating & terminal marking plate** (non-detachable), details to be included in one plate only. The plate shall be of **stainless steel/Aluminium** only, with details clearly marked - (1 No.) detailed at clause no. 24.
- d) **Identification Plate** (2 Nos.) detailed at clause no. 24.
- e) **Technical Plate** (1 Nos.) detailed at clause no. 24.
- f) **Bi-metallic terminal connectors** on HT bushings and it may be ensured that connectors shall be fitted before dispatch.
- g) **Oil level gauge** of minimum 150 mm length of prismatic glass, indicating three positions of oil, marked as follows, shall be provided:

1)	-5 °C - Min.
2)	30 °C - Nor.
3)	98 °C - Max.

- h) **Free Air Type Breather** - (1 No.)
- i) **Thermometer pocket**, 12.5 mm dia with cap. shall be provided -- (1 No.)
- j) **HV BUSHING:** These shall be of 17.5 KV/ 250 Amp. Class porcelain/ polycrate with non adjustable, single gap type arcing horns - (3 Nos.).
- k) **LV BUSHING:** 1.1 KV/ 250 Amp. Class porcelain/ polycrate (M12 stem) - 4 Nos.
- l) **Under carriage:** For transformers of 100 KVA rating shall conform to REC specifications.
- m) **Brass rod** 12 mm diameter for HT - (3 Nos.)
- n) **Brass rod** 12 mm diameter for LT - (4 Nos.)
- o) Pressure Relief Valve of Aluminium body with 1" BSP Thread capable to operate at a pressure more than 0.4 Kg/cm2 (40 KPa) positive or negative**

- and close at 30 KPa on the top of the Conservator Tank on Oil Filling Cap with Anti Theft Clamp be welded to safeguard the valve. There shall be minimum gap of 10 mm between PRV Top Surface and Anti Theft Clamp.**
- p) Explosion vent having Pipe Diameter of minimum 50 mm on Top Cover of Tank and Pipe connected with Conservator.**

Note: LV/ HV Connectors shall not be the integral part of the bushing stems.

19. CONSERVATOR:

When a conservator is fitted, the oil gauge and the breathing device shall be fixed to the conservator. In addition, the cover of the main tank shall be provided with a self-sealing pressure release device designed to operate at minimum pressure of 8 PSI (0.564 Kg./cm. Sq.) to enable release of air trapped within the main tank, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank. The conservator shall be of cylindrical shape and it should be provided above the HV bushing with a minimum clearance of 50 mm and suitably inclined to maintain the clearance.

The total inner volume of conservator shall be **minimum 15 Litres for 100 KVA** transformer. The inside diameter of the pipe connecting the conservator to a main tank shall be min. of 30 mm and it should be projected into conservator in such a way that its end is approximately 25 mm above the bottom of conservator so as to create a sump for collection of impurities. The min. oil level (corresponding to – 5 deg. C.) should be above the sump level. The connecting pipe from conservator tank to main tank shall have a sloping flap so that oil falling from pipe shall not fall directly on the active job.

Apart from the features specified in this clause for conservator tank, the oil filling hole cap of conservator shall be welded with tank body with the help of suitable inverted 'U' shape clamp.

20. FREE AIR TYPE BREATHER:

The breather shall be only from reputed and approved manufacturer and as per the approved drawing. Inverted 'U' shape pipe shall be used for breather. Mounting arrangement of the breather shall be flanged/threaded type.

21. H V BUSHING TERMINAL DETAILS :

The transformer shall be provided with outdoor type 3 Nos. 17.5 KV /250 A class porcelain bushings, conforming to IS: 3347/1972 & IS: 2099/1973 from the manufacturer of repute. The LV/ HV bushings shall be on the opposite side of the tank. The bushing on the top cover of the transformer shall not be acceptable. The bushings rods and nuts shall be made of brass. The HV bushing shall be fitted on a conical pocket (full length tank) on the tank body and not directly on the pipe/ flange. However, small pieces of pipe may be mounted on conical pocket for maintaining electrical clearance if required. The inner porcelain portion of the bushing shall be projected about 50% of the length inside the conical pocket. HT bushing(s) mounting bolts should be tag welded.

The clamping ring of HV bushing shall be of galvanised MS Sheet having minimum thickness of 1.6 mm. The total weight of all the 12 aluminium caste member of HV bushing shall not be less than 210 grams.

The arcing horn(s) shall be single gap and fixed type. **The HV bushings shall generally conform to relevant IS: 3347(Part-1 to 5 of Sec-1), and IS: 2099 (As & where applicable). Embossing showing the manufacturer's name and month & year of manufacture shall be clearly visible on HV bushings, even after fixing on transformer(s).**

As mentioned earlier, suitable bi-metallic connectors shall be provided, forming an integral part of the bushing stem, having capacity of about 1.5 times the rated current of the transformer.

