

TECHNICAL SPECIFICATIONS OF THREE PHASE 11/0.433-0.250KV, STAR 1 (LEVEL-2), 100KVA TO 500 KVA DISTRIBUTION TRANSFORMER FOR UNDERGROUND DIASISTRIBUTION NETWORK

1.0 SCOPE:

As per the Electrical Transformer (Quality Control) Order, 2014, it is mandatory that No Electrical Transformers shall be manufacture or store for sale, sell or distribute which do not confirm to the specified standard and do not bear standard Mark of the Bureau. Moreover, as per the Guidelines of Bureau of Energy Efficiency (BEE), labelling of distribution transformer is mandatory & cannot be sold in the market without star label. Accordingly, the bidder shall have to submit valid BIS license of the quoted item or higher as per approved scheme of BIS and star rating certificate from BEE for 100 KVA to 500 KVA Transformers.

This specification covers, engineering, manufacture, assembly, stage testing, and inspection and testing before supply and delivery at site of mineral oil-immersed, natural air-cooled, 3 phase 11/0.433-0.250 KV non sealed type Distribution Transformers for indoor/outdoor use in power distribution systems with nominal system voltages.

It is not the intent to specify completely herein all the details of the design & construction of equipment. However 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 up to the Bidder's guarantee, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject/accept any work or material which, in his judgment is there or 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 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

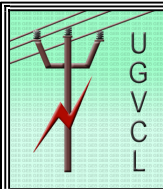
STANDARD RATINGS:

The Standard Ratings shall be as per IS 1180 (Part 1): 2014

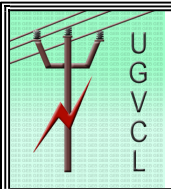
2.0 STANDARDS:

The materials shall conform in all respects to the relevant Indian / International Standard Specification, with latest amendments thereof; some of them are listed below:

Indian Standard	Title	International standard
IS 1180 / Part-I/ 2014 with latest amendments	Outdoor/Indoor type Oil immersed distribution Transformer up to and including 2500 KVA, 33KV Specifications Mineral Oil Immersed	
IS - 16585:2016	Magnetic materials - specifications for individual materials - Fe based amorphous strip delivered in the semi processed state	
IS 5484	Specifications for Aluminum wire rods	ASTM B-233
IS 649	Testing of Steel sheet and strips for magnetic circuits	
IS 191: 2007	Copper	
IS 335 : 1993	New insulating oils	BS 148, D-1473, D-1533- 1934 IEC Pub 296- 1969
IS 554 : 1999	Pipe threads where pressure-tight joints are made on the threads — Dimensions, tolerances and designation	



IS 1576 : 1992	Solid pressboard for electrical purpose	IEC 641
IS 1608 : 2005	Mechanical testing of metals — Tensile testing	
IS 1747 : 1972	Nitrogen	
IS 1885 (Part 38) :1993	Electro technical vocabulary: Part 38 Power transformers and reactors	
IS 1897 : 2008	Copper strip for electrical purpose	
IS 2026	Power transformers :	IEC 76
IS 2099 : 1986	Bushings for alternative voltages above 1000 volts	
IS 3024 : 2006	Grain oriented electrical steel sheets and strips	
IS 3347	Dimensions for porcelain transformer bushings for use in lightly polluted atmospheres	DIN 42531,23,3
IS 8603:2008	Dimensions for porcelain transformer bushings for use in heavily polluted atmospheres,12/17.5 KV,24 KV and 36 KV	
IS 5/1961	Specification for colours for ready mixed paints.	
IS-10028	Installation, Maintenance of Transformers	
IS-4257	Dimension for clamping arrangement for bushings (for porcelain and metal parts)	
IS- 6160	Rectangular conductors for electrical machine	
IS- 3401	Silica gel	
IS-1866	Code of practice for maintenance & supervision of Mineral insulating oil in equipment	
IS 3639 : 1966	Fittings and accessories for power transformers	



IS 4253 (Part 2) : 2008	Cork composition sheet: Part 2 Cork and rubber	
IS 6162	Paper-covered aluminum conductors	
IS 7404 (Part1) : 1991	Paper covered copper conductors: Part 1 Round conductors	
IS 7421 : 1988	Porcelain bushings for alternating voltages up to and including 1 000 V	
IS 8999 : 2003	Pipe threads where pressure tight joints are made on the threads — Verification by means of limit gauges	
IS 9335	Specification for Insulating Kraft Paper	IEC 554
IS 11149 : 1984	Specification for rubber gaskets	
IS 12444 : 1988	Continuously cast and rolled electrolytic copper wire rods for electrical Conductors	ASTM B-49
IS 13730	Specification for particular types of winding wires:	
IS/IEC 60947- 2:2003(Part:2)	Low voltage switchgear and control gear - Circuit breakers	
16081 : 2013	Insulating liquids — Specification for unused synthetic organic esters for electrical purposes	
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	

Material conforming to other internationally accepted standards, which ensure equal or higher 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.

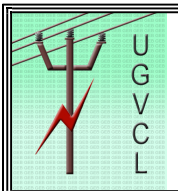
3.0 SYSTEM DETAILS:

The distribution transformers shall be installed outdoor/indoor locations along 11 kV distribution networks, which consist of underground/ overhead networks. The HV winding shall be connected with HT SFU/OCB/VCB/SF6 CB of the ring main unit through 11kV (E) XLPE/PILC cable or with DO fuse through bare conductor. LV winding shall be connected to LV distribution box/switch type fuse section pillar through 1.1 kV Single core 300 mm² or suitable size Aluminum conductor Cable.

