



Maharashtra State Electricity Distribution Company Limited

SPECIFICATION NO. Stores: MSC-II/DT/25kVA/2011

TECHNICAL SPECIFICATION

FOR

**25 kVA, 11/0.433, 22/ 0.433 kV THREE STAR RATING,THREE PHASE DISTRIBUTION
TRANSFORMERS**

with CSP Feature

FOR

DISTRIBUTION SYSTEM

IN

MAHARASHTRA

INDEX

| Clause No. | Contents |
|-------------------|---------------------------------------|
| 1 | Scope |
| 2 | System Particulars |
| 3 | Service Condition |
| 4 | Applicable Standards |
| 5 | Specific Technical requirement |
| 6 | Design & Construction |
| 6.1 | Core |
| 6.2 | Windings |
| 6.3 | Losses |
| 6.4 | Insulation Material & Clearances |
| 6.5 | Impedance Value |
| 6.6 | Tank |
| 6.7 | Heat Dissipation. |
| 6.8 | Total minimum Oil Volume |
| 7 | Conservator. |
| 8 | Breathers. |
| 9 | Terminals |
| 10 | Bushing and connections |
| 11 | Internal Connections |
| 12 | Tank base channel |
| 13 | Protection |
| 14 | Lightening Arrestors |
| 15 | Terminal Marking Plate & Rating Plate |
| 16 | Fittings |
| 17 | Transformer Oil |
| 18 | Tests & Inspection |

| | |
|--------------|--|
| 19 | Type Tests |
| 20 | Drawings |
| 21 | Rejection |
| 22 | Cleaning & Painting |
| 23 | Guaranteed Technical Particulars |
| 24 | Testing facilities |
| 25 | Submission of Routine Test Certificate |
| 26 | Stage Inspection |
| 27 | Testing of all distribution transformers for no load and full load losses. |
| 28 | Random Sample Testing |
| 29 | Inspection & Testing of Transformer Oil |
| 30 | Quality Assurance |
| 31 | Qualifying Requirements |
| 32 | Final Inspection |
| 33 | Performance Guarantee |
| 34 | Cost Data Sheet |
| 35 | Schedule |
| Schedule A | Guaranteed and Other Technical Particulars |
| Schedule B | Tenderer's Experience |
| Annexure-I | Air Pressure Test |
| Annexure-II | Unbalance Current Test |
| Annexure-III | Temperature Rise Test |

MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY LTD
TECHNICAL SPECIFICATION FOR 25 kVA, 11/0.433, 22/0.433 kV THREE STAR RATING,
THREE PHASE DISTRIBUTION TRANSFORMERS with CSP Feature.

(Tech Spec.No. Stores: MSC-II/DT/25kVA/2011)

1 Scope:-

- 1.1 This specification covers design, manufacturing, testing and delivery of the Oil Immersed, Air Natural (ONAN) with Completely Self Protected feature, outdoor type, three star rating, three phase, 25 kVA, 11 kV & 22 kV, 50 Hz, Distribution Transformers. 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.
- 1.2 THE RESPECTIVE DRAWINGS ALONGWITH NOTES AND SPECIFICATION ATTACHED HERETO FORM AN INTEGRAL PART OF THIS SPECIFICATION FOR ALL PURPOSES.
- 1.3 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.
- 1.4 The design and constructional aspects of materials shall not withstanding any anomalies, discrepancies, omissions, in-completeness, etc. in these specifications and will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, Electricity Act 2003 and other statutory provisions.
- 1.5 The Bidder/supplier shall bind himself to abide by these considerations to the entire satisfaction of the purchaser and will be required to adjust such details at no extra cost to the purchaser over and above the tendered rates and prices.

1.6 Tolerances:

The tolerance in respect of guaranteed electrical performance shall be as specified in table 7 of IS 2026 (Part-I)-1997.

2.0 System Particulars:-

The transformers shall be suitable for outdoor installation with following system particulars and they should be suitable for service under fluctuations in supply voltage as permissible under Indian Electricity Rules

| | |
|--|----------------------------------|
| 2.1 Nominal System Voltage | :11 kV or 22 kV |
| 2.2 Corresponding Highest System Voltage | :12 kV or 24 kV |
| 2.3 Neutral earthing | :Solidly earthed |
| 2.4 Frequency | : 50 Hz with ± 3 % tolerance |
| 2.5 Number of Phase | : 3 |

3.0 SERVICE CONDITIONS:

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

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

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

Reference Ambient Temperature for temperature rise : 50 Deg C

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

4.0 APPLICABLE STANDARDS:-

4.1 The design, manufacture and performance of the equipment shall comply with all currently applicable statutes, regulations and safety codes. Nothing in this specification shall be construed to relieve the bidder off his responsibilities.

4.2 The Distribution Transformers shall conform to IS: 2026 as amended up to date or other International Standards for equal or better performance. Unless otherwise modified in this specification the Distribution Transformers shall comply with the Indian Standard Specification IS 2026 latest.

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

| | | |
|----|--|---|
| a. | IS 2026(Part I,II,IV)/1997, (Part-III)/1981, (Part-V)/1994 | Power Transformer |
| b. | IS:1180/1989 (Part-1) | Outdoor type, Three phase distribution transformers up to and including 100 kVA, 11KV |
| c. | IS:335/1993 | New insulating oil- Specification (fourth revision) |
| d. | IS:2099/1986, IS: 7421-1988, IS:3347 (Part-I /Sec-2)-1979, IS:3347 (Part-I /Sec-1)-1982 amended up to date | Bushing |

| | | |
|----|-----------------------------------|--|
| e. | IS 5 | Colours for ready mixed paints and enamels. |
| f. | IS 13730 (Part-27)1996 | Specification for particular types of winding wires. |
| g. | IS: 8623/1993 amended upto date | Specification for Low –Voltage Switchgear and control gear Assemblies. |
| h. | IS: 3073/1974, IS: 3070(Part-II) | Specifications for L.A's |
| i. | CBIP Publication No.295:2006 | Manual on transformers |

4.4 In case of conflict arising out due to variations between the applicable standard and the standards specified herein the provisions of this specification should prevail.

5.0 Specific Technical requirement:

5.1 Standard kVA Ratings:-

The standard ratings for transformer shall be 25 kVA.

5.2 Nominal voltage ratings :

Primary voltage : 11 kV/ 22 kV

Secondary voltage : 0.433 kV

5.3 Winding connections:-

i. H.V. Winding : Delta (Δ)

ii. L.V. Winding : Star (Y)

The neutral of the L.V. winding shall be brought out to a separate insulated terminal. The voltage group shall be Dyn-11.

5.4 Temperature Rise:

a. The temperature rise for top oil over an ambient temperature of 50° C should be 35 °C maximum measured by thermometer in accordance with IS 2026.

b. Temperature rise for winding over an ambient temperature of 50° C should be 40° C maximum (measured by resistance method in accordance with IS 2026.

5.5 No load voltage ratio:-

The no load voltage ratio shall be 11000/433 Volts or 22000/433 Volts.

6.0 Design & construction:

6.1 Core

i. The core shall be stacked type or wound core type or delta core type.

a) For Stack core :-

The core shall be of high grade cold rolled grain oriented (C.R.G.O) annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together to the frames firmly to prevent vibration or noise. All core clamping bolts shall be effectively insulated. The complete design of core must ensure permanency of the core losses with continuous working of the transformers.

b) For Wound core :-

The core shall be 'C' type construction of high grade cold rolled grain oriented (C.R.G.O.) annealed steel lamination having low loss and good grain properties, coated hot oil proof insulation or Amorphous core material. The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The core material shall not be brittle in case of CRGO material.

Core clamping for C.R.G.O./Amorphous Wound core type transformers shall be as follows:

1. Core clamping shall be with top and bottom U- shaped core clamps made of sheet steel clamped
2. M.S. core clamps shall be painted with 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) Delta Core:

The delta core has the triangular structure consisting the triangular Bottom yoke, triangular top yoke and three vertical limbs connecting the three vertices of the said Bottom and top yoke. The core shall be of high grade cold rolled grain oriented (C.R.G.O) 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 permanency of the core losses with continuous working of the transformers.

- ii. The grade of core laminations shall be **M4 or better**.

The successful bidder, shall be required to submit the manufacturer's test report showing the Watt Loss per kg and the thickness of the core lamination, to ascertain the quality of Core materials.

The purchaser reserves the right to get sample of the core material tested at any Government recognized laboratory.

- iii. The transformer core shall not be saturated for any value of V/f ratio to the extent of 112.5% of the rated value of V/f ratio (i.e. 11000 / 50 or 22000/50) (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and will not get saturated. The bidder shall furnish necessary design data in support of this situation.

iv. Flux density:-

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

- v. The No load current at rated voltage shall not exceed the percentage given in Table below. The no load current shall not exceed 2 times that at rated voltage when the applied voltage is 112.5%.

| | | | |
|-----|--------|--|------------------------------|
| Sr. | kVA | At Rated Voltage | At 112.5 % Rated Voltage |
| No. | Rating | 2 % of the full load current in LT winding | 4 % of the full load current |
| 1 | 25 | | |

vi. Number of steps of core shall be minimum of

| | | | |
|------------|------------------|--------------------------------|------------------|
| | Stack core | Wound core (CRGO/Amorphous) | Delta core |
| For 25 kVA | 5 standard steps | No steps | 5 standard steps |

6.2 Winding:-

i. Materials:

HV winding shall be done by super enamel coated copper conductors and LV winding shall be done by Double paper covered electrolytic copper conductor/super enamel for both 11 and 22 kV class transformers.

ii. Current Density:

Current density for HV and LV should not be more than 2.8 A / sq.mm.

iii. L.V. Neutral formation shall be at top.

6.3 Losses:

The total losses at 50% & 100% loading for three phase, three star rating 25 kVA, 11 /0.433 kV and 22/ 0.433 kV distribution transformers at rated voltage, frequency and at 75 deg. Centigrade shall not exceed the values indicated as below:

TABLE – 1

| KVA Rating | Voltage Ratio in kilovolts | Losses at 50% loading (Watts) at 75 °C | Losses at 100% loading (Watts) at 75 °C |
|-------------------|-----------------------------------|---|--|
| 25 | 11/0.433 | 210 | 695 |
| 25 | 22/0.433 | 221 | 730 |

No positive tolerance shall be allowed on the maximum losses given in the table for both 50 % & 100 % loading values. 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.

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

Note : Please refer Annexure IV i.e. Schedule 5 of the technical specifications for 3 star distribution transformers given by Bureau of Energy Efficiency (the same is attached with technical specification). As per Govt. of India gazette notification dt. 06.07.2009 and BEE guidelines followed by Government of Maharashtra & B.R.1150 dt. 28.05.2010, it is compulsory to display Star label sticker on each supplied distribution transformer at suitable place.

6.4 Insulation material & clearances:

- i** **Materials** – Makes of Electrical grade insulating craft paper, Press Board, Perma wood/ Haldi wood insulation shall be declared in GTP by the bidder. The test reports for all properties as per relevant I.S. amended up to date shall be submitted during inspection.
- ii** The electrical clearance between the winding and body of the tank (between inside surface of the tank and outside edge of the windings) should not be less than 25 mm for 11 kV class and 30 mm for 22 kV class transformers.

Minimum external clearances of bushing terminals

| | | 11 kV | 22 kV |
|----|----------|---------|--------|
| HV | Ph to Ph | 255 mm. | 330 mm |
| | Ph to E | 140 mm | 230 mm |
| LV | Ph-to-Ph | 75 mm. | 75 mm |
| | Ph to E | 40 mm. | 40 mm |

6.5 Impedance Value-

The percentage impedance at 75 ° C. shall be 4.5% for 11 kV class and 5% for 22 kV class (tolerance of $\pm 10 \%$).

6.6 Tank

6.6.1 The transformer tank shall be made up of prime quality M.S. sheets of rectangular/round /hexagonal/elliptical shape. The transformer tank shall be of robust construction. All joints of tank and fittings should be oil tight and no bulging shall occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plates shall be of such strength that the complete transformer when filled with oil may be lifted bodily by means of the lifting lugs provided. Tank inside shall be painted by varnish. Top cover plate shall be slightly sloping, approximately 5 to 10 deg. towards HV bushing and edges of cover plate should be bent downwards so as to avoid entry of water through the cover plate gasket. The width of bend plate shall be 25 mm min. The top cover shall have no cut at point of lifting lug. The rectangular/ hexagonal tank shall be fabricated by welding at corners.

6.6.2 In rectangular shape tanks, horizontal or vertical joints in tank side walls and its bottom or top cover will be not allowed. Only one vertical joint will be allowed in round shape tank and only two joints are allowed in hexagonal /elliptical shape tank. In addition the cover of the main tank shall be provided with an air release plug.

Side wall thickness : 3.15 mm. (min.)

Top and bottom plate thickness : 5 mm. (min.)

6.6.3 Reinforced by welded angle 50X50X5 MM on all the outside walls on the edge of tank to form two equal compartments. The permanent deflection is not more than 5mm up to 750 mm length and 6mm up to 1250 mm length when transformer tank without oil is subject to air pressure of 35 KPa above atmospheric pressure for 30 min. Pressure test shall be performed carefully at the time of 1st stage inspection only to confirm the adequacy of reinforcement angle and gauge of the tank and certified by E.E.(IW).

6.6.4 All welding operations to be carried out by MIG process.

6.6.5 **Lifting lugs : 2 nos.** welded heavy duty lifting lugs of MS plate of **8mm** thickness suitably reinforced by vertical supporting flat of same thickness as of lug welded edgewise below the lug on the side wall, up to reinforcing angle. They shall be so extended that cutting of bend plate is not required. **2 nos** welded heavy duty lifting lugs of MS plate of 8 mm thickness should be top plate of the transformer.

6.6.6 **Pulling lugs : 4 nos.** of welded heavy duty pulling lugs of MS plate of **8mm** thickness/pulling holes in the base channel shall be provided to pull the transformer horizontally.

6.6.7 **Top cover fixing bolts:** GI nut bolts of 3/8” dia. with one plain washer shall be used for top cover fixing, spaced at 4” apart. 6mm neoprene bonded cork/nitrile rubber bonded oil resistance gaskets conforming to type B/C IS 4253 Part-II amended up to date will be placed between tank and cover plate.