22. L V BUSHING TERMINAL DETAILS:

LV Bushing side shall be opposite to the HV Bushing side. 4 Nos. LV Bushings (1.1 KV/ 250 A) shall be mounted on a special pocket on the tank wall. Projection of the LV pocket shall be such that inner portion of the LV stem shall not project more than 20 mm inside the tank, to facilitate unhindered lifting of the core coil assembly. Bushing stem of M12 size shall be of brass. Rest of the components shall conform to the requirement of IS: 3347 (Part I/section 2). The LV bushings shall generally conform to relevant IS: 3347 (Part-1 to 5 of Sec-1), and IS: 2099 (As & where applicable). Embossing showing the manufacturer's name and month & year of manufacture shall be clearly visible on LV bushings, even after fixing on transformer(s).

23. TRANSFORMER OIL:

The transformer shall be supplied complete with first filling of EHV Grade transformer oil, up to the normal oil level. The oil shall conform to IS: 335-1993 (latest amended) and should be ISI Marked and having the specified aging characteristics.

The make of Transformer Oil shall be either APAR/SAVITA/ RAJ LUBRICANTS/ ANAMIKA/SHARAVATI/ MADRAS PETRO/ RAJ PETROL/ LUBRICHEM, MUMBAI/ OPANAMA PETROCHEM, ANKELSHWAR/ TASHKENT OIL, VADODARA/COLUMBIA. The transformer oil sample taken from the transformer shall be subject to testing as per provisions of IS:1866.

The oil manufacturer's test certificate shall be made available at the time of inspection to the inspecting officer.

24. IDENTIFICATION DETAILS:

A. Rating & terminal marking plate: Each Transformer shall be provided with non detachable name, rating and terminal marking plate fitted in a visible position. All details shall be given on one plate. Material of the plate shall be stainless steel /**aluminium** only. Thickness shall be 0.9 mm (with a tolerance of ± 0.1 mm). The

plate shall be made absolutely un-detachable either through welding or riveting or through any other approved method.

Each HV & LV terminal shall be duly marked with its terminal numbers. (e.g. HV terminal with capital letter 1U, 1V, 1W and LV terminal by corresponding small letters) 2u, 2v, 2w and the neutral terminal by 2n). In the diagram to be given on the name plate, the relative position of various terminals- when viewed from top – shall be clearly shown. Inspection shall not be undertaken unless all these details are verified by the Inspecting Officer.

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

- i) P.O. No. - Month & Year.
- ii) Sr. No. of Transformer.
- iii) Date of dispatch - Month & Year
- iv) Date of expiry of guarantee period – month & year
- v) Maximum Guaranteed Losses at 50% loading & at 100% loading.
- vi) Recommended fuse sizes for HV & LV sides.
- vii) Name & Full address of the manufacturer.
- viii) Capacity of the transformer.
- ix) Rating of the transformer.
- x) Type – Oil filled naturally cooled.
- xi) IS: 1180 (Part-1/2014).
- xii) BIS Level-2 with BIS License No.

ALL DETAILS ON THE NAME RATING AND DIAGRAM PLATE SHALL BE INDELIBLY MARKED i.e. BY ENGRAVING, STAMPING or PUNCHING.

B. Technical cum Identification Plate - M.S. plate of size 125 x 75 x 2.5 mm having following details punched with letters of size 8mm X 6mm shall be continuously welded to the main tank body below the middle HV bushing in clearly visible position:-

- A) Name of the Firm
- B) TN No.
- C) Make
- D) Sr. NO.
- E) AJMER DISCOM
- F) Rating
- G) Date of Dispatch
- H) Date of Expiry of G. P.
- I) Core :-
 - 1. Core Dia
 - 2. Core Area
- J) LV Coil :-
 - 1. ID/OD Dimensions
 - 2. Conductor Size
- K) HV Coil :-
 - 1. ID/OD Dimensions
 - 2. Conductor Size
- L) Limb Centre
- M) Window Height

Further following details is to be embossed on the width side of the tank preferably in center opposite to Name & Rating Plate. The dimensions of letters should be 10x10x1 mm. The punching shall be distinct and visible.

MAKE _____

S. No. _____

T N _____

The details of Make, TN No. & Sr. No. of transformer shall also be punched on the top cover. The punching shall be distinct and visible.

25. GUARANTEED AND OTHER TECHNICAL PARTICULARS FOR TRANSFORMERS:

Guaranteed Technical particulars of the transformers offered shall be furnished in A-4 size paper by the Tenderer in the pro-forma appended herewith at **Annexure-A**. Complete details shall be furnished. Tolerances on weight quantity and dimension figures shall be $\pm 5\%$ (except for internal configuration) at the tender stage, subject to maintaining the minimum electrical clearances as per the specification. However, no negative tolerance shall be allowed on the short circuit type tested design. Electrical performance data shall be subject to tolerances as per ISS, unless otherwise specified in this specification. However, the No Load loss and Load loss figures shall be maximum guaranteed without any positive tolerance.

26. TYPE TEST CERTIFICATES:

The bidder shall furnish type test certificates of offered design / similar design, wherever available, with the bid not older than five years from the date of opening of technical bid.

27. DRAWINGS AND OTHER DOCUMENTS:

The tenders shall be accompanied with the following drawings / Calculation sheets, as per the offered designs. The drawings shall be only on A-3 (420 x 297 mm) size paper and calculation sheet shall be on A-4 size paper only.