The Transformers shall be suitable for indoor/outdoor installation/PSS installation/with HV and LV cable box type as per requirement with three phases, 50 Hz, 11 kV systems in which the neutral is effectively earthed and they should be suitable for service under fluctuations in supply voltage up to plus 10% to minus 15%.

3.1 SERVICE CONDITIONS:

Sr. No.	Parameters	Values
1	Location	At various locations in Gujarat
2	Max ambient air temperature in °C	50
3	Min. ambient air temperature in °C	0
4	Max average daily ambient air temperature in °C	45
5	Max. yearly weighed average ambient temperature in °C	40
6	Max. altitude above mean sea level	1000 Mtr
7	Maximum relative humidity	0 to 100%
8	Average thunder storms (days/ Annum)	15



9	Average rainy days (days/ Annum)	90
10	Average annual rain fall	800/ 900 mm
11	Number of months of tropical monsoon	3 Months
12	Basic wind speed as IS:875	44 mtr/sec
13	Seismic Zone	4

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

4.0 PRINCIPAL PARAMETERS:

Sr. No.	Item	Parameters	Unit
1	Continuous rated capacity	100 to 500	KVA
2	System voltage (max.)	12	kV
3	Rated voltage HV	11	kV
4	Rated voltage LV (Ph-Ph and Ph-n)	0.433 - 0. 250	KV
5	Frequency	50 +/- 5%	Hz
6	No. of Phases	Three	Three
7	Connection HV	Delta	
8	Connection LV	Star	
9	Vector group	Dyn-11	
10	Type of cooling	ONAN	
11	Audible maximum permissible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers:	Rating in KVA	Db
		100	51
		101-300	55
	301-500	56	
12	Permissible temperature rise over ambient		
	of top oil measured by thermometer	35	° C
	of winding measured by resistance	40	° C
13	Minimum clearances in air of bushing		

	terminals with connectors fitted.		
	HV phase to phase/ phase to earth	255/205	mm
	LV phase to phase/ phase to earth	75/55	mm
	LV Phase to Neutral/ Neutral to Earth	75/55	mm
14	Basic Insulation Level (Minimum)	95	KV

5.0 TECHNICAL REQUIREMENTS:

5.1 CORE

(1) CRGO

(a) Transformer core shall be stacked core type shell type or with wound core construction using new and high quality CRGO core with heat resistant insulating coating. The core shall be of NEW/Fresh high grade cold rolled grain oriented annealed lamination core 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 complete design of core must ensure permanency of the core losses 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.

(b) CORE CLAMPING :

- i) MS channel shall be used on top and bottom.
- ii) Core Channel on LV side to be reinforced at equidistance, if holes / cutting is done for LT lead in order to avoid bending of channel.
- iii) MS Channels shall be painted with hot oil-resistant paint.
- iv) The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 112.5% without injurious heating at full load conditions and shall not get saturated. The Bidder shall furnish necessary design data in support of this situation.

v) The nominal flux density in any part of the core shall not exceed 1.69 Tesla 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 1.9Tesla. (REF IS 1180 PART-1 2014 6.9.1&7.9.1)

vi) No load current shall not exceed the below mentioned percentage of full load current by energizing the transformer on secondary side

Particulars	Up to 200KVA	Above 200KVA
At rated voltage and frequency on the secondary.	3%	2%
At voltage by 112.5% of rated voltage but at rated frequency.	6%	5%

vii) Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of un, vn, wn voltage will be carried out.

viii) Clamping and Tie-rods shall be made from HT Bright Bars steel & shall be painted with hot oil resistant paint.(IS 1180 table 12)

(2) AMORPHOUS :

(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 FOR AMORPHOUS METAL TRANSFORMERS :

- i) Core clamping shall be with top and bottom U-shaped core clamps made of sheet steel clamped HT steel tie rods for efficient clamping.
- ii) MS core clamps and MS rods shall be painted with hot oil-resistant paint.
- iii) HT Steel rods shall be used as tie rods.
- iv) Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to arrest movement of the active part. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.
- v) The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 112.5% without injurious heating at full load conditions and shall not get saturated. The Bidder shall furnish necessary design data in support of this situation. (REF IS 1180 PART-1 2014 6.9.1&7.9.1)
- vi) No load current shall not exceed 2% of full load current and will be measured by energizing the transformer at rated voltage and frequency on the secondary. Increase of voltage by 12.5% shall not increase no load current by Max. 5% of full load current.
- vii) Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of un, vn, wn voltage will be carried out.
- viii) Clamping and Tie-rods shall be made from HT Bright Bars steel & shall be painted with hot oil resistant paint. (IS 1180 table 12)

5.2 WINDINGS:

Copper conductor shall be used for above 200 KVA Transformers, while Aluminum conductor shall be used for other capacities of Transformers.

(1) MATERIALS:

Double paper covered aluminum/ Electrolytic Copper conductor or class H Super enamel cover aluminum/ Electrolytic Copper conductor shall be used for 11 KV class Transformers. A mix of Electrolytic copper & aluminum conductors for HV & LV winding will not be permitted.

(2) CURRENT DENSITY (MAXIMUM):

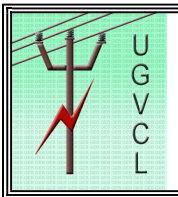
For Copper conductor : Shall not be more than 2.3 A/sq.mm.