6.6.8 **Vertical clearance:** - The height of the tank shall be such that minimum vertical clearance up to the top cover plate of 120 mm is achieved from top yoke.

6.7 Heat Dissipation:

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

6.8 Total Minimum Oil Volume:

| Sr.No. | KVA rating | Oil in liters (exclusive of oil absorbed in core & coil assembly) |
|--------|------------|---|
| | | 11 kV/ 22 kV |
| 1. | 25 KVA | 100 Liters minimum |

Note: The firm should maintain the oil volume in all supplied transformers as mentioned above.

7.0 **Conservator: No conservator tank is required for 25 kVA transformers.**

8. **Breather:** No breather is required for 25 kVA transformers.

9.0 Terminals :

9.1 Brass rods 12 mm. dia. for HT with necessary nuts, check-nuts and plain thick tinned washer.

- 9.2 Tinned copper rods 12 mm dia. for LT extension as shown in the drawing for cable lug connections, with necessary nuts, check nuts and plain thick tinned washers.

10.0 Bushings & Connections:

- 10.1 For 11 kV (HV side), 12 kV Porcelain Bushing shall be used and for 433 volts (LV side), 1.0 kV Porcelain Bushing shall be used. Bushings of the same voltage class shall be interchangeable. The HV /LV Bushings assembly shall be as per relevant IS:3347 amended up to date. Porcelain part of the LV bushings shall be as per IS:3347 and Porcelain part of the HV bushings shall be as per IS 8603 (part I & III)-1977 (for heavily polluted atmosphere). The rated values, performance requirements & tests for HV/LV Bushings shall be in accordance with IS 2099-1986. The Clamping arrangement of 12 kV porcelain Bushings shall be accordance with IS: 4257 (part I)-1981.
- 10.2 HV Bushings shall be mounted on top cover of the transformer and LV Bushings shall be fixed on tank body at equidistance throughout on opposite side of HV Bushings. However, in case of Round/ Hexagonal/Elliptical shape tanks, the HV Bushings shall be mounted on top cover of the transformer and LV Bushings shall be fixed on tank body at equidistance throughout on opposite side of HV Bushings.
- 10.3 HV bushings shall be mounted on sheet metal pocket, in such a way that all H.V. Bushings shall be tilted to maintain required external air clearances. Bushings having type tested, as per relevant IS amended up to date shall only be acceptable.
- 10.4 The minimum creepage distance for all the bushings shall not be less than 25 mm per kV.

11.0 Internal connections:

11.1 H.V. Winding :

- i. In case of H.V. winding all jumpers from winding to bushing shall have cross section larger than winding conductor.
- ii. Inter coil connection shall be by crimping and brazing.
- iii. In case of Copper Winding Delta joints shall be with crimping and Brazing only.
- iv. Lead from delta joint shall be connected to bushing rod by brazing only.

11.2 L.V. Winding:

- i. L.T. Star point shall be formed of Copper flat of sufficient length. Lead from winding shall be connected to the flat by crimping and brazing.
- ii. Firm connections of L.T. winding to bushing shall be made of adequate size of 'L' shaped flat. Connection of L.T. Coil lead to 'L' shape flat shall be by crimping and brazing. Alternatively 'L' shape lug of adequate capacity effectively crimped shall be acceptable.
- iii. 'L' shape flat/lug shall be clamped to L.V. Bushing metal part by using nut, lock-nut and washers.
- iv. For copper winding crimping and silver brazing alloy shall be used.

12.0 Tank base channel :

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

13.0 Protection:

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

13.1 The transformers shall have the following CSP features:

a. Internal HV Fuses on the HT side of transformers:

Specification for HT Fuses:

Expulsion /any other suitable fuse placed in series with primary winding. This fuse is mounted normally inside of the primary bushing and is disconnected to high voltage winding through a terminal block. This has to protect that part of electrical distribution system, which is ahead of the distribution transformers from faults, which occurs inside the distribution transformers i.e. either the winding or some other of the transformer. The blowing characteristics of the fuse and LT beaker shall be coordinated that the fuse shall not blow for any faults on the secondary side of the transformer and these faults shall be cleared by the LT breaker only. The time current characteristics and co-ordination with HV fuses shall be submitted alongwith the offer.

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

i. LT Circuit Breaker:

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

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

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

The circuit breaker may be an electro-mechanical device with three elements viz. (a) temperature sensing (b) latching and tripping and (c) current interrupting. The temperature sensing function might be accomplished through the use of bimetallic strips which would be built into breaker, such that load current of the transformer flows through them. In addition to this, a magnetic tripping device is to be provided for increasing the opening speed of the breaker under high fault conditions. The circuit breaker shall be mounted inside of the transformer so that these bimetallic strips are within the top oil layer of the transformer. The latching and tripping functions of the circuit breaker may be carried out within assembly similar to those used in industrial type air circuit breaker. The circuit breaker shall also be closed and opened manually standing on ground and with a magnetic trip device also. The current interruption element shall consist of copper current carrying parts plus a set of copper tungsten current interrupting contacts the magnetic element increase the opening speed of the circuit breaker under high fault current conditions. The response of circuit breaker to the activity shall remain unchanged by the addition of the magnetic trip element. The specification to which the breakers conform shall be indicated.

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

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

ii. Load Management Signal Light :

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

The LT circuit breaker shall have a set of auxiliary contacts built-in for signal light operation. These, normally open contacts, shall form part of the signal light circuit. The signal light circuit shall consist of an auxiliary transformer winding (one or two turns) which generates about 4V, for the signal light contact set within the circuit breaker, and the signal light is mounted on the transformer tank. The signal light contact set is mechanically connected to the main circuit breaker latching and bimetal system. The signal light mechanism is adjusted so that the signal light contacts will close at a pre-set thermal condition, which occurs before the main latching system opens the main contact. The net result is a visual external indication that a pre-set load condition has reached by the transformer. The signal light mechanism does not reset itself when the load drops off, the signal light remains lighted once the signal light contact closes and can only be turned off by manually operating the external circuit breaker handle.

14.0 Lightning Arrestors:

The Lightning Arrestors (Disconnecter type) of high surge capacity of 9 kV(Vrms), 5 kA(8/20 micro wave shape) for 11 kV class transformers and 18 kV(Vrms), 5 kA (8/20 micro wave shape) for 22 kV transformers conforming to IS: 3070/1974 shall be mounted on the HV bushings of transformer, clamped securely to the tank, to protect the transformer and associated line equipment from the occasional high voltage surges resulting from lightning or switching operations. The earthing terminal of the lightning arresters shall be grounded separately.

15.0 Terminal Marking Plates and Rating Plates:

Terminals shall be provided with terminal marking plates. The transformer shall be provided with riveted rating plate of minimum 18 SWG aluminum anodized material sheet in a visible position. The entries of the rating plate shall be indelibly marked (i.e. by etching, engraving or stamping).

Marking as 'M.S.E.D.C.L'S and 'Sr. No.' of transformer shall be engraved on transformer main tank below L.T. bushings.

The name of the company, order No., capacity, month and year of manufacturing shall be engraved on the tank of transformer just below the nameplate clearly visible. The engraving can be done on separate plate which shall be firmly welded to main tank and shall form integral part of the tank.

16.0 Fittings

The fittings on the transformers shall be as under:

| | | |
|---|--------------------------|-------|
| 1 | Rating and diagram plate | 1 no. |
|---|--------------------------|-------|

| | | |
|----|---|--|
| 2 | Earthing terminals with crimping lugs. | 2 nos. |
| 3 | Lifting lugs (2 nos for transformer tank top plate & 2 nos of transformer tank | 4 nos. |
| 4 | Thermometer pocket | 1 no |
| 5 | Oil Indicator on tank | 1 no |
| 6 | Platform mounting channel with suitable holes | 2 nos |
| 7 | HT & LT Bushing | 3 nos. of 12 kV HT Bushing for 11 kV and 24 kV for 22 kV transformers and 4 nos. of LT Bushing (1.1kV) shall be provided. Each Bushing (HV & LV) should be provided with 3 nos. of brass nuts and 2 plain brass washer. |
| 8 | Pulling lugs | 4 nos |
| 9 | HV fuse | 3 nos |
| 10 | Signal Light | 1 nos |
| 11 | Metal Oxide Lightning Surge Arrestor with Disconnecter. | 3 nos |

17.0 Transformer Oil

Transformer oil to be used in all the Distribution transformers shall comply with the requirements of latest IS 335/1983 amended up to date thereof. In addition the oil should conform to 'Ageing Characteristics' specified below for New Oil and Oil in Transformers. Type test certificates of oil being used shall be produced to EE (IW) at the time of stage inspection.

New oil - Ageing characteristics after accelerated ageing test 96 hrs at 115° C (open beaker method with copper catalyst):

i. Specific Resistance (Resistivity)

a) at 20 ° C :- 2.5×10^{12} Ohm-Cm (Min)

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

ii Dielectric dissipation factor - 0.20 (Max .tan delta) at 90 ° C.

iii Total acidity mg/KOH/gm - 0.05 (Max)

iv Total sludge value (%) by weight - 0.05 (Max.)

v The method of testing these aging characteristics is given in Appendix - C of IS 335 amended up to date.

vi. Oil filled in Transformers:

The important characteristics of the transformer oil after it is filled in the transformer (within 3 months of filling) shall be as follows: -

| Sr.No. | Characteristics | Specifications |
|--------|---|----------------------|
| 1. | Electric Strength (Breakdown voltage) | 30 kV (Min) |
| 2. | Dielectric dissipation factor (Tan Delta) at 90 deg.C.) | 0.01 (Max) |
| 3. | Specific Resistance (Resistivity) at 27 deg. C (ohm-cm) | 10×10^{12} |
| 4. | Flash Point, P.M. (closed) | 140 ° C (Min) |
| 5. | Inter facial tension at 27 ° C. | 0.03N/M (Min) |
| 6. | Neutralization value (total acidity) | 0.05Mg.KOH/gm (Max.) |
| 7 | Water content PPM | 33 (Max) |

18.0 Test and Inspection:-

18.1 Routine Tests:-

i. All transformers shall be subjected to the following routine tests at the manufacturer's works. The tests are to be carried out in accordance with the details specified in IS 2026 or as agreed upon between the purchaser and the manufacturer.

1. Measurement of winding resistance.
2. Ratio, polarity and phase relationship.
3. Impedance voltage.
4. Load losses.
5. No-load losses and No-load current.
6. Insulation resistance.
7. Induced over voltage withstand.
8. Separate source voltages withstand.

ii. All the routine tests shall be conducted in the suppliers' laboratory at their cost.

iii. Heat run test shall be arranged free of cost on the unit selected from the 1st lot by Executive Engineer / Authorized Representative.

iv. The calculations to confirm the thermal ability as per Clause no. 9.1 of latest IS: 2026 Part-I or equivalent International Standard shall be submitted to Executive Engineer (IW).

18.2 Challenge Testing :

The manufacturer can also request challenge testing for any test based on specification and losses. The challenger would request for testing with testing fees. The challenge test fees are proposed at least three times the cost of testing. This is likely to deter unnecessary challenges. The challenger would have the opportunity to select the sample from the store and any such challenge should be made within the guarantee period. The party challenged, challenger and the utility could witness the challenge testing.

The challenge testing would cover following tests:

1. Measurement of magnetizing current.
2. No load losses test.
3. Load losses test (at 50 % loading or as per acceptance test).
4. Temperature rise test.

The challenge test could be conducted at NABL Laboratory, like ERDA and CPRI. If the values are within the limits the products gets confirmed else not confirmed. No positive tolerances in losses is permitted. If the product is not confirmed the manufacturer would pay the challenge fee and challenger would get the fee refunded. However as a redressal system the challenger would be allowed to ask for fresh testing of two or more samples from the store and the same be tested in NABL Laboratory in presence of party challenge, challenger and the utility.

If any one of the above sample does not confirm the test, then the product is said to have failed the test. In such cases the manufacturer will be declared as unsuccessful manufacturer for the said product with wide publicity and would not allow to complete in tenders of the MSEDCL for the period of three years and heavy penalty would be imposed.

19.0 Type Tests:-

19.1 In addition to routine test as above Impulse voltage Withstand test and Dynamic Short Circuit Test as under shall be successfully carried out at laboratories accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with IS 2026/1977 as amended from time to time and technical specifications, within the last 5 (five) years prior to the date of offer. The bidder shall furnish the following type tests reports (along with General arrangement drawing, Rating and Diagram Plate and Internal Constructional drawing) along with the offer.

- i. Impulse Voltage with stand Test shall be carried out as per Clause No. 13 of IS 2026 (Part-III)/81 on all three HV phases chopped on tail. Impulse Voltage shall be 75 kVp & 125 kVp for 11 kV and 22 kV class transformers respectively.
- ii. Dynamic Short circuit Test

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

- i. If above tests are carried out beyond 5 years
- ii Impulse Voltage Withstand test and Dynamic Short Circuit test carried out not from NABL approved Laboratory.
- iii If there is any change in the design/ type of old type tested transformers to be offered against this specification.

Note: However, In that case successful bidders have to carry out the type tests at the laboratories accredited by NABL before commencement of supply at their own expense on the sample drawn by the purchaser from the lot offered for first Stage Inspection.

- 19.3 The following balance type test should be carried at the manufacturer's works invariably in the presence of M.S.E.D.C.L's representative at the time of inspection from the first lot.
- i. Temperature Rise Test
 - ii Air pressure test as per clause no. 22.5 of IS:1180 (Part I)/1989
 - iii Unbalanced current test – unbalanced current should not be more than 2% of full load current.
- 19.4 The type test reports should be get approved from the Chief Engineer (Stores) before commencement of supply of transformers.
- 19.5 In respect of the successful bidder, the purchaser reserves the right to demand repetition of some or all the type tests in presence of the purchaser's representative. In case the unit fails in the type tests, the complete supply shall be rejected. The bidders are therefore requested to quote unit rates for carrying out each type test, which however, will not be considered for evaluation of the offer.