- a) Name rating / diagram plate drawing.
- b) Outline and general arrangement drawing.
- c) Core-coil assembly drawing.
- d) Core section (for limb and yoke) along with flux density calculation sheet / drawing.
- e) Cooling area calculation sheet.
- f) Thermal Ability short circuit calculation sheet.
- g) Core loss and magnetization curves of the laminations.
- h) Heat dissipation calculations (heat dissipation by tank walls excluding top and bottom should be 500 W/sq.meter).

28. QUALITY ASSURANCE PLAN:

The purchaser intends to purchase Transformers only from quality conscious manufacturers.

The tenderer shall furnish the details in respect of following, in the schedules prescribed herein this specification, failing which the offer is liable for rejection.

- a) List of testing equipment and instruments (with class of accuracy) available with tenderer for inspection, testing and checking the Transformers offered, as per tender specification in the schedule of testing facilities (Schedule-VIII). The calibration details should also be included.
- b) List of machines/equipment/T&P available with the tenderer for manufacturing the Transformers, in the schedule of plant and machinery (Schedule-IX).
- c) Details of type tests conducted on the Transformers offered to supply in the schedule of type test (Schedule-X).
- d) List of raw material components and sub-assembly to be used for manufacturing the equipment offered, in the schedule of raw materials and components.

The tenderer should possess adequate facilities for inspection and testing of the Transformers, as per requirement of the relevant ISS and this specification. In case any supplier is found not having all the instruments/equipment required for testing, the offer shall be ignored. No borrowing of instruments / equipment shall be allowed. Testing of the Transformers shall also not be allowed at the works of any other manufacturer. However, testing may be allowed at any Government Testing Laboratory.

29. INSPECTION AND TESTING:

(i) The inspection and testing shall be conducted as per relevant clause of the General Conditions of Contract (Section-II) at the place of manufacture. The transformers shall be completely assembled and tested at the factory. The inspection may be carried out by the purchaser at any stage of manufacturing. The supplier shall grant free access to the purchaser's representative at all reasonable times when the manufacturing work is in progress. Inspection and testing of any material under this specification by the purchaser shall not relieve the supplier of his obligation of supplying the material in accordance with the specification and shall not prevent subsequent rejection if the material is found to be defective.

(ii) The supplier shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being manufactured in accordance with the specification. The bidders must have adequate set of instruments for conducting testing as per ISS/ Specification. The instruments for measurement of losses shall be of accuracy class of 0.5 or better. The instruments shall be duly calibrated and Calibration Certificate should not be older than one year on the date of presentation to the Inspecting Officer. The calibration shall be arranged from

NABL accredited testing house. A comprehensive list of testing equipment/ instruments indicating make, Sr.No., type, class of accuracy, calibrating agency, calibration date etc. should be furnished along with the bid. The calibrated instruments shall be duly sealed by calibrating agency to avoid any tampering with calibration and the details thereof shall be clearly mentioned in the Calibration Certificate(s).

(iii) The supplier shall keep the purchaser informed in advance, about the manufacturing programme so that arrangements can be made for inspection. The supplier shall give minimum fifteen days advance intimation to enable the purchaser to depute his authorised representative for inspection/ witnessing of various tests on the equipment/ material as detailed below:

NOTE: - Penal provision shall be made for any short technical parameters found / noticed in the transformers at any time even beyond guarantee period.

30. ROUTINE/ ACCEPTANCE TESTS:

- A) 100% testing of the Distribution Transformers shall be carried out at firm's works for measurement of total load losses at 50% & 100 % loading. Remaining testing shall also continue to be carried out as per practice.
- (B) All the assembled/ finished transformers prior to despatch shall be subjected to routine tests as per IS: 2026. Minimum 25% of the offered lot size samples subject to minimum 5 Nos will be taken for routine and acceptance tests. The supplier shall invariably furnish manufacturer's routine test certificate along with inspection call of the offered transformers for pre-despatch inspection. **The inspection offers without furnishing of routine test certificates as per ISS of all the transformers offered for final inspection shall not be entertained, and any delay on this account shall be to firm's account.**

The selected samples shall be subjected to the following routine/ acceptance tests at the manufacturer's works in accordance with the relevant ISS:

1. Insulation resistance
2. Separate source voltage withstand test
3. Induced over voltage withstand test
4. Measurement of windings resistance cold (at or near the test bed temperature)
5. Measurement of Voltage ratio and check of voltage vector relationship
6. Measurement of Impedance voltage.
7. Measurement of total losses at rated voltage and normal frequency (at 50% & 100% loading).
8. Measurement of No load current at 100 % and 112.5% of rated voltage and normal frequency.
9. Checking of rating and terminal marking plate.
10. Pressure test & oil leakage test as per IS: 1180 part-1 /2014
11. Checking of weights, dimensions, fittings and accessories, tank sheet thickness, oil quantity, material, finish, paint thickness and workmanship as per purchase order and contract drawings.
12. Physical verification of core – coil dimension, internal clearances, provisions of required oil ducts in the HV and LV winding, conductor sizes, individual weights of HV and LV winding core laminations etc., with reference to contract drawings and type test report(s) by dismantling selected unit(s). The physical verification

shall be conducted on units equivalent to one unit per 50 Nos or part thereof of offered quantity randomly selected from the offered lot. The dismantled unit(s) after re-assembly shall be accepted by the purchaser after routine testing in presence of his representative.