For Aluminum Conductor: Shall not be more than 1.30 A/sq.mm.

Note: LV winding shall be in form of even layers so that the neutral formation will be at top.

(3) INTERNAL INSULATIONS AND CLEARANCES:

- (a) Insulating material: Electrical grade insulating craft paper of Triveni/Ballarpur/Cauvery or equivalent make subject to approval of the purchaser shall be used. Similarly Press Board of Senapathy, Whitelay or Raman make or equivalent subject to the approval of the purchaser shall be used. Perma wood or Haldi wood blocks shall be used for top and bottom yoke insulation.
- (b) All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard solid, conforming to type B 3.1 of IEC 641-3-2. 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.



- (c) Transformer rating 200 KVA and above, an axial duct of 3 mm is to be provided if the radial thickness of coils is more than 50 mm and/or the axial length of individual coil is more than 80mm. The radial duct shall be adequate for free circulation of oil as well as to withstand voltage between adjacent coils. The inter – layer insulation shall be of Nomex / Epoxy dotted Kraft paper or a minimum 4 layers of 2 mil (0.05mm) paper of approved manufactures.
- (d) Proper bonding of inter layer insulation with the conductor shall be ensured. Inter layer insulation shall be Epoxy dotted Kraft Paper.
- (e) Internal Clearances& Number of HV/LV Coils :

Sr. No.	Parameters	Up to 200 KVA	Above 200 KVA & up to 400 KVA	Above 400 KVA
1	Minimum Radial clearance of LV Coil to Core in mm	4	4	4
2	Minimum radial clearance between LV coil to HV coil in mm	11	11	11
3	Phase to phase clearance in mm between HV conductors with a provision of minimum of 2 x 1 mm press board to cover the tie rods.	10	10	10
4	Minimum electrical clearance between inside surface of the Tank and outside edge of the winding in mm	30	30	30
5	End Insulation, Coil end to Earth in mm	25	25	25
6	No. of Coils LV per Phase	1	1	1
7	Minimum No. of HV Coils up to 500 KVA (Cross over winding) – for Stack core	4	8	10
	- Do – for Wound core	1	1	1

8	Minimum No. of axial wedges between LV and HV winding equi. - spaced around	8	8	8
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Note: Above minimum Internal clearances (Bare conductor) have to be maintained for Amorphous as well as CRGO core Transformers.

5.3 TAPS

- (1) No tapping shall be provided for 100 KVA distribution transformers.
- (2) For ratings above 100 KVA, tapings shall be provided on the higher voltage winding for variation of HV voltage within range of (-) 7.5% to +10% in steps of 2.5%.
- (3) Tap changing shall be carried out by means of an externally operated self-Position rotary switch (to be mounted on top plate) and when the transformer is in de-energized condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Provision shall be made for locking the tapping switch handle in position. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

5.4 OIL :

The insulating oil shall comply with the requirements of relevant standards IS 335: 1993. Oil shall be filled under vacuum of 250 Tor +/- 5 %.

5.5 LOSSES & LABELLING:

The maximum allowable losses at rated voltage and rated frequency permitted at 75°C and percentage impedance up to 1000 KVA, 11/0.433 KV Transformers shall be as per Level-2 of IS 1180 (Part 1) :2014 and Star rating plan as per latest BEE guidelines, whichever applicable. However, rating wise total losses shall be limited to the values as under.

Losses of the Transformer should not exceed following values and for transformers having tapings shall be guaranteed at maximum current tap and it should not exceed following values.

11000/433-250 V Rating in KVA	Energy Efficiency (Level-2)		% Impedance at 75 ⁰ C
	Max. Losses at 50% loading in Watts	*Max. Losses at 100% loading in Watts	
100	475	1650	4.5
200	780	2300	4.5
315	1025	3100	4.5
400	1225	3450	4.5
500	1510	4300	4.5

*Total Load Loss in watt at 100 % loading = No Load loss in watt + Full Load loss in watt at 75 Deg. C

% impedance shall be subject to tolerance specified in IS: 2026. **Bids not meeting the limits indicated above will be treated as non responsive.**

Bids with higher losses than above specified values would be treated as non-responsive. While in case of tapped transformer, Bids with higher losses than above specified values at maximum current tap, would be treated as non responsive. However, the manufacturer can offer losses lower than above.

NOTE: - Offer without **BIS and BEE** certification will be out rightly rejected without any correspondence.

5.6 EVALUATION CRITERIA:

- (1) The Tender price bids will be evaluated on the basis of firm Price End Cost including GST and Cess.
- (2) Bidder can offer CRGO or Amorphous core material for any rating and they have to specify clearly in their offer. Price bid must be submitted for respective core.

- (3) Bidder has to clearly mention offer quantity with core material in tender Annexure.
- (4) Price matching will be carried out on the base of unit end cost including GST and cess, if any.

5.7 TEMPERATURE RISE:

The temperature rises over ambient shall not exceed the limits described below (Total losses guaranteed offered in GTP shall have to be fed for Temperature rise test)

Temperature Rise	100 KVA to 200 KVA	Above 200 KVA to 500 KVA
Top oil temperature rise measured by thermometer	35 °C	40 °C
Winding temperature rise measured by resistance	40 °C	45 °C

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

5.8 TANK:

Transformer tank construction shall conform in all respect to clause 15 of IS 1180(Part-1):2014. The transformer tank can be with radiator fins/ rounded or elliptical cooling tubes or made of corrugated panels.