20.0 Drawings :-

- 20.1 A set of following drawings with all dimensions shall be submitted by the Bidder along with the offer:
- i. General Dimensional drawing.
 - ii Core Assembly drawing.
 - iii Internal Construction Drawing
 - iv Rating & Diagram Plate Drawing.
 - v HV/LV Bushings indicating measurement of creepage distances.
 - vi Operation and Maintenance Manual.
- 20.2 The drawings shall be of A-3 (420 x 297 mm) size only. The bidder should also supply along with his offer the pamphlets/literatures etc. for fittings / accessories.
1. The successful Bidders shall submit complete set of Drawings (as listed in Cl.No.20.1) of transformer in triplicate indicating dimensions to CE (Stores) for approval and get approved it before offering 1st stage inspection.
- 20.3 The bidder should not change design once offered as per A/T, Approved drawings and Type Test Reports.

21.0 Rejection :-

- 21.1 Apart from rejection due to failure of the transformer to meet the specified test requirements the transformer shall be liable for rejection on any one of the following reasons.
- i. Load loss exceeds the values mentioned in Cl.. No.6.3 above.
 - ii. Impedance voltage value exceeds the Guaranteed value plus tolerances as mentioned at Cl..No.6.5 above.
 - iv Type test are not carried out as per clause no. 19 of the specification.
 - v. Drawings are not submitted as per clause no. 20.1 of the specification.

vi. GTP not submitted as per clause no. 23 of the specification.

vii Heat dissipation calculation sheet are not submitted as per clause no.6.8 of the specification.

22. Cleaning and Painting.

- i. The surface of the tank shall be properly pre-treated / phosphated in a seven tank process and shall be applied with a powder coating of 40 micron thickness. The powder coating shall be of Aircraft Blue colour (shade No. 108) for transformers. Powder coating shall be suitable for outdoor use. The seven tank process facility shall be enhance to ensure proper quality for outdoor application.
- iii. The month and year of supply shall be painted in Red Bold Marathi language at two places, one on conservator and other at sum conspicuous place on the transformer which shall be clearly visible from the ground.

23. Guaranteed Technical Particulars:

The bidder should fill up all the details in GTP parameter list, the statement such as “as per drawings enclosed”, “as per MSEDCL’s requirement” “as per IS” etc. shall be considered as details are not furnished and such offers shall liable for rejection.

24. Testing facility

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

25. Submission Routine Test Certificate

a. The successful bidder shall submit the routine test certificate along with documentary evidence for having paid the Excise Duty for the following raw materials viz. Oil, copper, Aluminium for conductors, insulating materials, core materials, bushings at the time of routine testing of the fully assembled transformer.

b. Instruction and operation Manual

The successful bidder shall be required to submit 5 copies of instruction and Operation manual for each lot of 100 Transformers (or part thereof) supplied. This instruction manual should give complete details about the pre-commissioning tests/checks and the details of preventive maintenance etc.

26 Stage Inspection :-

- 26.1 Supplier shall give 15 days’ advance intimation to the Chief Engineer (Stores) and S.E. (Store/Adm) to organize stage inspection in which assembly of core, windings and other core materials etc. would be inspected. In respect of raw materials such as core stamping, winding conductor, oil etc. successful bidder shall use these materials manufactured/supplied by the standard manufacturers and furnish the manufacturer's test certificates, as well as, proof of purchase from those manufacturers documentary evidence for having paid the excise duty for the information of the department.
- 26.2 Chief Engineer (Stores) will depute representatives from testing and inspection wing at the time of stage inspection.
- 26.3 10 % of the transformers from the offered lot will be tested for acceptance tests at factory, in the presence of purchaser's representative before dispatch.

- 26.4 The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representatives at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications and shall not prevent subsequent rejection if the equipment is found to be defective.
- 26.5 The purchaser may at its option, open a transformer supplied to the Stores, in presence of supplier at site or at Stores. If any of the technical particulars are seen to be in variance than the guaranteed technical particulars, the whole lot of transformer will be rejected without any liability on purchaser.
- 26.6 In addition to the above, the purchaser may pick up any transformer and decide to get it type tested from any laboratory accredited by NABL at purchaser's cost. The Bidder will have to organize packing of the transformer at company's Stores for which they will be paid necessary charges. If the transformer fails to meet the requirement of type tests, the quantity of transformers ordered on them will be forthwith rejected and the purchaser may purchase these transformers at the risk and cost of the supplier.

27. Testing of all Distribution Transformers for no load and full load losses

After inspection of new transformers at factory for acceptance of the lot, all distribution transformers from the lot will be tested for no load and full load losses at all stores. Tenderer has liberty to be present at the time of testing.

28. Random Sample Testing (RST)

The tenderer should intimate to C.E. (Stores), M.S.E.D.C.L of completion of dispatches of whole lot of Distribution Transformers to stores against this tender. C.E. (Stores), M.S.E.D.C.L for will select the stores for Random Sample Testing (RST) and depute E.E. (Testing) to carry out RST of the lot.

E.E. (Testing) will select a transformer from the lot of transformers already tested for No load & full load losses. 15 days advance intimation will be given to tenderer for joint inspection. The date of RST will not be altered to the convenience or request of supplier. If supplier's representative fails to attend on the date fixed for RST, the RST will be carried out in his absence and results of RST will be binding on supplier. In case the selected transformer fails in any of the tests, complete lot of transformers will be rejected.

29. Inspection & Testing of Transformer Oil:

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

30. Quality Assurance

- 30.1 The bidder shall invariably furnish following information along with the offer failing to which the offer will be rejected.
- 30.2 Certificates of following materials.
- i. Copper conductor
 - ii. Transformer oil
 - iii. Core

iv. Insulating paper.

v. Porcelain Bushings

vi Steel Plate used for Tank

- 30.3 Names of the supplier for the raw material, list of standard accordingly to which the raw materials are tested, list of test normally carried out on raw materials in presence of bidder's representatives, copies of type test certificates.
- 30.4 Information and copies of test certificate as in (i) above respect of bought out accessories including terminal connectors.
- 30.5 List of manufacturing facilities available. In this list the bidder shall specifically mention whether lapping machine, vacuum drying plant, air conditioned dust free room with positive air pressure for provision of insulation and winding etc are available with him.
- 30.6 Level of automation achieved and list of areas where manual processing still exists.
- 30.7 List of areas in manufacturing process where stage inspection are normally carried out for quality control and details of such tests and inspections.
- 30.8 Special features provided in the equipments to make it maintenance free
- 30.9 List of testing equipment available with the bidder for final testing of transformers and test plant limitation, if any, vis-à-vis the type, special acceptance and routine tests specified in the relevant standards and the present specification.
- 30.10 The successful bidder shall submit the Routine Test Certificate along with documentary evidence having paid for the excise duty for the following raw materials viz Oil, Copper for conductors, insulating materials, Core materials, Bushing at the time of routine Testing of the fully assembled transformer.

31.0 Qualifying Requirement: AS PER TENDR CLAUSE

32. Final Inspection

10 % of the transformers offered will be tested for all tests without opening the transformer. Heat Run Test will have to be carried out on the transformer having maximum no load and full load losses taken together. **Chief Engineer (Stores) will depute representatives from testing and inspection wing at the time of Final inspection.**

33. Performance Guarantee:

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

34. COST DATA SHEET:-

The bidders shall submit the cost data sheets indicating the break up prices and quantity of each raw material and components along with the unit rates required for manufacture the offered transformers along with the offer. The cost data sheet format is enclosed herewith.. If the rates quoted are not

justified with the cost data sheets, the offer shall not be considered for evaluation and placement of the order.

The cost data sheets shall be scrutinized by CPA section.

| FORMAT FOR COST DATA | | | | | |
|--|------------------------------------|---------|----------------|----------|--------------|
| ITEM ----- KVA , ----- KV DISTRIBUTION TRANSFORMER | | | | | |
| Sr. No. | PARTICULARS | UNIT | UNIT RATES Rs. | QUANTITY | AMOUNT (Rs.) |
| 1 | CORE (M4) | KG | | | |
| 2 | Super enameled Copper(HV Winding) | KG | | | |
| 3 | COPPER WITH DPC (LV Winding) | KG | | | |
| 4 | INSULATION PAPER | METER | | | |
| 5 | OIL | LTRS | | | |
| 6 | TANK | KG | | | |
| 7 | CHANNELS | KG | | | |
| 8 | INSULATORS/BUSHINGS | NO | | | |
| 9 | OTHERS | LUMPSUM | | | |
| | | | | TOTAL | |
| | WASTAGE @ % | | | | |

35 Schedules

35.1 The bidder shall fill in the following schedules which form part of the tender specification and offer. If the schedules are not submitted duly filled in with the offer, the offer shall be rejected.

Schedule `A' -Guaranteed Technical Particulars.

Schedule `B' – Tender's Experience

35.2 The discrepancies between the specification and the catalogs, Literatures and indicative drawings which are subject to change, submitted as part of the offer, shall not be considered and representation in this regard will not be entertained.

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

35.4 The Bidder shall submit the list of orders for similar type of equipments, executed or under execution during the last three years, with full details in the schedule of Tenderer's experience (Schedule 'B') to enable the purchaser to evaluate the tender.

Annexure I

Air Pressure Test

Name of Supplier:

Order No.:

Capacity & Voltage Ratio of Distribution Transformer : _____ kVA, ____/0.433 kV

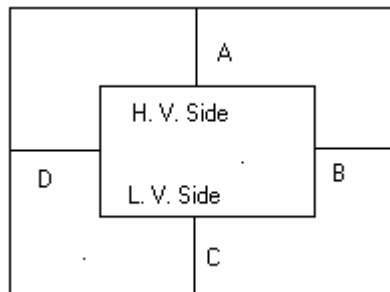
Vector Group Dyn11

Sr. No. of equipment Tested:

Date of Testing:

Reference Standard

All the opening of the transformer tank were closed with suitable gasket, bushing, valves and plugs. The compressor pipe connected at oil filling hole on conservator and a pressure gauge was fitted at air vent plug. The parallel string were places around the tank, the distance between string and tank as shown in following diagram were recorded before applying the pressure and after releasing pressure.



Tank Thickness: Side _____ mm. Top & Bottom _____ mm

Test Pressure: _____ kg/cm² applied for 30 Minutes.

| Test Point | Distance before Test In mm | Distance after release of Pressure in mm | Deflection In mm |
|------------|-------------------------------|---|---------------------|
| A | | | |
| B | | | |
| C | | | |
| D | | | |

Permanent Deflection : _____ mm. Permissible Limit of Permanent Deflection as per Specification : _____ mm

Test witnessed by

Tested by

Annexure II

Unbalance Current Test

Name of Supplier:

Order No.:

Capacity & Voltage Ratio of Distribution Transformer : _____ kVA, ____/0.433 kV

Vector Group Dyn11

Sr. No. of equipment Tested:

Date of Testing:

Reference Standard

Transformer Secondary terminals 2U, 2V & 2W are shorted. The shorted 2U, 2V & 2W is connected to 2N through Ammeter. The primary terminals 1U, 1V & 1W are connected to supply. The rated current _____ A is fed to primary and unbalance current is noted on Ammeter.

Unbalance Current Measured in Ammeter : _____ A

Rated current in Secondary Side : _____ A

Permissible limits as per specification : 2% of the Rated current in Secondary Side

% of Unbalance current with reference to Rated current in Secondary Side

$$= \frac{\text{Unbalance Current} \times 100}{\text{Rated current in Secondary Side}}$$

=

=

Test witnessed by

Tested by

| | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

Reduced to Rated Current _____ amps

| | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

Calculation of Temperature Rise in Winding

LV Winding : Since the resistance of LV winding is less than 0.005 ohm, Temperature Rise in LV Winding is taken as temperature rise of oil as per clause no. 4.3 of IS:2026 (Part II)/1977

Temperature Rise in LV Winding = _____ °C

HV Winding Resistance across 1U1V at _____ °C = _____ ohm

Measurement of Hot Resistance of HV Winding after Shut Down.

| Time | Resistance |
|------|------------|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

Hot winding Resistance at Ambient Temperature _____ °C (from graph) = _____ Ohm

Temperature Rise in H. V. Winding is

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

=

=

Results :

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

Test witnessed by

Tested by

Schedule `A'

GUARANTEED TECHNICAL PARTICULARS

As indicated in E-Tendering GTP Parameter

SCHEDULE - "B"

TENDERER'S EXPERIENCE

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

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

NAME OF FIRM _____

NAME & SIGNATURE OF TENDERER _____

DESIGNATION _____

DATE _____

Revision: 2

Date: 21/07/2009

Schedule 5 – Distribution Transformer

Technical Specifications - Distribution Transformer

1.0 Scope

- 1.1 This standard specifies the requirements for participating in the pilot energy labeling scheme for oil immersed, naturally air cooled, three phase, and double wound non sealed type out door distribution transformer.
- 1.2 The referred Indian Standard are IS 1180 (part I) Out door type three- phase Distribution transformers upto and including 200 kVA, 11 kV – specification, IS:2026 (part 2) Specifications of power transformers – for Temperature-rise and IS :2500 (part-I) -2000: Sampling Schemes indexed by Acceptance Quality Limit (AQL) for lot-by-lot inspection.
- 1.3 The standard ratings covered under the pilot energy labeling scheme is 16, 25, 63, 100, 160 and 200 kVA and non standard ratings from 16 kVA to 200 kVA.

2.0 Schedule of Tests:

2.1 Method of Tests:

The testing code and procedure for distribution transformer would be as per IS 1180 (part 1): 1989 with all amendments as of date. The exception is conditions on limits of temperature rise. For the scheme the following would be used. Reduce the temperature rise limits of top oil and transformer winding from the existing IS 1180 (part 1): 1989 level of 45^o C & 55^o C to 35^o C & 40^o C.