During final inspection, sheet thickness shall also be measured of the transformer opened for physical verification. The instrument for measurement of sheet thickness will be provided by the supplier.

13. Oil dielectric strength (break down voltage) test shall be carried out on the transformers opened for physical verification and average value shall be calculated.
14. Checking of manufacturer's test certificates and invoices for major raw materials shall be done and copies thereof duly signed by firm's representatives and inspecting officers shall be enclosed with the inspection report.

Invoices of CRGO/ AMORPHOUS material shall be provided by the supplier to the inspecting officer at the time of inspection and same shall be verified by the inspecting officer.

Following tests shall also be carried out at manufacturer's works on one complete unit of **100 KVA** Transformers unit:

- i) Over Flux Density Test (in the first lot and may be repeated in subsequent lots if desired by purchaser).
- ii) Measurement of unbalance current.
- iii) Magnetic Balance Test (See note below)
- iv) Oil Leakage Test (See note below)

Note- It will be mandatory for the manufacturer firms to maintain record of BDV value of the transformer oil and shall furnish to the inspecting officer who in turn shall furnish the same to the Nigam's CTL for verification purpose. The Inspecting Officer during inspection shall verify record of Meggar value of the offered DT's and furnish the same with inspection report to the Nigam's CTL. Simultaneously, record of Air Pressure Test shall also be checked by the inspecting officer and same be furnished with report to the CTL. CTL will conduct testing of DT's only after receipt of record of BDV value, Meggar value and air pressure test results.

Fifteen days clear notice shall be arranged for pre-despatch inspection by purchaser's representative as per General Conditions of Contract.

After successful inspection, the inspecting officer shall seal **each and every transformer by sealing the transformer with 2 Nos. poly-carbonate seals on longitudinal side as per the manner mentioned in Clause No. 17 above.** Before sealing, the inspecting officer will ensure that all the offered transformers are complete and duly fitted with name, rating and diagram plate, identification plate (on tank body & Top cover) as specified in this specification.

Also after inspection/ testing, inspecting officer(s) shall affix Signature Seals also on each Transformer in addition to other seals.

i) INSULATION RESISTANCE MEASUREMENT:

Insulation resistance of selected samples shall be measured with a 2500 V Megger, of standard make such as M/s AVO, M/s Sakova, M/s Wako, M/s Evershed, Vignole or

Metrawatt. The minimum insulation resistance, in Mega Ohms, shall be as indicated in the table below:

	20 Deg.C.	30 Deg.C.	40 Deg.C	50 Deg.C.	60 Deg.C.
11000 Volts (HV)	800	400	200	100	50
433 Volts (LV)	400	200	100	50	25

ii) PRESSURE TEST: (As per IS: 1180 (Part 1):2014) -This test shall be conducted as type test at a Govt. approved/ a Govt. recognized/ NABL accredited laboratory. The pressure gauge and vacuum gauge shall be duly calibrated and sealed by an independent recognized test lab(s).

The test procedure shall be as detailed below:

The tank subjected to pressure of 80 KPa for 30 minutes and vacuum of 250 mm of mercury for 30 minutes. There should be no air leakage at any point. The Permanent deflection of flat plate, after pressure has been released, shall not exceed the values given below:

Length of plate up to	Deflection
750 mm	5.0 mm
751 to 1250 mm	6.5 mm
1251 to 1750 mm	8.0 mm

iii) MAGNETIC BALANCE TEST:

This test shall be conducted as an additional test on one sample transformer from each lot offered for inspection.

The application of low voltage to the middle limb will induce approximately equal voltages on the two end limbs. The application of voltage to the end limbs will induce greater voltage in the middle limb and less voltage in the other end limb. Uniformity of induced voltages shall confirm the healthiness of the transformer windings.

The procedure for the test shall be as under:

- Apply 250 Volts between LV terminals-2u-2n and measure voltages between 2v-2n & 2w -2n.
- Apply 250 Volts between 2v-2n and measure voltages between 2u-2n & 2w-2n.
- Apply 250 Volts between 2w-2n and measure voltages between 2u-2n & 2v-2n.

The measured voltages shall satisfy the conditions detailed as above.

iv) OIL LEAKAGE TEST (As per IS: 1180 Part-1/2014):

The oil leakage test shall be conducted on one unit selected from the offered lot. The assembled transformer for non-sealed and sealed Type with all fittings including bushing in position shall be tested at a pressure equivalent to twice the normal head measured at the base of tank for 8 hrs. There should be no leakage at any point.

31. TYPE TESTS:

Bidders have to furnish valid type test report of offered item not older than five years. In case, bidder do not furnish valid type test reports along with their bid then a bank guarantee of Rs.5.0 lac shall be furnished along with bid in lieu of non-furnishing of valid type test reports and **following Type Tests shall be conducted on one unit as per IS: 1180 (Part-I)/2014 in accordance with IS: 2026 (Part-I to III) at NABL/Govt. approved Lab as under:**

i) **Short circuit test for dynamic and thermal ability:** The short circuit test for dynamic and thermal ability shall be arranged at CPRI, Bangalore/ Bhopal or ERDA, Vadodara on one unit of each rating. The transformer(s) for the test shall be selected/ sealed by our inspecting officer from the first lot which shall be of minimum 20 Nos. (if ordered quantity is 500 Nos.) OR 50 Nos. (if ordered quantity is more than 500 Nos.) / **selected by Random sample selection committee of AJMER Discom.** The short - circuit test shall be conducted only after successful routine tests including measurement of total losses at 50% and 100% loading. The supply shall be accepted only after arranging successful type test on the selected transformer(s).