(1) FOR RECTANGULAR PLAIN TANK:

- (a) The transformer tank shall be of robust construction rectangular in shape and shall be built up of tested MS sheets.

The tank shall be made of prime quality MS sheet of thickness stated below with necessary stiffener to withstand the pressure built in during the expansion of oil due to temperature rise.

Rating of Transformer	Minimum thickness of plate in mm	
	For Side	For Top & Bottom
Up to 100 KVA	3.15	5
Above 100 KVA	4	6

The exterior of the transformer tank and other ferrous fitting shall be thoroughly cleaned, scraped /sand blasted and given a priming coat and two finishing coats of durable oil and weather resistant paint of dark admiral grey conforming to colour code No. 632 of IS-5/1961.

- (b) The internal clearance of tank shall be such that, it shall facilitate easy lifting of core with coils from the tank.
- (c) All joints of tank and fittings shall be oil tight and no bulging should occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plate shall be of such strength that the complete transformers when filled with oil may be lifted bodily by means of lifting lugs. Inside of tank shall be painted with hot oil resistive paint.
- (d) Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure qualifications and welder performance qualification certificates to the customer.
- (e) The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet. Detachable radiators with shut off valves above 500 KVA as required shall be provided. All removable covers shall be provided with weatherproof, hot oil resistant, resilient gaskets. The design shall be such as to prevent any leakage of water into or oil from the tank.
- (f) Lifting lugs: 2 Nos. of lifting lugs are to be provided in Transformers below 100 KVA rating and 4 Nos. lifting lugs are to be provided in Transformers for 100 KVA and above rating transformers. Lifting lugs of MS plate 8 mm thick

(min) suitably reinforced by vertical supporting flat welded edgewise below the lugs on the side wall.

- (g) Pulling lugs: 4 Nos. of welded heavy duty pulling lugs of MS plate 8 mm thick (min) shall be provided to pull the transformer horizontally.
- (h) Top cover fixing bolts of G.I adequately spaced and 6 mm Neoprene bonded cork gaskets conforming to IS 4253 part-II shall be placed between tank and cover.
- (i) The bolts outside tank shall have 2 flat washers & one spring washer.
- (j) Top cover of the transformer tank shall be slanting minimum 5 to 10 mm towards HV Bushing so that entry of water can be avoided.
- (k) HT/LT termination box shall be providing at side of transformer. Necessary clearance between phases, neutral and earth shall be maintained.

(2) CONSERVATOR:

- (a) On Transformers of all ratings with rectangular plain tank the provision of conservators is obligatory.
- (b) When a conservator is provided, oil gauge and the plain or dehydrating breathing devise shall be fixed to the conservator which shall also be provided with a drain plug and a filling hole (1¼" normal size thread) with cover. The capacity of a conservator tank shall be designed to contain 10% of the total quantity of oil and its contraction and expansion due to temperature variations. Normally 3% quality of total oil will be contained in the conservator. In addition 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.
- (c) The inside diameter of the pipe connecting the conservator to the main tank should be within 30 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 deg C) should be above the sump level.

- (d) To overcome the oil leakages, side plate of Conservator tank shall be welded. Bolting with gasket will not be allowable.

(3) DEHYDRATING BREATHER:

- (a) Breather shall be screwed type. It shall have die cast aluminum body & further, inside container for silica gel shall be of tin sheet. Inverted U-shape pipe shall be used for connection of breather. The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the colour 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. The make and design of breather shall be subject to approval of DISCOM, Gujarat.

- (b) Individual Breather shall be packed in a cotton bag shall be bound with individual transformer in a clear visible position.

(4) SURFACE PREPARATION & PAINTING

- (a) All paints shall be applied in accordance with the paint manufacturer's recommendations.
- (b) All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.
- (c) 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, wherever

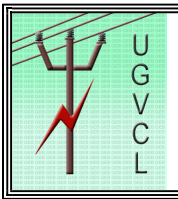
airless spray is not possible, conventional spray be used with prior approval of purchaser.

- (d) The Supplier shall, prior to painting protect nameplates, lettering gauges, sight glasses, light fittings and similar such items.
- (e) 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.
- (f) Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning by Seven Tank process including phosphate of the appropriate quality (IS 3618).
- (g) 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.
- (h) Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale shall only be used where blast cleaning is impractical. Manufacturer explains such areas in his technical offer clearly.
- (i) **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.

(j) **Paint Material**

- i) The colour of the finishing coats shall be dark admiral gray conforming to No. 632 of IS-5 of 1961.
- ii) Inside of tank shall be painted with oil resistance paint of colour shade yellow/green. For external surfaces, one coat of thermosetting powder paint shall be used.



- iii) 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.
- iv) To the maximum extent practicable the coat shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. Each coat of paint shall be allowed to harden before the next is applied.
- v) Particular attention must be paid to full film thickness at edges.
- vi) The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below.

Sr. No.	Paint Type	Area to be painted	No. of coats	Total Dry film thickness (min.) in microns
1	Thermo setting powder paint OR Liquid paint: a) Epoxy (Primer) b) Polyurethane (finished coat)	Outside	1	60
2	Thermo setting powder paint OR	Inside	1	30
	Liquid paint: Hot oil resistant paint of colour shade yellow/green		1	35

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

(k) Painting Procedure:

- i) All painting shall be carried out in conformity with both Specification and with the paint manufacturer's recommendation. All paints in any

one particular system, whether shop or site applied, shall originate from one paint manufacturer.