2.2 Parameters to be tested:

Parameters for initial testing the type test parameters set out in IS 1180 (part 1) and the same is reproduced below:

- a. Measurement of winding resistance [IS 2026 (part I):1977]
- b. Measurement of voltage ratio and check of voltage vector relationship [IS 2026 (part I):1977]
- c. Measurement of impedance voltage/short circuit impedance and load loss [IS 2026 (part I):1977]
- d. Measurement of no-load loss and current [IS 2026 (part I):1977]
- e. Measurement of insulation resistance [IS 2026 (part I):1977]
- f. Induced over-voltage withstand test [IS 2026 (part 3):1981]
- g. Separate-source voltage withstand test [IS 2026 (part 3):1981]
- h. Lightning impulse test [IS 2026 (part 3):1981]
- i. Temperature-rise test [IS 2026 (part 2):1977]
- j. Short-circuit test [IS 2026 (part I):1977]
- k. Air pressure test [IS 1180 (part 1): 1989]
- l. Permissible flux density and over fluxing [IS 1180 (part 1): 1989]

Parameters for verification & challenge testing are as follows:

- a. Measurement of winding resistance [IS 2026 (part I):1977]
- b. Measurement of impedance voltage/short circuit impedance and load loss [IS 2026 (part I):1977]
- c. Measurement of no-load loss and current [IS 2026 (part I):1977]
- d. Temperature-rise test [IS 2026 (part 2):1977]

3.0 Tolerances:

No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% & 100% loading values.

4.0 Star rating plan:

4.1 Basis:

The existing efficiency or the loss standards are specified in IS 1180 (part 1). This standard defines load losses and no load losses separately. For the BEE labeling programme total losses at 50% and 100% load have been defined.

The highest loss segment is defined as star 1 and lowest loss segment is defined as star 5. The existing IS 1180 (part 1) specification losses are the base case with star 1. The basis for star rating plan is as follows:

| Case | Basis of losses (Total at 50% Load Condition) |
|------------------|--|
| Base case Star 1 | Current purchasing practice (IS 1180 (part 1)Max Losses) |
| Star 2 | Some utility purchase specs like AP, NDPL |
| Star 3 | Losses from TOC design (Moderate) |
| Star 4 | Losses from lowest TOC design |
| Star 5 | High efficiency design |

4.2. Star Rating plan:

The total losses at 50% and 100% loading shall not exceed the values given below:

| Rating | 1 star | | 2 star | | 3 star | | 4 star | | 5 star | |
|--------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|
| | Max Losses at 50% (Watts) | Max Losses at 100% (Watts) | Max Losses at 50% (Watts) | Max Losses at 100% (Watts) | Max Losses at 50% (Watts) | Max Losses at 100% (Watts) | Max Losses at 50% (Watts) | Max Losses at 100% (Watts) | Max Losses at 50% (Watts) | Max Losses at 100% (Watts) |
| 16 | 200 | 555 | 165 | 520 | 150 | 480 | 135 | 440 | 120 | 400 |
| 25 | 290 | 785 | 235 | 740 | 210 | 695 | 190 | 635 | 175 | 595 |
| 63 | 490 | 1415 | 430 | 1335 | 380 | 1250 | 340 | 1140 | 300 | 1050 |
| 100 | 700 | 2020 | 610 | 1910 | 520 | 1800 | 475 | 1650 | 435 | 1500 |
| 160 | 1000 | 2800 | 880 | 2550 | 770 | 2200 | 670 | 1950 | 570 | 1700 |
| 200 | 1130 | 3300 | 1010 | 3000 | 890 | 2700 | 780 | 2300 | 670 | 2100 |

For non standard rated transformer from 16 kVA upto 200 kVA which is not listed above ,the total losses at 50% and 100% loading for a given non standard rated transformer is going to be determined by the following equations :

$$Y_0 \text{ 50\%} = \left[\frac{K_{X0} - K_{X1}}{K_{X2} - K_{X1}} \right] \times \left[L_2 - L_1 \right] + M_L X_1$$

$$Y_0 \text{ 100\%} = \left[\frac{K_{X0} - K_{X1}}{K_{X2} - K_{X1}} \right] \times \left[L_2 - L_1 \right] + M_L X_1$$

Where;

K = kVA rating of the transformer

L = losses

M_L = Maximum Losses for a given star rating.

X_0 = kVA rating of the Non Standard Rating transformer

X_1 = kVA rating of the Standard rated transformer below X_0

X_2 = kVA rating of the Standard rated transformer above X_0

L_2 = Maximum Losses for a given star rating of standard rating transformer above X_0 @ a particular loading.

L_1 = Maximum Losses for a given star rating of standard rating transformer below X_0 @ a particular loading.

$M_L X_1$ = Maximum Losses of X_1 @ a particular loading for a given star rating.

5. **Qualifications:**

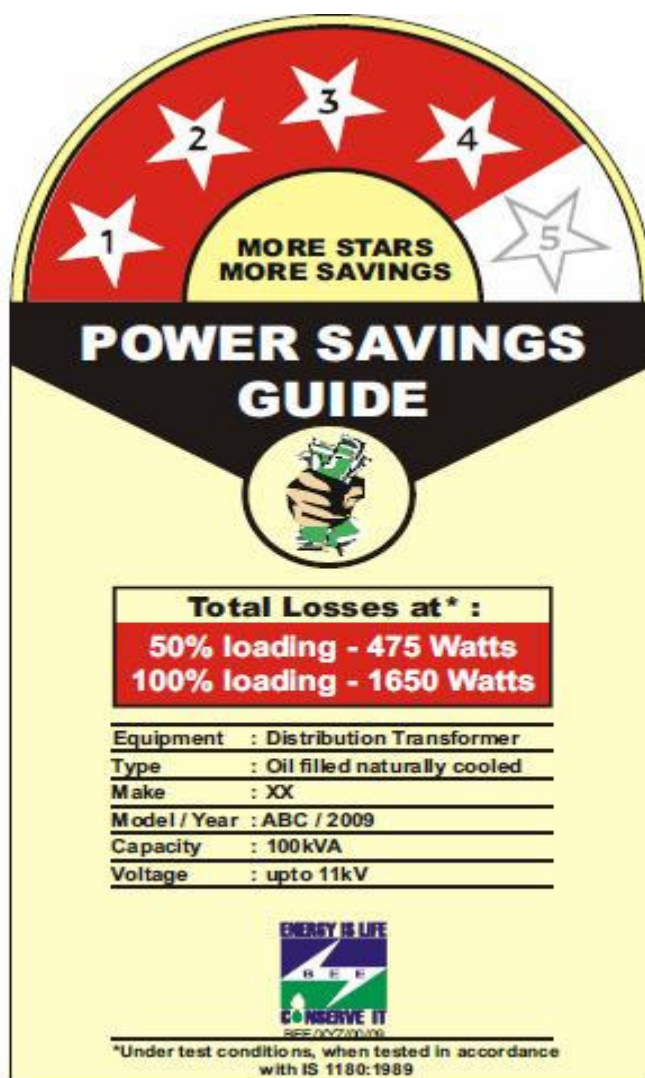
- a) The products should conform to minimum requirements of IS 1180 (part 1): 1989 to participate in BEE S&L Programme.
- b) BIS product certification or at-least, Quality Certification such as ISO -9000 should be required to participate in BEE S&L Programme.

6.0 Sampling plan:

Sampling for test checking would be carried out after the deliveries are made to the utility on the basis of tender. Sampling would be guided by IS 2500 (part-I) -2000: Sampling Schemes indexed by Acceptance Quality Limit (AQL) for lot-by-lot inspection

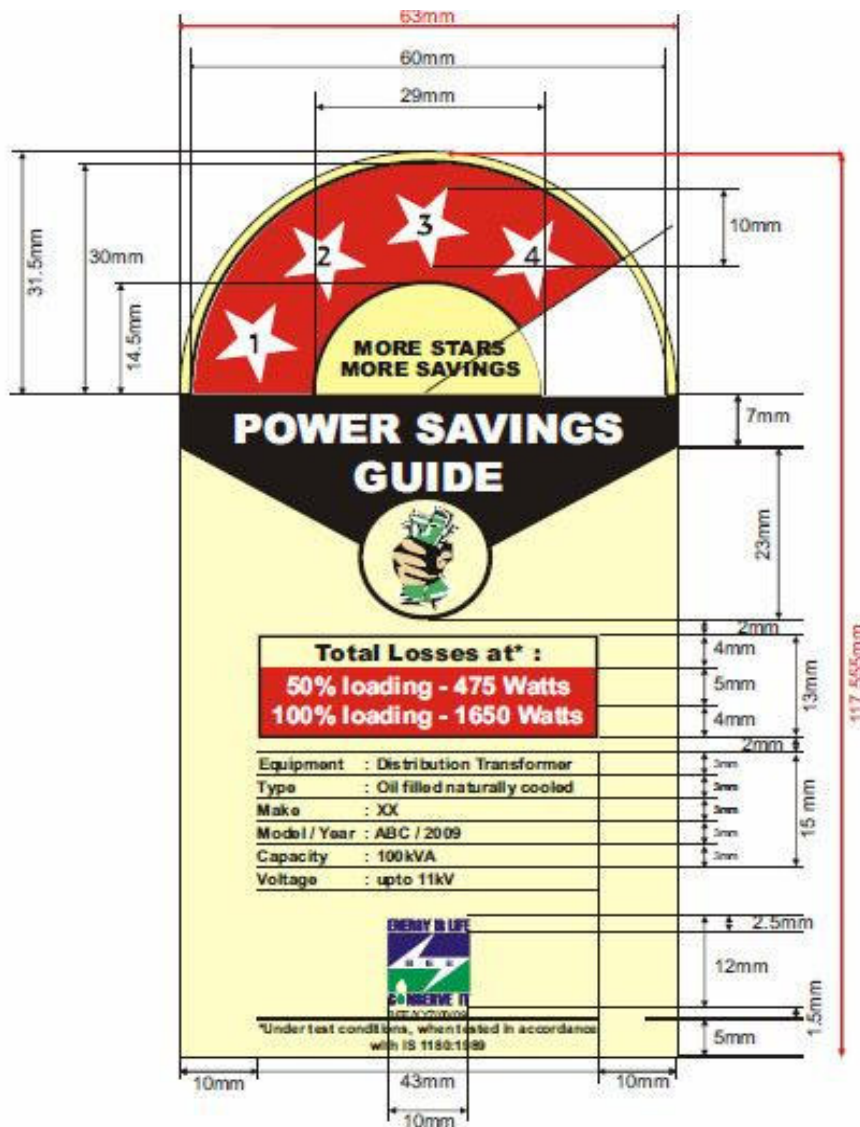
7.0 Label design, manner of display:

7.1. Detailed label specifications (size, colour scheme, font size, security features, if any, etc), content of the label (parameters displayed on the label) is provided below:

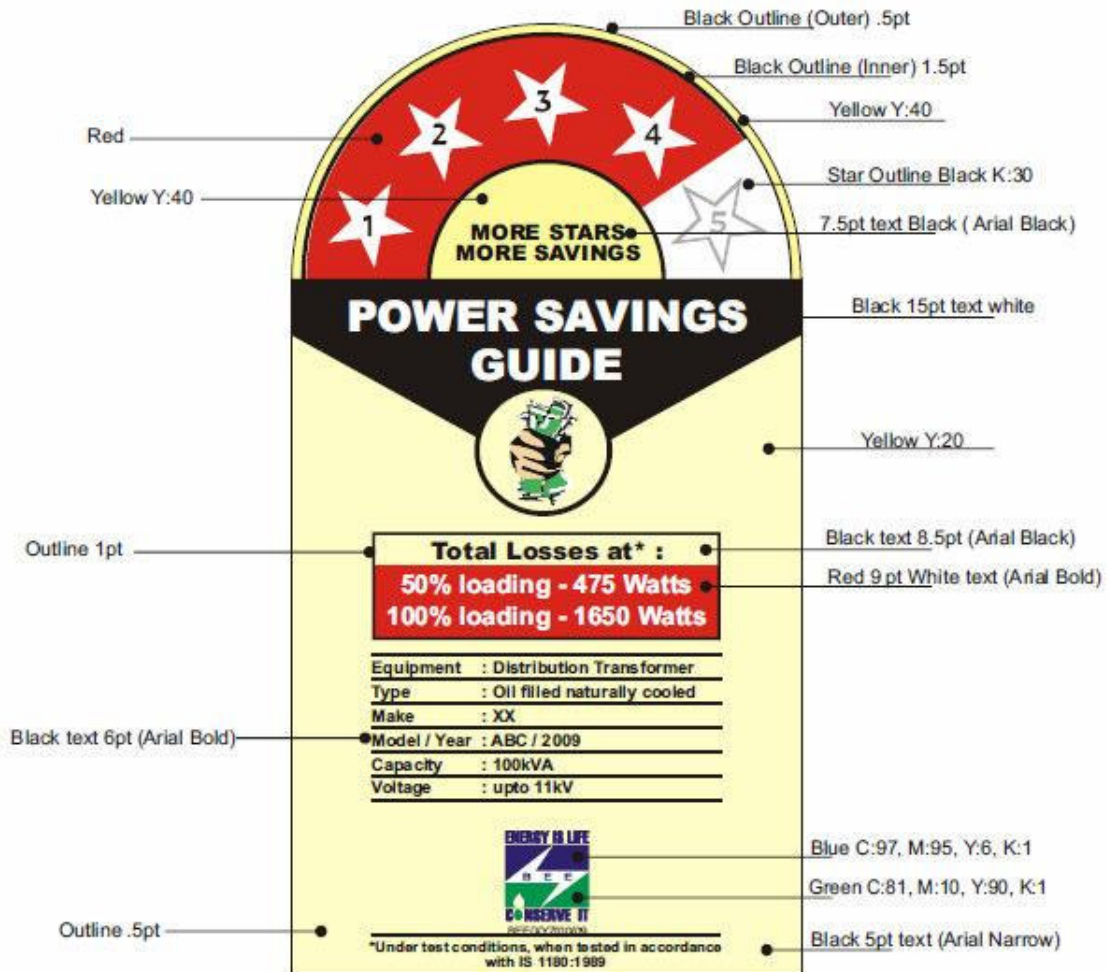


7.2. Manner of display of label:

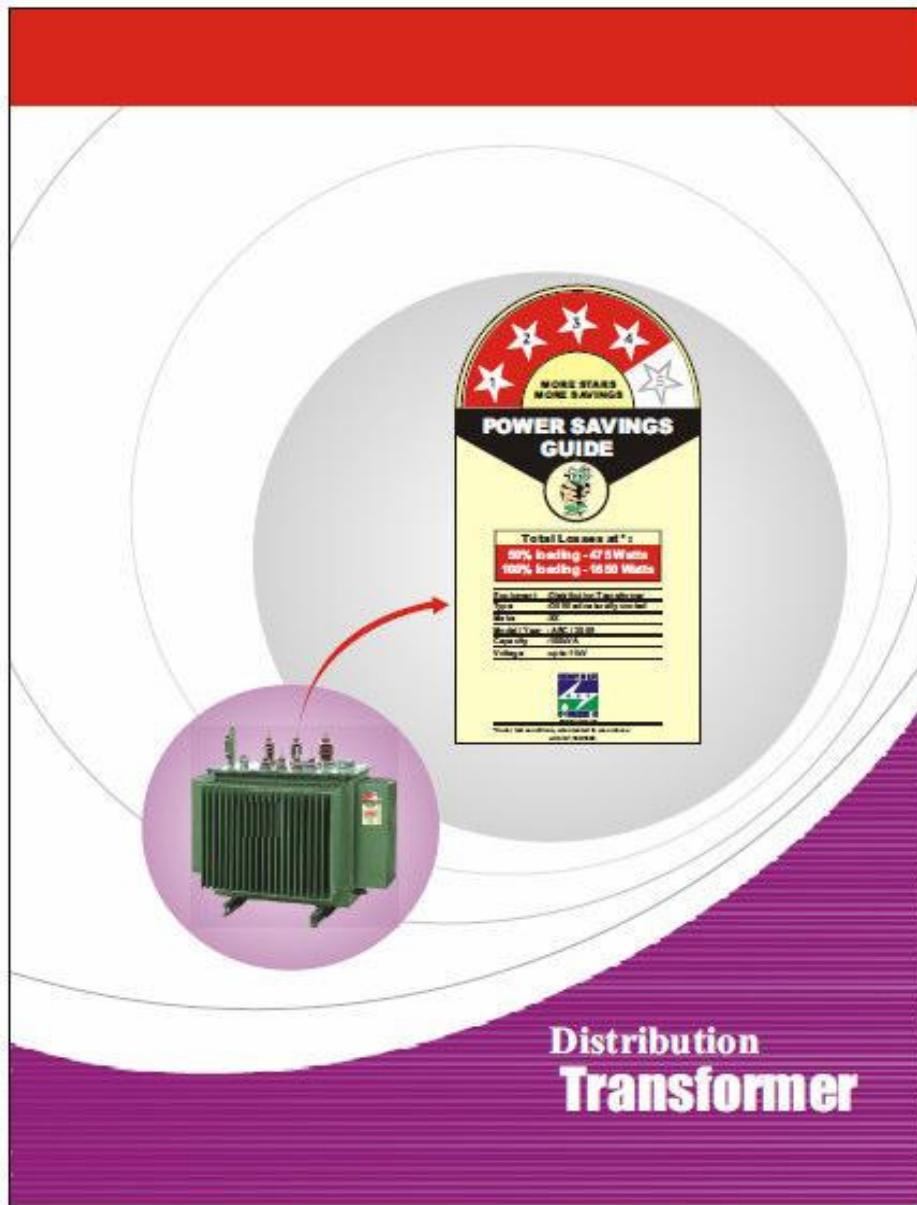
The label shall be applied on the front base of the equipment near the name plate, so as to be prominently visible on the equipment.



7.3. Colour Scheme:



Sample Picture of manner of affixing of Label:



8.0 Labelling Fees:

1. Registration fee is payable on application for authority to affix labels is Rs. 1000/-
(Rupees one thousand only)
2. Registration fee is payable on application for renewal of authority to affix labels is Rs. 500/- (Rupees five hundred only)
3. Labeling fee for affixation of label on each Distribution Transformer is Rs. 100
(One hundred rupees only).

Three Star , three phase , 25 kVA, 22 /0.433 & 11/0.433 kV Distribution Transformer with CSP feature & DTC metering

| Sr.No. | GTP Parameter | |
|--------|---|----------|
| 1 | Name of Manufacturer . | T |
| 2 | Reference Standard | T |
| 3 | Whether transformer is Oil Natural Air Natural cooled type (Yes/ No) | B |
| 4 | Whether transformer is suitable for Indoor /Outdoor installation | T |
| 5 | Rating of transformer in KVA | N |
| 6 | Primary Voltage in kV | N |
| 7 | Secondary Voltage in kV | T |
| 8 | Whether neutral is solidly earthed (Yes/ No) | B |
| 9 | Colour of transformer | T |
| 10 | Vector Group | T |
| 11 | Approximate overall length of transformer in mm | N |
| 12 | Approximate overall breadth of transformer in mm | N |
| 13 | Approximate overall height of transformer in mm | N |
| 14 | Approximate length of transformer tank in mm | N |
| 15 | Approximate breadth of transformer tank in mm | N |
| 16 | Approximate height of transformer tank in mm | N |
| 17 | Thickness of the side of transformer Tank plate in mm | N |
| 18 | Thickness of the bottom of transformer tank plate in mm | N |
| 19 | Thickness of the top of transformer tank plate in mm | N |
| 20 | Weight of Tank & fittings in kgs | N |
| 21 | Total Weight of Transformer in kgs | N |
| 22 | Type of Tank (corrugated/conventional) | T |
| 23 | Degree of slope to the top plate of Transformer. | T |
| 24 | In case of Corrugated tank, Thickness of corrugated sheet (in mm) | T |
| 25 | Type of H.V. fuse used in CSP | T |
| 26 | Rating of H.V. fuse | T |
| 27 | Rating of L.T. breaker used in CSP in volt & amps | T |
| 28 | Opening time of L.T. circuit breaker | T |
| 29 | Load management signal provided (Yes/No) | B |
| 30 | Circuit breaker reset handle enclosed in metal enclosure with lock & key arrangement (Yes/No) | B |
| 31 | Whether Time current characteristics for LT circuit breaker and HV fuse to indicate co-ordination between circuit breaker and fuse are uploaded online in the offer (Yes/No) | B |
| 32 | Name plate details are as per the requirement specified in tender. (Yes/ No) | B |
| 33 | No of radiators provided and location with arrangement | T |
| 34 | Thickness of the radiator of transformer in mm | N |
| 35 | No of radiator fins . | T |
| 36 | Total radiating surface of transformer tank in Sq. mtrs. | N |
| 37 | Core material used & its grade | T |
| 38 | Type of core | T |
| 39 | Weight of Core in kgs | N |
| 40 | No. of steps of core for CRGO core | N |
| 41 | Diameter of core in mm | N |
| 42 | Effective core area.(sq.cm) | N |
| 43 | Flux density in Tesla | N |
| 44 | Thickness of core lamination in mm | N |
| 45 | The temperature shall in no case reach a value that will damage the core itself, other parts or adjacent materials (Yes/No) | B |
| 46 | Type of connection for H.V. Winding (Delta) (Yes/ No) | B |
| 47 | Type of connection for L.V. Winding (Star) (Yes/ No) | B |
| 48 | Material of H.V. winding | T |
| 49 | Material of L.V.Winding | T |
| 50 | Insulation provided to H.V winding. | T |
| 51 | Insulation provided to L.V. winding. | T |
| 52 | Current density of H.V. winding (in Ampere/ sq.mm) | N |
| 53 | No of LV winding turns | N |

| | | |
|-----|---|----------|
| 54 | No of HV winding turns | N |
| 55 | Resistance of LV winding per phase at 20 deg C in ohms | T |
| 56 | Resistance of HV winding per phase at 20 deg C in ohms | T |
| 57 | Current density of L.V. winding (in Ampere/sq. mm.) | N |
| 58 | Clearance between Core & L.V. winding in mm | N |
| 59 | Clearances between L.V. & H.V. winding in mm | N |
| 60 | Clearances between HV Phase to Phase in mm | N |
| 61 | Clearances between end insulation to Earth in mm | N |
| 62 | Clearances between winding to tank in mm (min 30 mm)Yes/No | B |
| 63 | Weight of Aluminum in kgs | N |
| 64 | Inter layer insulation provided in H.V winding to design for Top & bottom layer | T |
| 65 | Inter layer insulation provided in L.V winding to design for Top & bottom layer | T |
| 66 | Inter layer insulation provided in between all layer in H.V winding | T |
| 67 | Inter layer insulation provided in between all layer in L.V winding | T |
| 68 | Details of end insulation | T |
| 69 | Whether wedges are Provided at 50% turns of the Coil (Yes/ No) | B |
| 70 | Insulation materials provided for core | T |
| 71 | Length of coil used for HV winding in meter. | N |
| 72 | Cross section area of the coil used for HV winding (sq.mm) | T |
| 73 | Length of coil used for LV winding in meter. | N |
| 74 | Size of strip used for LV winding in mm | T |
| 75 | No. of conductors in parallel for LV winding | N |
| 76 | Total cross section area of LV conductor in sq. mm | N |
| 77 | No. of H.V coils /phase | N |
| 78 | Thickness of locking spacers between H.V. coils (in mm) | N |
| 79 | Weight of Oil in kgs | N |
| 80 | Volume of Oil in Ltrs | N |
| 81 | Quantity of total oil absorption (in liters) in first filling | N |
| 82 | Total oil Volume including Total Oil absorption in liters | N |
| 83 | Grade of Oil used. | T |
| 84 | Name of Oil manufacturers to be supplied. | T |
| 85 | Breakdown Values of Oil at the time of first filling (kV/mm) considering 2.5 mm gap | T |
| 86 | Conservator tank to the transformer with oil level indicator (showing three levels) and drain plug is provided (Yes/ No) | B |
| 87 | Drain Valve (20 mm) provided to the transformer tank (Yes/No) | B |
| 88 | Earthing terminals with lugs is provided (Yes/No) | B |
| 89 | Lifting lugs provided (Yes/No) | B |
| 90 | Oil filling hole with cap (on conservator) is provided (Yes/No) | B |
| 91 | Thermometer pocket is provided (Yes/No) | B |
| 92 | Quantity of Silica-Gel filled in breather (in gm) | N |
| 93 | Material of HV and LV Bushings and makes thereof | T |
| 94 | Reference standard of Bushings | T |
| 95 | Rating of L.V. Bushing | T |
| 96 | Minimum Creepage Distance of HV Bushing in mm (min.25 mm per kV) | N |
| 97 | Minimum Creepage Distance of LV Bushing in mm (min.25 mm per kV) | N |
| 98 | Rating of H.V. Bushings (in kV) | N |
| 99 | Rating of L.V. Bushing (in kV, kA) | T |
| 100 | Min. External clearances of H.V. bushing terminals between ph. to ph (255 mm) | B |
| 101 | Min. External clearances of H.V. bushing terminals between ph. to earth (140 mm) | B |
| 102 | Min. External clearances of L.V. bushing terminals between ph. to ph (75 mm) | B |
| 103 | Min. External clearances of L.V. bushing terminals between ph. to earth (40 mm) | B |
| 104 | Rating of Lightning Arrestors and Make thereof | T |
| 105 | Reference Standard of Lightning Arrestors. | T |
| 106 | Maximum winding temperature rise in °C over an Ambient temp. of 50°C by Resistance Method | N |
| 107 | Maximum temperature rise of Oil in °C over an Ambient temp. of 50°C by thermometer. | N |
| 108 | Magnetizing current (No load) in Amps and its % of full load current at rated voltage referred to L.V. side. | T |
| 109 | Magnetizing current (No load) in Amps and its % of full load current at maximum voltage (112.5% of rated voltage) referred to L.V. side. | T |

| | | |
|-----|---|---------|
| 110 | Max core loss at rated voltage and rated frequency (Watts) . | N |
| 111 | Maximum Total Losses (No load + Load losses at 75°C) at 50% loading (Watts) | N |
| 112 | Maximum Total Losses (No load + Load losses at 75°C) at 100% loading (Watts) | N |
| 113 | Efficiency at 75 °C at unity P.F. at 125% load | N |
| 114 | Efficiency at 75 °C at unity P.F. at 100% load | N |
| 115 | Efficiency at 75 °C at unity P.F. at 75 % load | N |
| 116 | Efficiency at 75 °C at unity P.F. at 50% load | N |
| 117 | Efficiency at 75 °C at unity P.F. at 25% load | N |
| 118 | Efficiency at 75 °C at 0.8 P.F. lag at 125% load | N |
| 119 | Efficiency at 75 °C at 0.8 P.F. lag at 100 % load | N |
| 120 | Efficiency at 75 °C at 0.8 P.F. lag at 75 % load | N |
| 121 | Efficiency at 75 °C at 0.8 P.F. lag at 50 % load | N |
| 122 | Efficiency at 75 °C at 0.8 P.F. .lag at 25% load | N |
| 123 | Efficiency at 75 °C at 0.8 P.F. leading at 125% load | N |
| 124 | Efficiency at 75 °C at 0.8 P.F. leading at 100% load | N |
| 125 | Efficiency at 75 °C at 0.8 P.F. leading at 75% load | N |
| 126 | Efficiency at 75 °C at 0.8 P.F. leading at 50%load | N |
| 127 | Efficiency at 75°C at 0.8 P.F. leading at 25 % load | N |
| 128 | Regulation at Unity P.F (in %) | N |
| 129 | Regulation at 0.8 P.F. lag. (in %) | N |
| 130 | Regulation at 0.8 P.F. leading. (in %) | N |
| 131 | % Impedance value at 75°C | N |
| 132 | Separate source power frequency withstand test for HV for 1 minute in kv(min) | T |
| 133 | Separate source power frequency withstand test for LV for 1 minute in kv(min) | T |
| 134 | Induced over voltage withstand test for 1 min. specify voltage frequency, time for test. | T |
| 135 | Impulse test value (in kVp) . | T |
| 136 | Type test report of L.T. circuit breaker used in CSP submitted alongwith offer in physical form & soft copy | B |
| 137 | The test certificates of Aluminium/copper conductor, core , insulating paper, porcelain bushings, steel plate used for enclosure of offer transformer is enclosed along with the offer in soft copy.(Yes/ No) | B |
| 138 | All type test report of type tests carried out on transformer at NABL laboratory shall be submitted along with the offer as per cl. XXII (c) of Section (I) i.e. Instructions to tenderers. (Yes/ No) | B |
| 139 | Unbalance current test, Air pressure test and temperature rise test shall be conducted as per format enclosed with the technical specification along with the offer (Yes/ No) | B |
| 140 | All drawings shall be furnished for each offered item separately along with this offer (Yes/ No) | B |
| 141 | Oil absorption calculation sheet shall be furnished for each offered item separately along with this offer (Yes/ No) | B |
| 142 | Heat dissipation calculation shall be furnished for each offered item separately along with this offer (Yes/ No) | B |
| 143 | Flux density calculation sheet with no. of Primary & Secondary turns shall be furnished for each offered item separately along with this offer (Yes/ No) | B |
| 144 | Calculation sheet for 112.5% of Rated V/f ratio (over fluxing calculation sheet) shall be furnished for each offered item separately along with this offer (Yes/ No) | B |
| 145 | Required documents, plant and machinery, list of order executed/under execution shall be furnished for each offered item separately along with this offer (Yes/ No) | B |
| 146 | The information required under Quality Assurance shall be submitted with the offer in physical format & soft copy(Yes/ No) | B |
| 147 | The cost data in the prescribed format shall be submitted with offer in physical format & soft copy (Yes/ No) | B |
| 148 | The performance Guarantee of the transformers in years | N |
| 149 | Power frequency withstand voltage dry & wet in kV(rms) for H.V Bushing | T |
| 150 | Dry lightning Impulse withstand voltage test in kV (peak) Stating the wave form adopted for H.V. bushing | T |
| 151 | Star label shall be displayed on each supplied transformer (Yes/No) | B |
| 152 | METERING UNIT enclosure material & thickness (in mm) | Text |
| 153 | Metering Unit overall dimensions of enclosure (LXBXH) (in mm). | Numeric |
| 154 | Design & construction of metering unit is as per drawings enclosed with specification (Yes / No) | Boolean |
| 155 | First chamber provided to cover transformer L.V. bushings (Yes/ No) | Boolean |
| 156 | Type of CTs provided in the metering Unit with rating & details of | Text |