(ii) Impulse voltage withstand test:

Impulse voltage withstand test: The impulse voltage withstand test shall be arranged at any testing house accredited to NABL for purpose of impulse test. The test shall be conducted on one unit of each rating to be selected by our inspecting officer from the first lot of 20 Nos. (if ordered quantity is 500 Nos.) OR 50 Nos. (if ordered quantity is more than 500 Nos.). The test procedure shall conform to the requirement of Clause 13 of IS: 2026 (Part-III). The supply shall be accepted only after arranging successful impulse test on the selected transformer(s) **Impulse voltage withstand test shall be for carried out at minimum 75 KVp as per latest amended IS:1180 Part-I/2014**

ii) TEMPERATURE RISE TEST : [As per IS 2026 (Part 2)]

Temperature rise test shall be conducted on Maximum measured total loss (No load at rated excitation + Load loss at max. current tap at 75 oC) at 100% loading shall be supplied during temperature rise test at a Govt. approved/ a Govt. recognized/ NABL accredited laboratory/ILAC i.e. International Laboratory Accredited Laboratory/ ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign laboratory).

The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bids not meeting the above limits of temperature rise will be treated as non responsive.

(iii) PRESSURE TEST: (As per IS 1180 (Part 1):2014)

This test shall be conducted as type test at a Govt. approved/ a Govt. recognized/ NABL accredited laboratory. The pressure gauge and vacuum gauge shall be duly calibrated and sealed by an independent recognised test lab(s).

The test procedure shall be as detailed below:

The tank subjected to pressure of 80 KPa for 30 minutes and vacuum of 250 mm of mercury for 30 minutes. There should be no air leakage at any point. The Permanent deflection of flat plate, after pressure has been released, shall not exceed the values given below:

Length of plate up to	Deflection
750 mm	5.0 mm
751 to 1250 mm	6.5 mm
1251 to 1750 mm	8.0 mm

No extra time shall be allowed for arranging these type tests & BIS Certification etc. The cost of above Type Tests shall be borne by the supplier.

The programme indicating date and place of type test(s), be intimated enabling purchaser to depute his representative to witness the test if desired. The testing house shall be advised to arrange type test result directly along with drawings duly attested by the testing authority for our scrutiny and approval. The type-tested transformer(s) shall also be accepted as the part of the supplies.

The requirement of arranging above type tests shall however, not to be insisted on the suppliers who have arranged above type tests within last 5 years from the date of opening of this tender on similar design. Minor changes in the present specification will not necessitate repetition of type test(s), if design of core-coil assembly is similar in essential details.

32. RANDOM SELECTION AND TESTING (RST):

32.1 The purchaser may select transformer(s) from the supplied lot(s) at random from the stores for conducting the following type tests, at any test house(s) as mentioned above. The supplier shall arrange these tests including loading, unloading and to & fro transportation from our stores to the test house(s). The charges for such tests shall be reimbursable to the supplier on actual basis on production of documentary evidence in case the selected sample successfully withstand type test(s). In case of otherwise, no charges will be reimbursed.

- i) Short circuit withstand test for Dynamic & Thermal ability. Measurement of total Losses at 50% and 100% loading shall form part of tests conducted before and the after the short circuit test and recorded in the report.
- ii) Impulse test as per Clause No.13 of IS: 2026 (Part-III). Impulse voltage shall be 75 KVp minimum
- iii) Temperature Rise Test.
- iv) Air Pressure Test at 80 KPa for 30 minutes and vacuum of 250 mm of mercury for 30 minutes for transformer upto 200 KVA rating and 80 KPa for 30 minutes and vacuum of 500 mm of mercury for 30 minutes for transformer above 200 KVA rating and upto including 2500 KVA rating as per IS:1180 Part-I:2014.
- v) Purchaser reserves the right to carry out any site tests he may decide upon at his own expenses. In case equipment/ material are not found as per

P.O., all expenses incurred during the testing will be to supplier's account and material shall be replaced by the supplier at site free of cost.

FAILURE IN TYPE TEST(S):

In the event of failure / unsatisfactory results of the transformer(s) in Dynamic & Thermal Ability to withstand Short Circuit Test / impulse type tests, the supplier shall have to replace the supplies already made and no further transformers shall be accepted. The purchaser however, at his option, may accept the transformers already supplied with the following conditions:

- i) Guarantee period of the supplied transformers issued to the field shall be increased by double the normal Guarantee period.
- ii) Bank Guarantee shall be extended to cover the additional Guarantee period.
- iii) For failure in any of the type tests listed under RST i.e., short circuit test & Impulse withstand test, **Temperature rise test and Air pressure test** no further supplies shall be accepted. The type test charges shall also not be reimbursable in this case and shall be borne by the supplier.
- iv) The transformers lying in the store(s) shall be replaced as per sub para (v) below.
- v) The bidder shall, however, be allowed to check the reasons of failure and if need be, to improve / modify the design. Further supplies, including replacements against supplies already made, shall be accepted only after successful type test(s) are arranged on fresh transformer(s) selected by the authorized representative of the purchaser. All the type tests shall be arranged in case there is change in the design, otherwise, type test shall be repeated only for the test in which failure has occurred. Charges for such test(s) shall be borne by the supplier. However, in the event of failure of transformer in the repeat type test, the purchaser may take following actions:
 - a) Cancel pending orders of the rating in which failure(s) has occurred, &
 - b) Not place any order of Distribution Transformers on the firm for one/ two year(s)

32.2 Measurement of total losses (at 50% & 100% loading):

(i) After pre-dispatch inspection of material at firm's works, the dispatch instructions will be issued for the respective store(s) as per requirement of Nigam. Sample(s) will be drawn from the lot(s) received in store(s) and will be subjected to the following test(s):

- a) One transformer will be selected out of every lot of 20 Nos. or part thereof for measurement of total Losses at 50% & 100% loading at rated voltage; No Load current (at 100% and 112.5% of rated voltage); Impedance voltage. The testing shall be arranged either at purchaser's own testing lab and / or at independent test lab. The testing charges for such tests shall be borne by the purchaser. The test results will be applicable to the respective lot of 20 Nos. from which sample was drawn.
- b) If dispatch instructions are less than 20 Nos. than one sample shall be selected from each store(s) and the test results so obtained shall be for the quantity consigned/ received by store(s).

The percentage impedance voltage at rated current shall not exceed the permissible limit of 4.5% with plus minus 10% tolerance failing which the sub lot of transformers represented by the sample shall be rejected.

The I.R. values of the sample(s) shall be measured at CTL, Jaipur and it must be more than 50 MEGA-OHM.

One sample out of 100 Nos. transformers or part thereof (the sample whose losses were observed highest in CTL) shall be selected for physical verification/ checking of window height, limb centre and checking of insulation of HV and LV windings at CTL.

Metal Parts shall be checked in CTL as per specification/IS on the transformer which is physically opened in CTL (from the lot of 100 Nos. or part thereof).

The No Load Voltage Ratio (Transformer Turn Ratio) shall be checked in CTL with the tolerance as per specification/ IS 2026 on the transformer from the lot of 10 Nos. or part thereof and the concerned sub lot shall be rejected if not meet out the requirement of IS.

Further, Internal clearances shall be checked without opening of core coil assembly in each of the transformers which have been selected for physical verification at CTL (i.e. one sample from a lot of 100 nos. or part thereof) in presence of firm's representative. No negative tolerance shall be admissible. If clearances are not found as per specification then the lot of 100 Nos. or part thereof shall be rejected.

The facility is being developed at CTL to test the Degree of Polarization (DP) of insulating paper used in Transformers. Therefore, the same shall be tested at CTL.

The sample of Oil be taken at CTL from the Transformer opened for physical verification in presence of firm's representative and same shall be tested at Nigam's CTL/NABL accredited Lab.

NOTE:

If the total losses are found more than 10% of specified losses at 100% loading then apart from rejecting the lot, firm's balance order would be cancelled and such firms shall not be awarded any order for one year or in next tender of tendered rating to be opened/finalized whichever is later.

If the window height and limb centre are found more than 7.5 mm, then apart from rejecting the lot, firm's balance order would be cancelled and such firms shall not be awarded any order for one year or in next tender of tendered rating to be opened/finalized whichever is later. However, a tolerance of ± 2 mm shall be allowed in window height.

No tolerance shall be allowed during CTL testing and in case any parameters which are to be tested in CTL are found beyond guaranteed parameters, the lot/sublot shall stand rejected.

32.3 CHALLENGE TESTING CLAUSE:

The other manufacturer who have either participated in the instant tender enquiry can request challenge testing for tests covered in this clause based on specification & losses. The challenger would request for testing with testing fee. The cost of to & fro transportations of all transformer tested under the provision of this clause along with loading & unloading and transit insurance at actual shall be borne by Challenger firm. The challenge testing fees shall be at least three times the cost of testing. The challenger would have the opportunity to select the sample from the store. The party challenged, challenger & the utility could witness the challenge testing. The challenge testing would cover the

- i. Measurement of Magnetizing current
- ii. No Load Losses test
- iii. Load Losses test
- iv. Temperature Rise Test.

The challenge test could be conducted at any Govt. / NABL accredited Lab. like ERDA

/CPRI. If the values are within limits as per specification including tolerance allowed in CTL, the products gets confirm else not confirmed. If the product is not confirmed, the manufacturer will pay the challenge fee and challenger would get the fee refunded. However, as a redressal system, the manufacturer (challenged firm) would be allowed to ask for fresh testing of two more samples from the store and the same be tested in a NABL/Govt. laboratory in presence of party challenged, challenger & the utility. If any one or both sample does not confirm the tests then the product is said to have failed the test. In such cases, the manufacturer (challenged firm) will be declared as unsuccessful manufacturer for the said product and balance supply shall not be availed and the balance order shall be cancelled with levy of maximum penalty. Firm shall also be debarred for one year or participating against next tender for that rating, whichever is later. The transformers already supplied (including tested in challenge testing) shall be accepted with the following conditions:

- i) Guarantee period of the supplied Transformers shall be increased by double the normal guarantee period.
- ii) Bank guarantee shall be extended to cover the additional guarantee period.