- ii) Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer's recommended condition.
- iii) 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.
- iv) 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. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.
- v) Paint applied to items that are not be painted shall be removed at Supplier's expense, leaving the surface clean, unstained and undamaged.

(I) Damaged Paintwork:

- i) Any damage occurring to painting of any part shall be made good to the same standard of corrosion protection and appearance as that originally employed, within guarantee/ warrantee period at free of cost.
- ii) Any damaged paint work shall be made good as follows:
 - The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

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

(m) Tests for Painted Surface:

- i) The painted surface shall be tested for paint thickness.
- ii) The painted surface shall pass the Cross Hatch Adhesion test, Salt spray test and Hardness test as per the relevant ASTM standards.

5.9 BUSHINGS AND TERMINALS:

- (1) The bushings shall have to be installed on side plate of the transformer in terminal box. Bushings shall be mounted in such a way that all bushings shall remain parallel and at equiv. distance throughout. Bushings having type tested, as per relevant IS amended up to date shall only be acceptable. The minimum creepage distance for both HV & LV Bushings shall not be less than 25 mm per kV.
- (2) For Primary Terminal: 17.5 kV Porcelain Bushings as per IS: 3347 shall be used as required by the purchaser for heavily polluted atmosphere having suitable diameter with nuts and check nuts for pad and platform mounted transformer.
- (3) For Secondary Terminal: 1.1 kV Epoxy bushings as per IS: 2099 shall be used as required by the purchaser for heavily polluted atmosphere having fixed palm type connectors with suitable locking arrangement to restrict the rotation of palm assembly. Palm shall be of copper and stud of copper duly brazed at the joint.
- (4) The transformer shall be fitted with suitable end termination boxes on 11 kV side to terminate one 11 kV/ 3 core Aluminum conductor XLPE/PILC

cable up to 300 mm² size as per drawing. The HT cable box shall be prevented from ingress of moisture into the box due to rainwater directly falling on the box. The H.T cable box shall be of split type with plain faces and machined and fitted with suitable gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut bolt arrangement and M.S 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 shall be copper. HT Cable support clamps should be provided to avoid tension due to cable weight. Required diameter of hole for cable entry shall be provided.

- (5) The transformer shall be fitted with suitable LV cable end box having non-magnetic material gland plate with appropriate size single compression brass glands on LV side to terminate 1.1 kV/ 1 core XLPE armoured cable as mentioned herein below. Required diameter of holes for entry of LV 1 core 4 nos. 300 mm² XLPE cable shall be provided.
- (6) Current density in HV and LV Terminals shall not exceed 1 Am/Sq.mm in case of Brass terminals and 2 Am/Sq.mm in case of copper terminals.
- (7) Copper Bus bar having current density shall not exceed 1.5 Am/Sq.mm shall be provided with suitable insulators in terminal box for HT/LT termination to avoid tension due to cable weight on bushing.

5.10 INTERNAL CONNECTION

- (1) HV WINDING:
 - (a) In case of HV winding all jumpers from winding to bushing shall have cross section double the winding conductor.
 - (b) Inter coil connection shall be done by brazing as per ASME, section-IX.
 - (c) In case of AL/CU winding Delta joint shall be with brazing only.

(d) Lead from Delta joint shall be connected to bushing rod by brazing only.

(e) Current density in any of the conductor (in Delta connections also) shall not exceed 1 Amp/sq.mm and 2Amp/sq.mm for aluminum conductor and copper conductor respectively.

(2) LV WINDING:

(a) LV star point shall be formed of AL/CU flat of sufficient size and length. Lead from winding shall be connected to the flat by brazing.

(b) Firm connection of LV winding to bushing shall be made of adequate size of "L" shape flat. Connection of LV coil lead to "L" shape flat shall be made by brazing. The "L" Shape flat shall be of copper for copper winding &

(c) Aluminum of Aluminum winding. "L" shape flat/lug shall be clamped to LV bushing metal part by using nut, locknut and washer.

5.11 TANK BASE CHANNEL:

Two numbers of channels with bi-directional rollers having following size are to be provided for the transformer

Transformer capacity in KVA	Size of base Channel in mm
Up to 200 KVA	100 x 50
Above 200 KVA and up to 500 KVA	125 x 65

5.12 NAME PLATE & TERMINAL MARKINGS:

(1) High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n. Neutral terminal to be brought out.

(2) Each Transformer shall be provided with combined non-detachable Name plate made of anodized aluminum/ stainless steel material securely fixed on the outer body, easily accessible. The information of Rating and terminal markings as per IS 1180 (Part-I) 2014, Clause No. 13 shall be engraved (punched) on combined name plate. The Transformer shall be marked with

the Standard Mark. Details of Guarantee Period shall also be mentioned in combined Name Plate being a special requirement of DISCOM.

5.13 FITTINGS:

The fittings on the transformers shall be as under:

Sr. No.	Item	Qty.
1	Rating and diagram plate	1 no.
2	Earthing terminals with lugs.	2 nos.
3	Lifting lugs	6 nos. (4 nos. for tank and 2 nos. for top plate of the transformer)
4	Oil filling hole with cap (on conservator)	1 no.
5	Drain valve - 32mm for all T/Fs (It shall be covered with metallic box spot welded to tank)	1 no.
6	Conservator with drain plug.	1 no
7	Thermometer pocket	1 no
8	Silica gel breather	1 no
9	Platform mounting channel (with hole suitable for axle of rollers)	2 nos.
10	Prismatic Oil level gauge indicating the position of oil marked (with background of yellow colour) as follows. Min. -5 °C, 30 °C, Max. 90 °C	1no.
11	HT Bushing	3 nos.
12	LT Bushing	4 nos.
13	Radiators	As per requirement
14	Pulling lugs	4 nos.
15	Rollers (Dia. 150 mm & width – 50 mm)	4 nos.
16	Pressure Relief vent for 200KVA and above ratings	1 no.