| | | |
|-----|---|---------|
| | design features | |
| 157 | CT's Class of accuracy and VA burden | Text |
| 158 | Cable size to connect CT secondary terminals to Meter & P.T. connections. | Text |
| 159 | Meter fixing arrangement is provided such that front and back as well as up and down with tilting adjustment can be done to accommodate various type & make of meter (s). (Yes/ No) | Boolean |
| 160 | Suitable space is provided to install GSM MODEM alongwith the Antenna for future communication with the meter. (Yes/ No) | Boolean |
| 161 | Inside & Outside Colour of Metering unit | Text |
| 162 | Degree of protection of Enclosure-IP-54 (Yes/No) | Boolean |
| 163 | Locking arrangement provided to cabinet as per specification (Yes/No) | Boolean |
| 164 | Size of glass window provided for Meter chamber. | Text |

115

REF. STANDARD : IS 2026-1977 & IS 1340
3 STAR RATING, 3 PHL. DISTRIBUTION TRANSFORMER

| | | | |
|-------------------------|------------------------------|-------------------|-----------|
| TYPE | OUT DOOR | TYPE OF COOLING | ONAN |
| RATED KVA | --- | OIL TEMP. RISE | 35 |
| RATED HV V | 11000 | WDG TEMP RISE | 40 |
| VOLTAGE LV V | 433 | VOLUME OF OIL | l |
| RATED HV A | --- | MASS OF OIL | kg |
| CURRENT LV A | --- | WEIGHT OF CORE | kg |
| PHASES | 3 | WEIGHT OF WDGs | kg |
| FREQUENCY Hz | 50 | TOTAL MASS | kg |
| IMPEDANCE % | --- | SERIAL NO | |
| GUARANTEED TOTAL LOSSES | WGS/100% LOSSES AT 20 DEGREE | --- | IN WATTS |
| INSULATION LEVEL | U75 AC 2B | CORE | DRGD/AMDT |
| VECTOR GROUP | DYn-11 | MONTH/YEAR OF MFG | --- & --- |
| OWNER | MSEDCL, MUMBAI. | | |
| A/T.NO. | | | |

CONNECTION DIAGRAM

VECTOR DIAGRAM

4 HOLES ø3

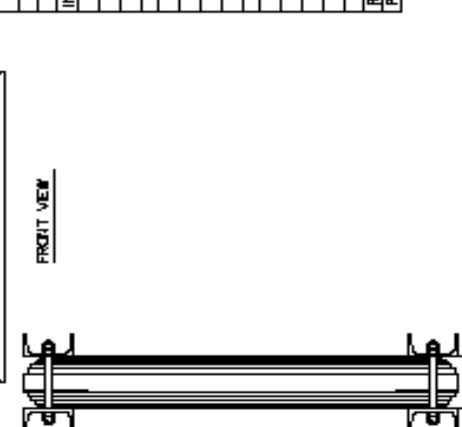
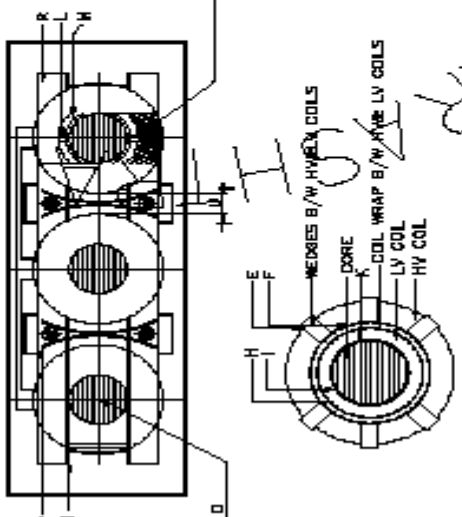
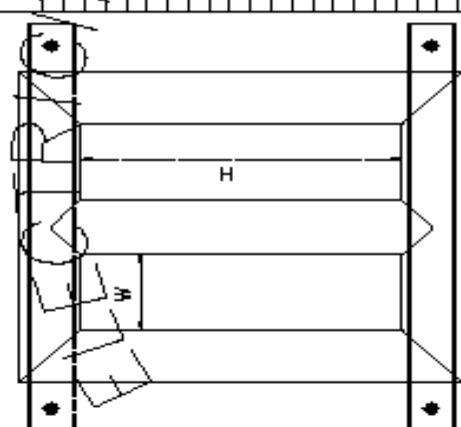
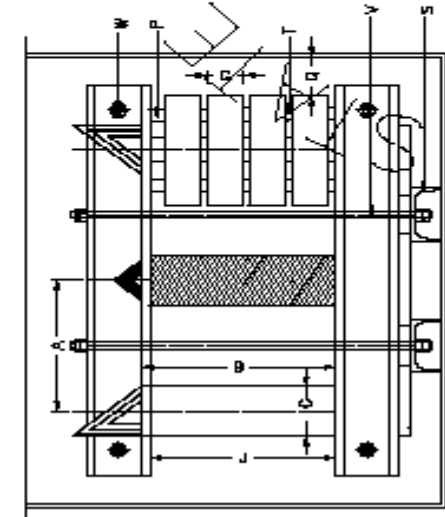
NOTE:

1. ACTUAL VALUES SHALL BE PUNCHED AT THE TIME OF DISPATCH.
2. RATING PLATE MATERIAL: ALUMINIUM ANODIZED
3. THICKNESS OF RATING PLATE: 18 SWG
4. WEIGHTS ARE SUBJECTED TO +10% TOLERANCE

THIS IS AN INDICATIVE DRAWING

NAME OF THE CUSTOMER: MSEDCL, MUMBAI-51
 A/T. NO. _____
 QUANTITY _____
 DETAILS OF DISTRIBUTION TRANSFORMER: ---KVA, 11/D. 433KV

| | | |
|----------------------------------|--|---------|
| NAME OF THE MANUFACTURE & SYMBOL | | |
| DATE | RATING & TERMINAL MARKING PLATE | |
| DRN | ---KVA, 11/D. 433KV CRGD/AMDT, DIST. TRANSFORMER | |
| CHD | SCALE | DRG. NO |
| APPD | | |
| ---KVA | NTS | |



- NOTES:
1. CORE CLAMPS ARE PARTED WITH WEDGES
 2. WEDGE OF PAPER BOARD, ALUMINUM/RESINANCE ALLOY/WOODEN PEEK
 3. ALL DIMENSIONS ARE IN MM.
 4. ALL DIMENSIONS WEIGHTS ARE SUBJECT TO +10% TOL.
 5. TOLERANCE EXCEPT THOSE MENTIONED AS M.M. DRP.
 6. DIMENSIONS ARE SELECTED TO FIT TOLERANCES.
 7. ITEM FORMATION AND HV/LV WINDING LEAD CONNECTIONS TO BE MADE AS PER DRAWING (WHERE OVER IT IS APPLICABLE)

THIS IS AN INDICATIVE DRAWING

| | | | | | | | | | | |
|------------|-----|---|----|------|-----|------|-------|-----|-----|-----|
| KVA PHASES | 100 | 3 | 50 | 1000 | 455 | 5.25 | 133.3 | 100 | KVA | NTS |
| FREQUENCY | | | | | | | | | | |
| COOLING | | | | | | | | | | |
| CURRENT | | | | | | | | | | |
| CHD | | | | | | | | | | |
| HT(V) | | | | | | | | | | |
| LV(V) | | | | | | | | | | |
| HT(V) | | | | | | | | | | |
| LV(V) | | | | | | | | | | |

ACTUAL NOTE:
 1. ALL DIMENSIONS ARE IN MM.
 2. DIMENSIONS WEIGHTS ARE SUBJECT TO +10% TOL.
 3. TOLERANCE EXCEPT THOSE MENTIONED AS M.M. DRP.

INTERNAL ARRANGEMENT DRWG
 -CONNECTIONS/DETAILS/TERMINATIONS

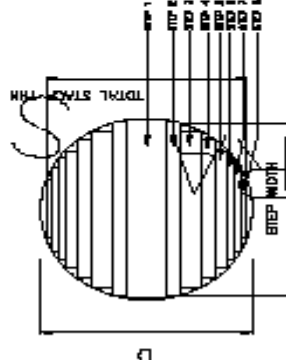
SCALE DRG.NO
 NTS

| CODE | DESCRIPTION | 6.9000 | 6.0000 | 6.0000 |
|------------|--------------------------------------|--------|--------------------|--------------------|
| A | LEG CENTER | | | |
| B | WINDOW HEIGHT | | | |
| C | CORE DIA | | | |
| D | EFFECTIVE CORE AREA | | | |
| HY COIL | | | | |
| | CONDUCTOR MATERIAL | | ES GRADE ALUMINIUM | ES GRADE ALUMINIUM |
| | HOLDER HV COILS PER PHASE | | | |
| E | OUTER DIAMETER WITH INS | | | |
| F | INNER DIAMETER WITH INS | | | |
| G | AXIAL LENGTH | | | |
| | CONDUCTOR CROSS SECTION | | | |
| | CONDUCTOR DIA | | | |
| | CONDUCTOR REGULATION | | DPC | DPC |
| | NO OF TURNS | | | |
| LV COIL | | | | |
| | CONDUCTOR MATERIAL | | ALUMINIUM | ALUMINIUM |
| H | OUTER DIAMETER WITH INS | | | |
| I | INNER DIAMETER WITH INS | | | |
| J | AXIAL LENGTH | | | |
| | EFFECTIVE CONDUCTOR CROSS SECTION | | | |
| | CONDUCTOR SIZE | | | |
| | CONDUCTOR REGULATION | | DPC | DPC |
| | NO OF TURNS | | | |
| INSULATION | | | | |
| K | WRAP ON CORE | | | |
| L | WEDGES BETWEEN HV & LV COILS | | | |
| N | CLEARANCE BETWEEN HV & LV COILS | | | |
| H | FRAME CHANNEL ISOLATION | | | |
| O | PHASE BANDER | | | |
| P | END INSULATION BLOCK | | 25mm | 25mm |
| Q | CLEARANCE TO TAPWALL FROM HV WDG | | 30mm(MIN) | 30mm(MIN) |
| R | CORE RIBS CHANNEL SIZE | | 70x10mm | 75x10mm |
| S | BASE CHANNEL SIZE | | 75x10mm | 75x10mm |
| T | NO OF SPACES B/W HV AXIAL COIL | | 6 | 6 |
| U | INTER PHASE CLEARANCE | | 10mm(MIN) | 10mm(MIN) |
| V | THICKNESS OF BRACKETS | | 10mm | 10mm |
| W | TE RIB SIZE & NO | | Ø12mmx 4/10 | Ø12mmx 4/10 |
| X | STUD SIZE & NO | | Ø12mmx 4/10 | Ø12mmx 4/10 |
| | RESISTANCE | | LV | LV |
| | RESISTANCE AT 20000 C (PER PHASE) IN | | | |

NAME OF THE MANUFACTURE & SYMBOL
 NAME OF THE CUSTOMER: MEDICAL NUMBER-81
 QTY: 10
 QUANTITY
 DETAILS OF DIMENSIONS TOLERANCES: -0.01/0.03/0.05/0.08/0.10

TECHNICAL DETAILS

| Sr. No. | DESCRIPTION | AS SPECIFIED | AS ORDERED |
|---------|----------------------------------|--------------|------------|
| 1 | CONDUCTOR | | |
| 2 | PHASE VOLTAGE (KV) | | |
| 3 | INSULATION SYSTEM (KV) | | |
| 4 | WINDING | | |
| 5 | WINDING FACTOR | | |
| 6 | CONDUCTOR TO CORE CLEARANCE (MM) | | |
| 7 | TEMPERATURE OF HOT OIL (DEG. C) | | |
| 8 | TEMPERATURE OF WINDING (DEG. C) | | |
| 9 | CORE LOSS | | |
| 10 | WINDING LOSS | | |
| 11 | CORE DIA | | |