33. GUARANTEE PERIOD:-

I. Performance guarantee of the transformer(s) with LT protection unit shall be for the period of 36 (Thirty Six) months from the date of dispatch of material. The date of expiry of guarantee period shall be marked on the rating plate. Transformer(s) along with LT protection unit failed within such guarantee period shall have to be replaced free of cost expeditiously. The Manufacturer may use Core and Transformer Tank of the GP failed Distribution Transformer. All other materials shall be replaced by new materials such as Transformer Oil, HV & LV Windings, Metal Parts and Fittings & Accessories, etc. The Testing Procedure of such replaced Distribution Transformer including Physical Verification shall be same as per Testing of New Distribution Transformer at Firm's Works as well as at CTL without any tolerance in the losses at 50% and 100% loading.

i) The firm will **replace** all type of GP failed Distribution Transformers without asking any segregation on account of manufacturing defect.

ii) The guarantee period failed transformers will directly be lifted by the suppliers from the respective circle store **within a period of 60 days from the date of intimation by the respective consignee and will supply replace Distribution Transformers against G.P. failed within 30 days from the date of lifting** in the ACOS/Nigam Store/central store.

iii) The loading of G.P. failed Distribution Transformers at circle store and un-loading of **replaced Transformer** at ACOS/ Nigam store will be on suppliers' account.

iv) The firm will **replace** G.P. failed transformers irrespective of breakage of body seals as well as physical damage of transformer tank body due to bursting. The period during which transformer remained defective/failed will not be accounted in the performance Guarantee

period. The period of defective will be reckoned from the date of first intimation (i.e. field officer/consignee whichever is earlier) to date of delivery of **replaced transformer**.

Firms shall lift the G.P. failed Transformer(s) within a period of 60 days from the date of intimation by the respective consignee and will supply new Distribution Transformers against G.P. failed within 30 days from the date of lifting positively. In case firm fails to deliver new Transformer(s) within 90 days from date of intimation, the cost of the transformer(s) shall be withheld from firm's financial hold and in case firm fails to deliver new transformer within 90 days from date of intimation, a penalty at the rate of ½% per week subject to maximum 10%, shall be levied for the late delivery of replaced Transformer(s). Firm shall lift G.P. failed transformers after furnishing safe custody bank guarantee, the slab of safe custody Bank Guarantee shall be as under.

Safe custody Bank Guarantee:-

In case if order is upto 1000 Nos. DT's the firm have to give safe custody Bank Guarantee for Rs. 5.00 Lacs and if order is more than 1000 Nos. but upto 3000 Nos. then the safe custody BG for Rs. 10.00 lacs and for orders more than 3000 Nos. DT's the value of safe custody BG shall be Rs. 20.00 Lacs. **The safe custody bank Guarantee (SCBG) shall be of 1% of the value of the contract or as per above mentioned slab whichever is lower.** In case firm fails to furnish the safe custody BG the amount equivalent to safe custody BG shall be deducted from firm's first bill due for payment. On furnishing of safe custody BG the amount so deducted shall be returned to the firm. The safe custody BG shall be valid for a period of 12 months over and above the normal GP. After a period of 16 months from normal GP the safe custody BG shall be returned back unless there is some specific direction from the purchaser.

II. All the **replaced** transformers by the manufacturer under guarantee clause shall carry a further guarantee of 12 months after **replacement** or unexpired guarantee of 36 months from the date of supply, whichever is later, after **replacement**. The bank guarantee equivalent to cost of **replaced** transformers shall be furnished after expiry of performance guarantee period to cover **such guarantee**. The purchaser also reserves the right to withhold the payment of supplier firm, under any other contract, if the performance of the supplier in **replaced** transformers is not satisfactory. Each supplier shall invariably furnish the detailed information about the total number of transformers failed and **replaced** by them, every month after commencement of supplies.

I. In order to ascertain that transformers have successfully completed guarantee period the following details shall be provided on the transformer body:

A. **A replacement identification steel plate on replaced transformer against G.P. failed transformer of size 75 x 75 x 2.5 mm duly engraved with following details shall be welded on the transformer body.**

Particulars	New(Original) Supply	1 st Replacement	2 nd Replacement	3 rd Replacement
Firm's Name/Logo				
TN				
Rating (KVA)				
Sr. No.				
Date of Dispatch				
Date of failure				
Guarantee period Upto				

B. Such metallic plate fixed on first **replacement** should not be removed at the time of second **replacement** or any subsequent **replacement**. However, necessary details of failure and **replacement** shall be graved on **the identification plate**, each time it is **replaced** in guarantee.

Note:-

All other plates such as rating and terminal marking plate and Technical cum Identification Plate have to be affixed on the replaced transformers. In case it is felt that these are loose, then it should be repaired suitably by welding or riveting.

C. The **replaced** transformer shall be provided with 40 mm wide red color band all around transformers including radiator each time it is **replaced** in G.P. Thus if a transformer is **replaced** three time in G.P. then there should be three colored bands each of size 40 mm.