17	Air release plug	1 no.
18	Oil filter valve (1.25 Inch, nominal size thread) on top of transformer	1 no.
19	HV/LV cable holding frames with clamps	1 no.
20	Stiffener angle 40x40x5 mm and vertical strip of 50x5 mm flat	As per tank size

5.14 SUBMISSION OF DRAWINGS AND CALCULATION SHEET:

The manufacturer has to submit the following details and drawings along with offer

- i) Guaranteed technical particulars as per DISCOM's prescribed Performa for design & constructional details
- ii) General Arrangement
- iii) Core Assembly drawing
- iv) Internal Construction drawing
- v) Technical Details Sheet
- vi) Rating & Diagram Plate Drawing (minimum size 105mm x 175 mm x 1.5 mm) showing: Name of Supplier, A/T No., KVA capacity, Month & year of manufacturing, Sr. No. of Transformer etc.
- vii) Drawing of Transformer Identification Number plate minimum size 150 mm x 20 mm x 1.5 mm)
- viii) Month & Year of manufacture to be written on conservator tank & body
- ix) Metal part of HV/LV steams
- x) Breather
- xi) Pressure Relief Device

- xii) Short circuit capacity calculation sheet
- xiii) Cooling capacity calculation sheet
- xiv) Flux density calculation sheet

The above drawings/ details are illustrative. However, the bidder may submit their own drawing/ details if they so desires.

After Placing of order by the respective DISCOM to successful bidder, supplier has to get approval of all above drawings before offering Prototype sample for inspection.

5.15 TESTS AND INSPECTION:

(1) Type Tests:-

Offered equipment shall be fully type tested by the bidder or his collaborator as per the relevant standards. The type test must have been conducted on a transformer of same design. The Bidder shall furnish type test reports along with the offer. All the required Type test reports for the tendered items as under should invariably furnish a Notarized Copy. Offers without type test reports will be treated as Non-responsive.

- i) Temperature rise test for determining the maximum temperature rise after continuous full load run.
- ii) Lightning Impulse voltage test: As per Clause No. 13 (With chopped wave) of IS – 2026- part-III latest version. BIL for 11 kV shall be minimum 95 KV Peak.
- iii) Short Circuit withstand Test
- iv) Pressure and Vacuum Test: As per IS - 1180 / part-I/2014
- v) Noise-level measurement
- vi) Magnetic Balance Test

- vii) Measurement of zero-phase sequence impedance
- viii) Measurement of Harmonics of no-load current
- ix) Pressure relief device test (if provided).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

(2) Routine Tests:

Following tests shall have to be carried out by manufacturers at their works (to be conducted on all units) before offering proto/lot acceptance tests and record of the same shall be maintained and produced at the time of acceptance tests for inspector's verification.

- i) Measurement of winding resistance (at all taps if applicable) [IS2026 (Part1)].
- ii) Measurement of voltage ratio, polarity, phase sequence and vector group [IS2026 (Part1)].
- iii) Measurement of short-circuit impedance (principal tapping, when applicable)
- iv) Load losses at rated current and normal frequency at 50 % and 100 % load [IS 1180 (Part1)].
- v) Measurement of no-load loss and current [IS2026 (Part1)].
- vi) Measurement of insulation resistance [IS2026 (Part1)].
- vii) Induced over-voltage withstand test [IS2026 (Part3)].
- viii) Separate-source voltage withstand test [IS2026 (Part3)].
- ix) Oil leakage test (as per IS: 1180-2014).

- x) Neutral current measurement, shall not be more than 2% of full load current (CEA Guideline 2008 clause no 34.9)
- xi) Measurement of no load losses and magnetizing current at rated frequency and at 90%, 100% and 112.5% voltage.

(3) Inspection of Proto Type Transformer:

The Manufacturer shall have to offer one no of prototype transformer along with relevant approved drawings as stated above at clause 5.14.

The proto type shall be subjected to following test conforming to IS 1180 Part-1 2014 & IS 2026 and all relevant IS with latest amendments.

- i) Verification of core laminations material documents and quality.
- ii) Verification of internal parameters with respect to approved drawings and GTP.
- iii) All Routine tests/ acceptance tests
- iv) Temperature rise test
- v) Verification of Air pressure and vacuum test certificate from manufacturer of tank.

On completion of proto type sample inspection and scrutinizing the reports, approval will be accorded by the respective DISCOM. On getting approval from respective DISCOM, bulk production shall be commenced by the supplier.

If any observation/ deviation found during proto inspection, supplier shall have to re-offer proto inspection with rectification/ new sample. However, inspection charges for un-successful proto sample will be borne by the supplier.

(4) Acceptance Tests:-

The testing shall be carried out in accordance with IS: 1180 (Part-1): 2014 and IS: 2026 latest amendment & CEA Guideline as applicable at the supplier's works before dispatch without any extra charges in the presence of purchaser's representative.

Valid calibration certificates from NABL lab of testing equipment's shall be available at supplier works for testing of transformers. Manufacturer shall possess 0.1 Class of accuracy instruments for measurement of losses.