THIS IS AN INDICATIVE DRAWING

| STEP NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--------------------------|-----------------|---|---|---|---|---|---|---|
| STEP WIDTH | | | | | | | | |
| STEP THK | | | | | | | | |
| TOTAL CROSS SECTION AREA | = 0.074 - 0.074 | | | | | | | |
| EFFECTIVE CORE AREA | = 0.074 - 0.074 | | | | | | | |

| DESCRIPTION | H | W | T | D |
|------------------------------|---|---|---|---|
| CORE WINDOW HEIGHT | | | | |
| CORE WINDOW CENTRE TO CENTRE | | | | |
| CORE STACK THK | | | | |
| CORE DIA | | | | |

NOTE:

1. ALL DIMENSIONS ARE IN mm.

2. DIMENSIONS & WEIGHTS ARE SUBJECT TO +10% TOLERANCE EXCEPT THOSE MENTIONED AS MIN.

3. DIMENSIONS & WEIGHTS ARE SUBJECT TO +10% TOLERANCE EXCEPT THOSE MENTIONED AS MIN.

| KVA PHASES | FREQUENCY | COOLING | VOLTAGE | CURRENT |
|------------|-----------|---------|---------|---------|
| 3 | 50 | ONAN | 10000 | 433 |
| | | | 525 | 153.3 |

| Sr. No. | DESCRIPTION | AS SPECIFIED | AS ORDERED |
|---------|----------------------------------|--------------|------------|
| 1 | WINDING | | |
| 2 | INSULATION SYSTEM (KV) | | |
| 3 | CONDUCTOR TO CORE CLEARANCE (MM) | | |
| 4 | TEMPERATURE OF HOT OIL (DEG. C) | | |
| 5 | TEMPERATURE OF WINDING (DEG. C) | | |
| 6 | CORE LOSS | | |
| 7 | WINDING LOSS | | |
| 8 | CORE DIA | | |
| 9 | WINDING LOSS | | |
| 10 | CORE DIA | | |
| 11 | CORE DIA | | |
| 12 | CORE DIA | | |
| 13 | CORE DIA | | |
| 14 | CORE DIA | | |
| 15 | CORE DIA | | |
| 16 | CORE DIA | | |
| 17 | CORE DIA | | |
| 18 | CORE DIA | | |
| 19 | CORE DIA | | |
| 20 | CORE DIA | | |
| 21 | CORE DIA | | |
| 22 | CORE DIA | | |
| 23 | CORE DIA | | |
| 24 | CORE DIA | | |
| 25 | CORE DIA | | |
| 26 | CORE DIA | | |
| 27 | CORE DIA | | |
| 28 | CORE DIA | | |
| 29 | CORE DIA | | |
| 30 | CORE DIA | | |
| 31 | CORE DIA | | |
| 32 | CORE DIA | | |
| 33 | CORE DIA | | |
| 34 | CORE DIA | | |
| 35 | CORE DIA | | |
| 36 | CORE DIA | | |
| 37 | CORE DIA | | |
| 38 | CORE DIA | | |
| 39 | CORE DIA | | |
| 40 | CORE DIA | | |
| 41 | CORE DIA | | |
| 42 | CORE DIA | | |
| 43 | CORE DIA | | |
| 44 | CORE DIA | | |
| 45 | CORE DIA | | |
| 46 | CORE DIA | | |
| 47 | CORE DIA | | |
| 48 | CORE DIA | | |
| 49 | CORE DIA | | |
| 50 | CORE DIA | | |
| 51 | CORE DIA | | |
| 52 | CORE DIA | | |
| 53 | CORE DIA | | |
| 54 | CORE DIA | | |
| 55 | CORE DIA | | |
| 56 | CORE DIA | | |
| 57 | CORE DIA | | |
| 58 | CORE DIA | | |
| 59 | CORE DIA | | |
| 60 | CORE DIA | | |
| 61 | CORE DIA | | |
| 62 | CORE DIA | | |
| 63 | CORE DIA | | |
| 64 | CORE DIA | | |
| 65 | CORE DIA | | |
| 66 | CORE DIA | | |
| 67 | CORE DIA | | |
| 68 | CORE DIA | | |
| 69 | CORE DIA | | |
| 70 | CORE DIA | | |
| 71 | CORE DIA | | |
| 72 | CORE DIA | | |
| 73 | CORE DIA | | |
| 74 | CORE DIA | | |
| 75 | CORE DIA | | |
| 76 | CORE DIA | | |
| 77 | CORE DIA | | |
| 78 | CORE DIA | | |
| 79 | CORE DIA | | |
| 80 | CORE DIA | | |
| 81 | CORE DIA | | |
| 82 | CORE DIA | | |
| 83 | CORE DIA | | |
| 84 | CORE DIA | | |
| 85 | CORE DIA | | |
| 86 | CORE DIA | | |
| 87 | CORE DIA | | |
| 88 | CORE DIA | | |
| 89 | CORE DIA | | |
| 90 | CORE DIA | | |
| 91 | CORE DIA | | |
| 92 | CORE DIA | | |
| 93 | CORE DIA | | |
| 94 | CORE DIA | | |
| 95 | CORE DIA | | |
| 96 | CORE DIA | | |
| 97 | CORE DIA | | |
| 98 | CORE DIA | | |
| 99 | CORE DIA | | |
| 100 | CORE DIA | | |

NAME OF THE CUSTOMER: MSEDCL, MUMBAI - 51
 A/T. NO. _____
 QUANTITY: _____
 DETAILS OF DISTRIBUTION TRANSFORMER: --- KVA, 11/0.433KV, CSP

NAME OF THE MANUFACTURE & SYMBOL

TECHNICAL DETAILS DRAWING

SCALE: DRG. NO.

NTS

KVA

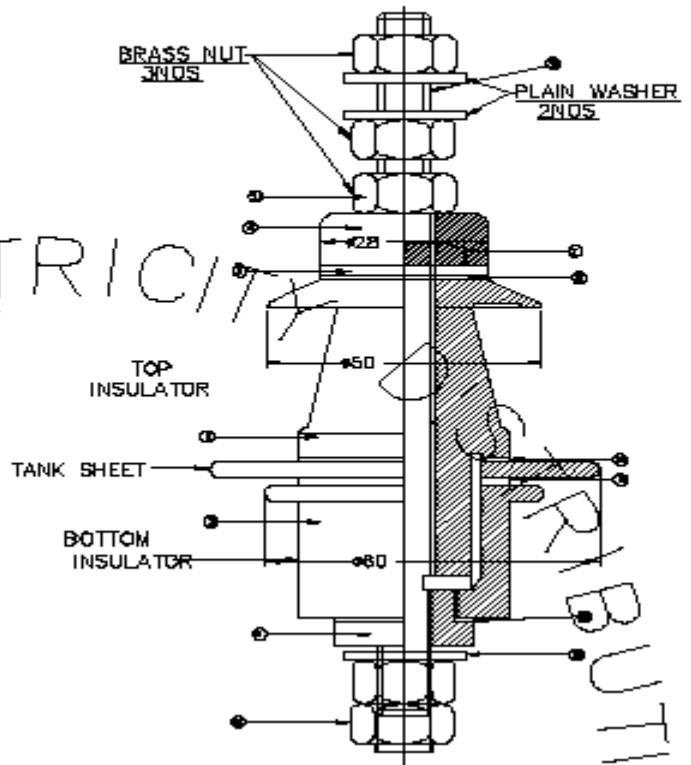
TRANSFORMER BUSHING AS PER IS:3347

ELECTRICAL CHARACTERISTICS:

1. RATED VOLTAGE : 1 KV
2. RATED CURRENT : 250 Amp
3. POWER FREQUENCY WITHSTAND VOLTAGE : 3 KV
4. CREEPAGE DISTANCE : 25 MM. (MIN.)

NOTE:

PERFORMANCE REQUIREMENTS OF THE BUSHING SHALL CONFIRM TO IS: 3347



MAKE: / / / /

| Sl. No. | DESCRIPTION | QTY |
|---------|-------------------------|-----|
| 1 | INSULATOR LAYER | 1 |
| 2 | INSULATOR LAYER | 1 |
| 3 | INSULATOR LAYER | 1 |
| 4 | TOP END WASHER | 1 |
| 5 | STEM WASHER | 1 |
| 6 | BOTTOM NUT | 1 |
| 7 | SEALING WASHER (TYPE M) | 1 |
| 8 | SEALING WASHER (TYPE M) | 1 |
| 9 | SEALING WASHER (TYPE M) | 1 |
| 10 | SEALING WASHER | 1 |
| 11 | INSULATOR LAYER | 1 |
| 12 | INSULATOR LAYER | 1 |
| 13 | HEXLOCK NUT M12 | 1 |
| 14 | PLAIN WASHER M12 | 1 |
| 15 | SEALING WASHER (TYPE M) | 1 |

NAME OF THE CUSTOMER: MSEDCL, MUMBAI-51
 A/T. NO. _____
 QUANTITY: _____
 DETAILS OF DISTRIBUTION TRANSFORMER: 100KVA, 11/0.433KV, CSP

NAME OF THE MANUFACTURE & SYMBOL _____

A/T. NO. _____

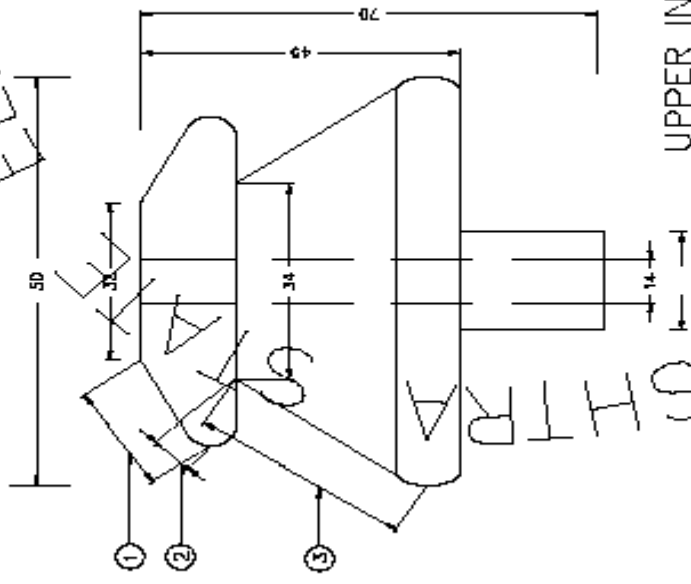
Note _____

LV BUSHING ASSEMBLY DRAWING
 100KVA, 11/0.433KV, CSP, 11/0.433KV, CSP, 11/0.433KV, CSP

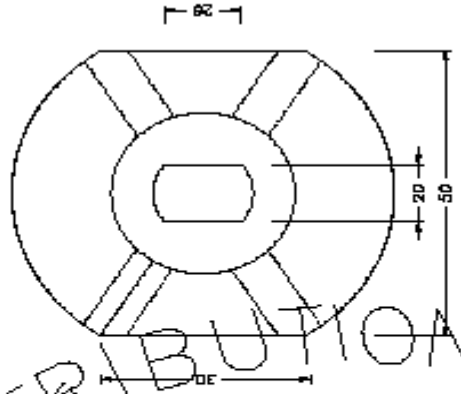
CHKD _____ DRG. NO _____
 APPD _____

THIS IS AN INDICATIVE DRAWING

ELECTRICITY DISTRIBUTION



UPPER INSULATOR



LOWER INSULATOR

| PT.No. | DIM |
|----------|-----|
| 1 | 14 |
| 2 | 11 |
| 3 | 40 |
| TOTAL 65 | |

- NOTE:
1. COLOUR - BROWN GLAZED.
 2. CREEPAGE DISTANCE - 25mm/KV
 3. AS PER IS: 3347(PART-1)/(SEC)
 4. ALL DIMENSIONS IN mm

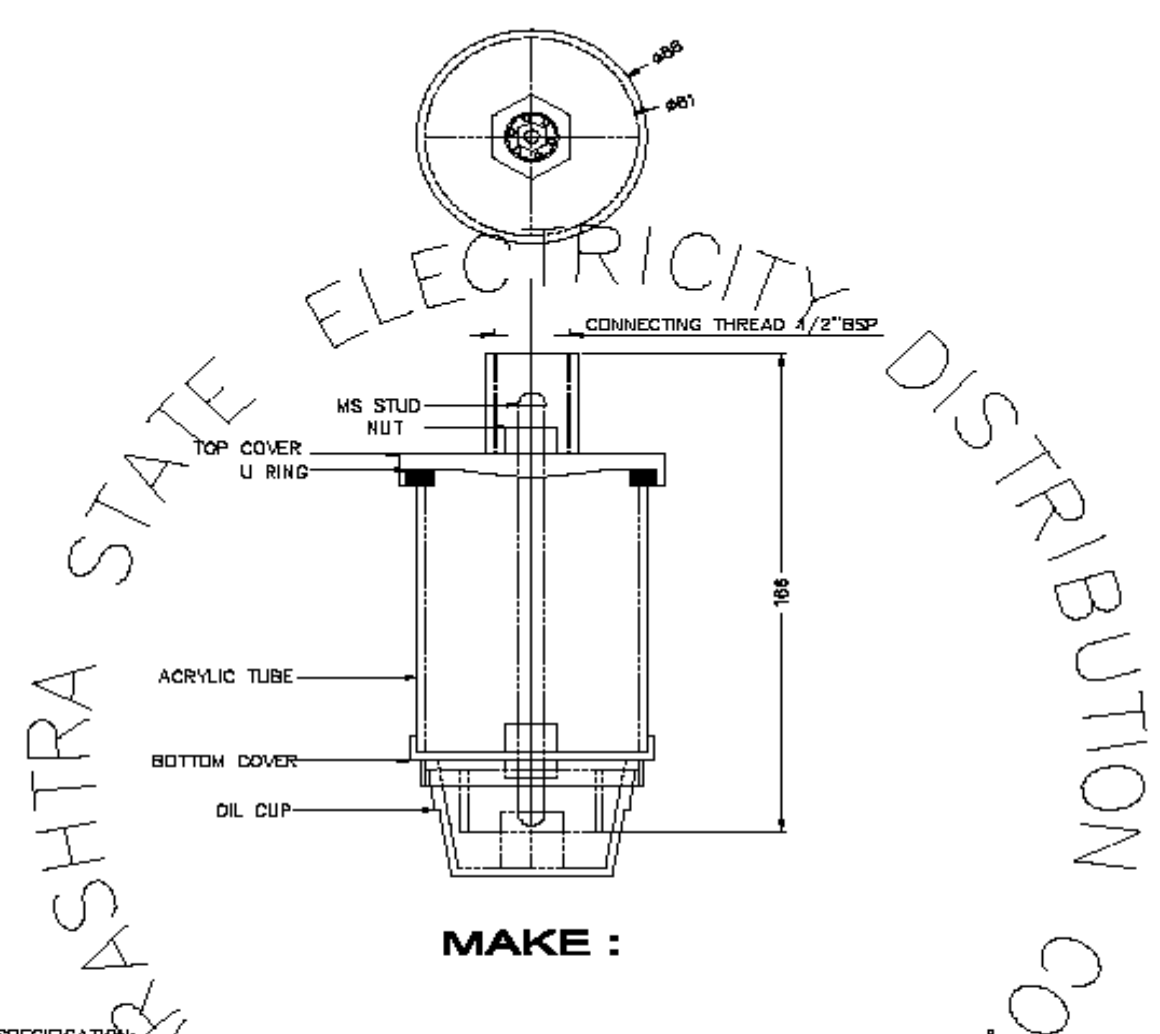
NAME OF THE CUSTOMER: MSEDCL,MUMBAI-51
 A/T. NO. _____
 QUANTITY: _____
 DETAILS OF DISTRIBUTION TRANSFORMER: --KVA,11/0.433KV,CSP