IV. Test checking of G.P. failed transformers will be allowed to the supplier at Nigam's store before lifting of G.P. failed distribution transformers to repair at supplier's works so that minor mistakes like loosing of connections/replacement of fuse wire/replacement of MCCB be carried out at Nigam's stores.

V. G.P. replaced Distribution transformer shall be got tested at CTL as per the sampling plan of new transformer. All provisions of testing shall be as per new supply and tolerance is not allowed in losses at 50% & 100% loading.

34. PRICE:

The prices shall be quoted on F.O.R. destination basis in the manner detailed in schedule of prices (Schedule-IV) indicating details of ex-works price, freight & insurance charges & Goods and Service Tax (GST) for delivery at our stores. The quoted prices shall be variable as per IEEMA price variation formula attached herewith at **Schedule-II**, without any ceiling for distribution transformers The **base date for price variation shall be 01.06.2018**. The prices

shall be quoted after considering modvat benefits & benefit of GST available to the supplier. The offers where the prices have not been quoted in prescribed manner are liable for rejection.

The bidder shall submit transformer cost analysis sheet along-with the tender- including the cost of raw materials, overhead expenses, estimated profit, etc., for each rating separately, as per the annexure attached with the specification. In case the cost analysis sheet is not enclosed Nigam may consider to ignore such offers.

NOTE: (i) Payments shall be made only after receipt of successful test report from our Central Testing Laboratory (CTL) on the samples selected from the material received at the stores, however, the payment priority shall be maintained from the date of submission of bills along with receipted challans to the Sr. Accounts Officer (CPC), AVVNL, AJMER.

35. DELIVERY SCHEDULE:

The bidders are required to indicate the delivery period in the schedule attached herewith. The commencement period shall include the time taken for conducting the type test and approval of drawings etc. The maximum commencement period should not be more than 45 days from the date of **receipt of P.O.** Further the monthly delivery quoted shall be such that the entire offered quantity shall be completed within a period of 10 months from date of issue of P.O. including commencement period. The offers deviating in deliveries as per above schedule given, shall be considered as non-responsive. The monthly delivery shall be quoted irrespective of the offered / ordered quantity and offers with any conditional deliveries shall be considered as non-responsive.

37. PERFORMANCE BANK GUARANTEE:

Performance security shall be solicited from all successful bidders except the department's of the State Government and undertakings, corporations, autonomous bodies, registered societies, co-operative societies which are owned or controlled or managed by the State Government and undertakings of the Central Government. However, a performance security declaration shall be taken from them. The State Government may relax the provision of performance security in particular procurement or any class of procurement.

The amount of performance security shall be 5% (**five percent**) of the amount of supply order in case of procurement of goods and services and 10% (**ten percent**) of the amount of work order in case of procurement of works. In case of Small Scale Industries of Rajasthan it shall be 1% (**one percent**) of the amount of quantity ordered for supply of goods and in case of sick industries, other than Small Scale Industries, whose cases are pending before the Board of Industrial and Financial Reconstruction (BIFR), it shall be 2% (**two percent**) of the amount of supply order.

The bank guarantee shall be initially valid for **36 months** and shall be further extended to cover the balance guarantee period whenever required by the purchaser. The performance bank guarantee shall be furnished in the prescribed proforma on a Rajasthan Govt. Non-Judicial stamp paper (where-ever applicable) amounting to 0.25% of the B.G value or Rs. 25,000/-, whichever is less. (It will also applicable on other type of Bank guarantee(s)). Outside the state of Rajasthan firms not furnishing the bank guarantee on non-judicial stamp paper of Rajasthan Govt. then they shall have to furnish a declaration certificate that the bank guarantee is duly stamped as per stamp duty applicable in their state. You shall also furnish manufacturer's warranty on Rajasthan Govt. Non-Judicial stamp paper amounting Rs.500/- as per clause No.1.41.2 (a) of GCC in the prescribed proforma.

38. QUANTITY:

Sr. No.	Item/ Rating	Quantity in Nos.
1.	11/0.4 KV, Outdoor type, Star Rating, Energy Efficiency Level-2,,Distribution Transformers, Aluminium wound with CRGO/ Amorphous Core The prices of Transformer component shall be variable as per IEEMA Price Variation Formula without any ceiling (Base Date 01.6.2018)	
	100 KVA	1150 Nos

NOTE:-

- A) Price bids shall be opened only of the firms who are having "BIS Certificaes" as on opening of technical bid.
- B) Besides above changes, the technical parameters of the specifications wherever are deviating from the IS:1180 (Part-I/2014), the same shall be in accordance with IS:1180 (Part-I/2014) and its latest amendments, if any and the changes where the IS:1180 (Part-I/2014) is silent for technical parameters, same shall be applicable as per Discom specification.

39. ADDITIONAL ORDER:

Repeat orders for additional quantities, up to 50% of original ordered quantities, may be placed by the Nigam, on the same rates, terms and conditions given in the contract.

40. Make of Brought Out Items:

The Make of brought out items like Bushings, Transformer Oil, MCCB etc. other than Make specified in the specification/work order may be accepted if confirms to relevant IS with due approval of AVVNL.