A. The following acceptance tests shall be carried out on each offered transformers.

- i) Physical verification of finishing and workmanship as per GTP and approved drawings.
- ii) Measurement of short-circuit impedance at normal tapping
- iii) No-load losses and No-load current
- iv) Measurement of load loss at 50 % and 100 % load at maximum current tap
- v) Neutral current to be measured by clamp-on meter, it shall not be more than 2% of full load current (CEA Guideline 2008 clause no 34.9)
- vi) Measurement of over excitation current at rated frequency and at 112.5% voltage.
- vii) Induced over-voltage withstand test (IS: 2026 Part-3).
- viii) Separate-source voltage withstand test (IS: 2026 Part-3).

B. The following acceptance tests shall be carried out on one transformer from offered lot.

- i) Measurement of winding resistance

- ii) Measurement of voltage ratio, polarity, phase sequence and vector group [IS 2026(Part1)]
- iii) Measurement of insulation resistance [IS2026 (Part1)].
- iv) Verification of thickness of paint coating.
- v) Temperature rise test on the unit selected by Authorized Representative
- vi) Oil samples (one sample per lot) to be sent for testing at NABL lab to comply with IS 1866. Testing charges will be borne by DISCOM.

(5) Special tests other than type and routine tests, as agreed between purchaser and Bidder shall also be carried out as per the relevant standards.

(6) Purchaser shall have every right to appoint a third party inspection to carry out the inspection process. The purchaser has reserved the rights to have the test carried out at his own cost by an independent agency at NABL accredited laboratory, wherever the dispute regarding the quality of supplies arise.

(7) The successful bidder shall have to submit the routine test certificates of bought out accessories and invoice for raw material at the time of inspection.

5.16 PACKING & FORWARDING:

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

5.17 AUDIT INSPECTION:

The representative of the Company may pick up samples from the lots supplied by the Supplier at the Stores location of the Company at random for quality check. The samples picked up will be tested for acceptance tests / type tests or as decided by DISCOM at Government approved laboratory in presence of representatives of supplier and DISCOM as per relevant ISS/BIS/ DISCOM P.O. specifications. In case if the materials does not confirm to

specifications or fails at Government approved laboratory or other laboratory decided by DISCOM for testing and if subsequent testing are to be carried out (which will solely at DISCOM discretion), then all Testing fees, expenses of the inspector and other expenses incurred by DISCOM will be to supplier's account. The decision in this regard for acceptance as above of DISCOM shall be final and this will be binding on the supplier.

The test results will be binding on the suppliers. DISCOM in general will not allow re-sampling. If the material fails in any of the acceptance tests/type tests carried out, the full lot of materials will be considered as rejected.

5.18 GUARANTEE FOR THE TRANSFORMERS:

All transformers supplied against this specification shall be guaranteed for a period of 66 months from the date of receipt at the consignee's Stores or 60 months from the date of commissioning, whichever is earlier. However, any engineering error, omission, wrong provisions, etc. which do not have any effect on the time period, shall be attended to as and when observed/pointed out without any price implication.

In case the distribution transformer fails within the guarantee period the purchaser will immediately inform the supplier who shall take back the failed distribution transformer within 15 days from the date of the intimation at his own cost and replace/repair the transformer within forty five days of date of intimation with a roll over guarantee, failing which bank guarantee shall be encashed without any notice and all business will be stopped with the said supplier at least for a period of 3 years. This clause itself shall be the notice to the supplier about encashment of Bank Guarantee in cases of his failure to adhere to timelines & no separate notice will be survived.

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.

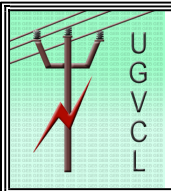
5.19 GUARANTEED TECHNICAL PARTICULARS:

GTP to be filled in and submitted by the tenderer in the Annexure I as per attached in tender for each offered rating. In Annexure I, the specific values shall be furnished and only quoting of IS reference is not sufficient. If the Annexure I not submitted duly filled in with the offer, the offer shall be liable for rejection.

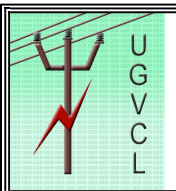
Annexure I

GUARANTEED TECHNICAL PARTICULARS

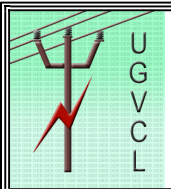
Sr. No.	Particulars	Unit / Type	As per Firm's Offer
1	Name of manufacturer		
2	Place of Manufacturing		
3	Transformer capacity	KVA	
4	Voltage	11/0.433-0.250 KV	
5	No. of Phases	3 No.	
6	Vector Group	DY-11	
7	Type of Cooling	ONAN	
8	Type of Transformer	Unsealed	
9	For 200 KVA & above transformers		
	a) No. of tap positions in HV winding		
	b) Voltage variation		
10	Energy Efficiency Level	Star-1 (Level-2)	
11	Losses		
i	Core loss	Watts	
	a) at Normal Voltage	Watts	
	b) at Maximum Voltage	Watts	
ii	Full Load losses at 75 °C.	Watts	
iii	Total losses at 50 % loading at 75 °C.	Watts	
iv	Total losses at 100 % loading at 75 °C.	Watts	



12	Percentage Impedance at 75 °C.	%	
13	Maximum temperature rise of		
	a) Windings by resistance method	40/45 deg C	
	b) Top Oil by Thermometer	35/40 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	
15	Efficiency at 75 °C.		
	a) at Unity P.F. &		
	125% load	%	
	100% load	%	
	75% load	%	
	50% load	%	
	25% load	%	
	b) at 0.8 P.F. &		
	125% load	%	
	100% load	%	
	75% load	%	
	50% load	%	
25% load	%		
16	Regulation at		
	a) Unity P.F.		
	b) 0.8 P.F. at 75 °C		
17	CORE	CRGO/ Amorphous	
i	Core Grade		
ii	Core diameter	mm	
iii	Gross Core area	Mtr ²	
iv	Net Core area	Mtr ²	
v	Flux density	Wb/Mtr ²	



vii	Wt. of Core	Kg	
viii	Loss per kg. of Core at the specified Flux density	Watts	
ix	Core window height	mm	
x	Centre to centre distance of the core	mm	
xi	The nominal flux density at		
	a) 100% rated voltage	$\leq 1.69 \text{ Wb/Mtr}^2$	
	b) 110% 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%		
	(i) CRGO Core: at 100% and 112.5% of rated Voltage		
	a) Up to 200 KVA Transformer	$\leq 3\%$ and $\leq 6\%$	
	b) Above 200 KVA Transformer	$\leq 2\%$ and $\leq 5\%$	
	(ii) Amorphous Core: at 100% and 112.5% of rated Voltage		
	a) All Ratings	$\leq 2\%$ and $\leq 5\%$	
18	WINDINGS	Aluminium / Copper	
i	No. of L.V. Turns	No.	
ii	No. of H V turns	No.	
iii	Size of LV Conductor bare/ covered	mm	
iv	Size of HV conductor bare/covered	mm	
v	No. of parallels	No.	
vii	Resistance of HV winding at 20 °C	Ohm	
viii	Resistance of LV winding at 20 °C	Ohm	
ix	Current density of LV winding	Amps/sq.mm.	
x	Current density of HV winding	Amps/sq.mm.	
xi	Wt. of the LV winding for Transformer	kg.	
xii	Wt. of the HV winding for Transformer	kg.	



UTTAR GUJARAT VIJ COMPANY LIMITED

CIN - U40102GJ2003SGC042906

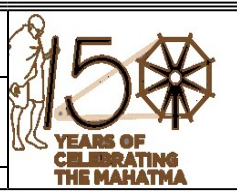
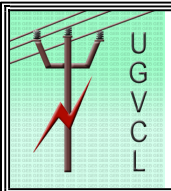
Regd.& Corporate Office : Visnagar Road : Mehsana : 384001 (North Gujarat)

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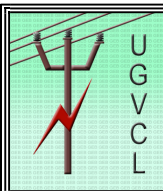
Website : www.ugvcl.com e-mail :- sp1@ugvcl.com,



xiii	No. of LV Coils/phase	No.	
xiv	No. of HV coils / phase	No.	
xv	Height of LV Windings	mm	
xvi	Height of HV winding	mm	
xvii	ID/OD of LV winding	mm	
xviii	ID/OD of HV winding	mm	
xix	Size of the duct in LV winding	mm	
xx	Size of the duct in HV winding	mm	
xxi	Size of the duct between HV & LV	mm	
xxii	Inter layer insulation provided in design for		
	1) Top & bottom layer		
	2) In between all layer		
	3) Details of end insulation		
	4) Whether wedges are provided at 50% turns of the HV coil		
xxiii	Insulation materials provided		
	a) For Conductors		
	(1) HV		
	(2) LV		
	B) For Core		
xxiv	Material and Size of the wire used		
	1) HV		
	a) SWG	No	
	b) Dia.	mm	
	2) LV	mm X mm	
	a) Strip size		
	b) No. of Conductors in parallel	No	
	c) Total area of cross section	sq.mm.	
19	Weight content of		
	a) Core lamination (min)	KG	
	b) Windings (min) Aluminium/Copper	KG	



	c) Tank & Fittings	KG	
	d) Oil	KG	
	e) Oil qty (min)	Litre	
	f) Total Weight	KG	
20	Oil Data		
	1. Qty for first filling (min)	Litre	
	2. Grade of oil used		
	3. Maker's name		
21	4. BDV at the time of filling	KV	
	Transformer		
	1) Overall length x breadth x height	mm X mm X mm	
	2) Shape of Tank		
	2) Tank length x breadth x height	mm X mm X mm	
	3) Thickness of plates for		
	a) Side plate (min)	mm	
	b) Top & Bottom plate (min)	mm	
	4) Conservator Dimensions	mm X mm	
22	5) Tank base channel dimensions	mm X mm X mm	
	HV Bushings & Terminals		
	1) Make of HV bushing		
	2) Rating in KV	KV	
	3) Turret Height	mm	
	4) Material of HV terminal	Brass/Copper	
23	5) Current Density of HV terminal	Amps/sq.mm.	
	LV Bushings & Terminals		
	1) Make of LV bushing		
	2) Rating in KV	KV	
	3) Turret Height	mm	
	4) Material of LV terminal	Brass/Copper	
24	5) Current Density of LV terminal	Amps/sq.mm.	
	Radiator		

**UTTAR GUJARAT VIJ COMPANY LIMITED**

CIN - U40102GJ2003SGC042906

Regd.& Corporate Office : Visnagar Road : Mehsana : 384001 (North Gujarat)

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Website : www.ugvcl.com e-mail :- sp1@ugvcl.com,

	1) Heat dissipation by tank walls exclusive top & bottom		
	2) Heat dissipation by radiator		
	3) Size of radiator		
	4) 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	