NAME OF THE MANUFACTURE & SYMBOL

A/T.IND: _____
 Date: _____
 CREEPAGE DISTANCE DRAWING OF LV BUBBLE TYPE/250MM
 MUMBAI DISTRIBUTION TRANSFORMER
 CHD _____ DRG.NO _____
 APPD _____

THIS IS AN INDICATIVE DRAWING

SILICAGEL BREATHER



MAKE :

SPECIFICATION:

| PART NAME | MATERIAL USED |
|--------------|---------------|
| TOP COVER | NYLON |
| BOTTOM COVER | NYLON |
| OIL CUP | ACRYLIC |

NAME OF THE CUSTOMER: MSEDCL,MUMBAI-51
 A/T. NO.
 QUANTITY:
 DETAILS OF DISTRIBUTION TRANSFORMER: -- KVA,11/D.433KV,CSP

| | |
|----------------------------------|--------|
| NAME OF THE MANUFACTURE & SYMBOL | |
| A/T.NO: | |
| Make: | |
| SILICA GEL BREATHER, 250gms | |
| CHD | DRG.NO |
| APPD | |

THIS IS AN INDICATIVE DRAWING

ELECTRICITY DISTRIBUTION

THIS IS AN INDICATIVE DRAWING

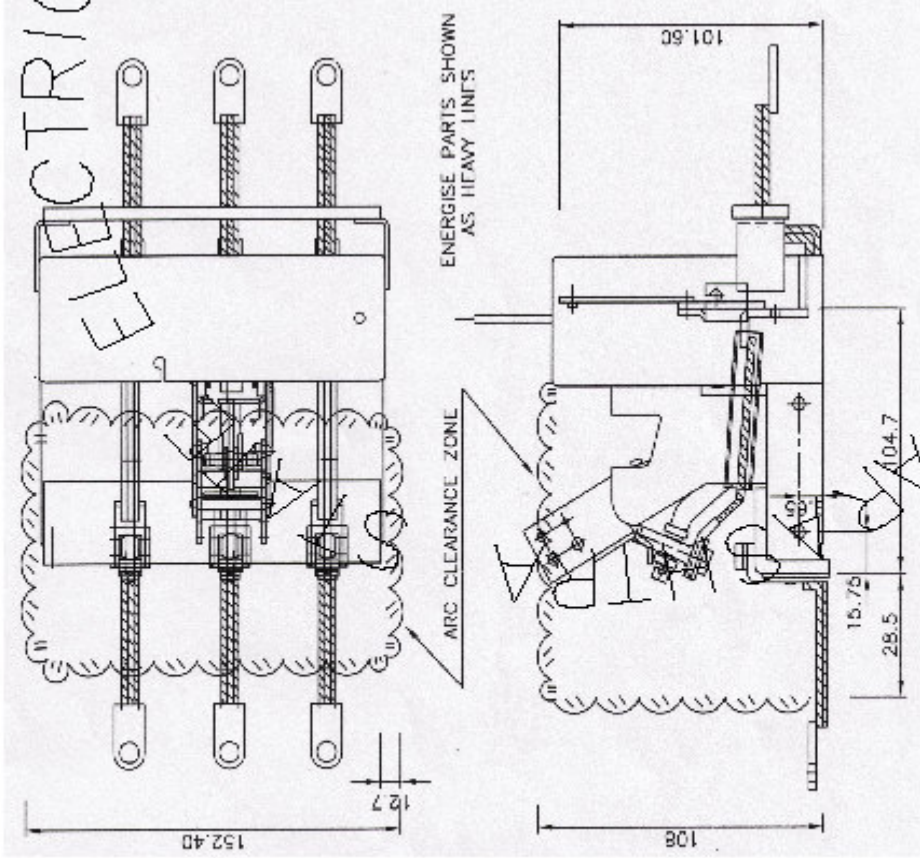
NAME OF THE CUSTOMER: MSEDCL, MUMBAI-51
 A/T. NO.:
 QUANTITY:
 DETAILS OF DISTRIBUTION TRANSFORMER:---KVA,11/0.433KV,CSP

NAME OF THE MANUFACTURE & SYMBOL

S.L. NO.:
 DATE: SWARUPRAJ ELECTRICALS LTD.
 HYDERABAD, KURUPALLY, HYDERABAD, A.P.

DRG. BREAKER 3PHASE, 3POLE MAJOR PART IDENTIFICATION

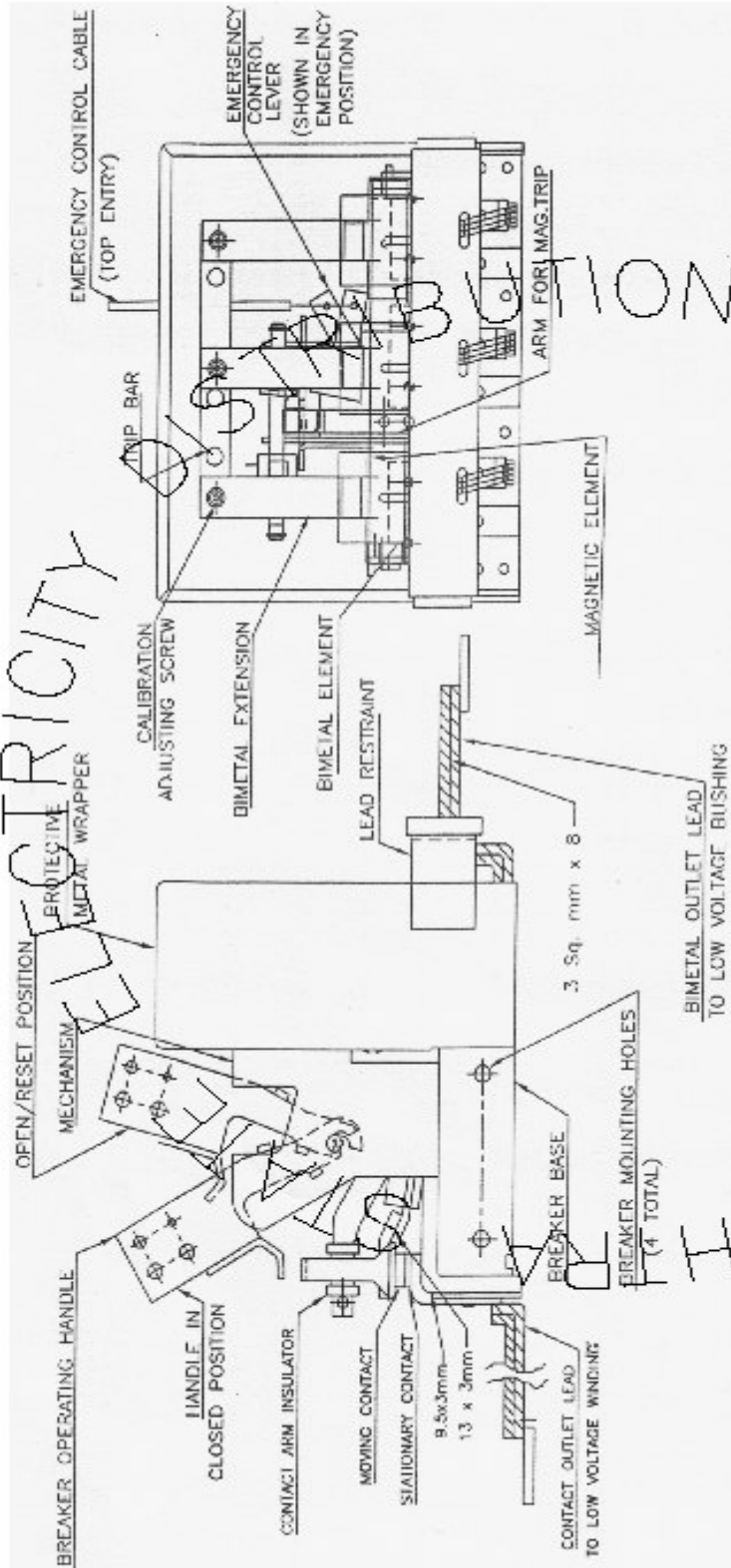
DRG. No. SEL-COR-EL-005a



Note: ALL DIMENSIONS ARE IN MM
 CAPACITY: 460V, 185AMP

MATHAN KAVANAN

ELECTRICITY



THIS IS AN INDICATIVE DRAWING

NAME OF THE CUSTOMER: MSEDCL, MUMBAI-51

A/T. NO.

QUANTITY:

DETAILS OF DISTRIBUTION TRANSFORMER: --KVA, 11/0.433KV CSP

NAME OF THE MANUFACTURE & SYMBOL

A/T. NO.

SAHREKAR ELECTRICALS LTD, BOMBAY, MUMBAI, HYDERABAD, AP

CQR BREAKER 3PHASE, 3POLE MAJOR PART IDENTIFICATION
--KVA, 11/0.433KV CSP DIST TRANSFORMER

CHD

APPD

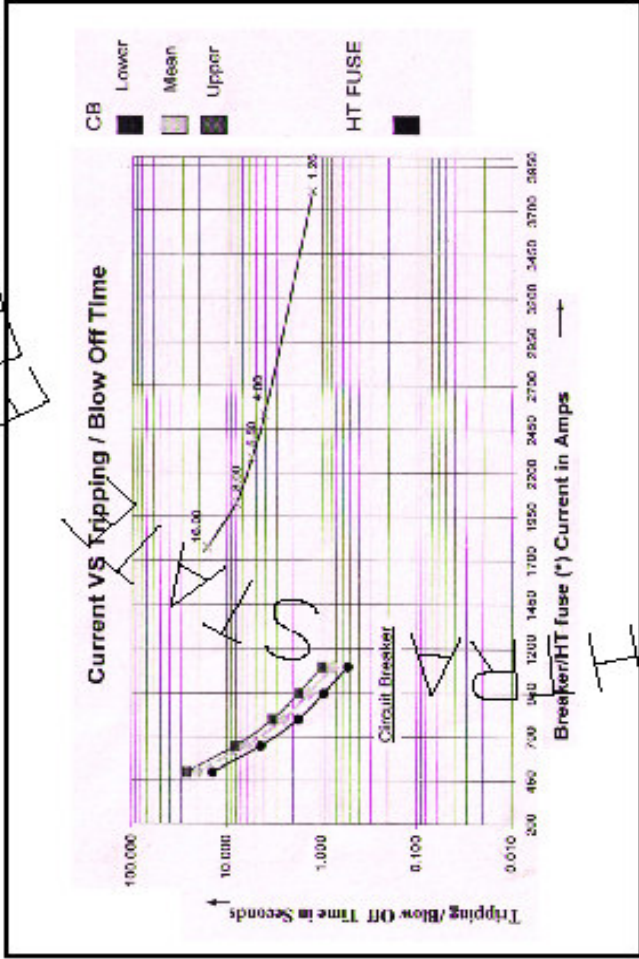
DRG. No. SEL - CQR - MI - 009

STANDARD PROTECTION CO-ORDINATION GRAPH

100KVA 3-PHASE 3-POLE (11KV Class)

3 MR 551

ELECTRICITY



| LOWER | | UPPER | | MEAN | |
|---------|-------|---------|-------|---------|-------|
| Current | Time | Current | Time | Current | Time |
| 500 | 14.00 | 500 | 26.00 | 500 | 20.0 |
| 950 | 4.31 | 950 | 8.060 | 950 | 6.20 |
| 900 | 1.750 | 900 | 3.250 | 900 | 2.50 |
| 950 | 0.945 | 950 | 1.750 | 950 | 1.350 |
| 1100 | 0.525 | 1100 | 0.875 | 1100 | 0.750 |

HT FUSE TYPE-7A

| Current | Time |
|---------|------|
| 1778 | 18.0 |
| 2032 | 8.0 |
| 2286 | 5.50 |
| 2540 | 4.0 |
| 2810 | 1.28 |

Transformation Ratio: 25.4

THIS IS AN INDICATIVE DRAWING

NAME OF THE CUSTOMER: MSEDCL, MUMBAI-51
 A/T. NO. *
 QUANTITY:
 DETAILS OF DISTRIBUTION TRANSFORMER: ---KVA, 11/0.433KV, CSP

NAME OF THE MANUFACTURE & SYMBOL

A. T. NO. *
 MUMBAI ELECTRICITY SUPPLY CO. LTD.
 HYDRABAD ELECTRICITY BOARD, A.P.

STANDARD PROTECTION CO-ORDINATION GRAPH

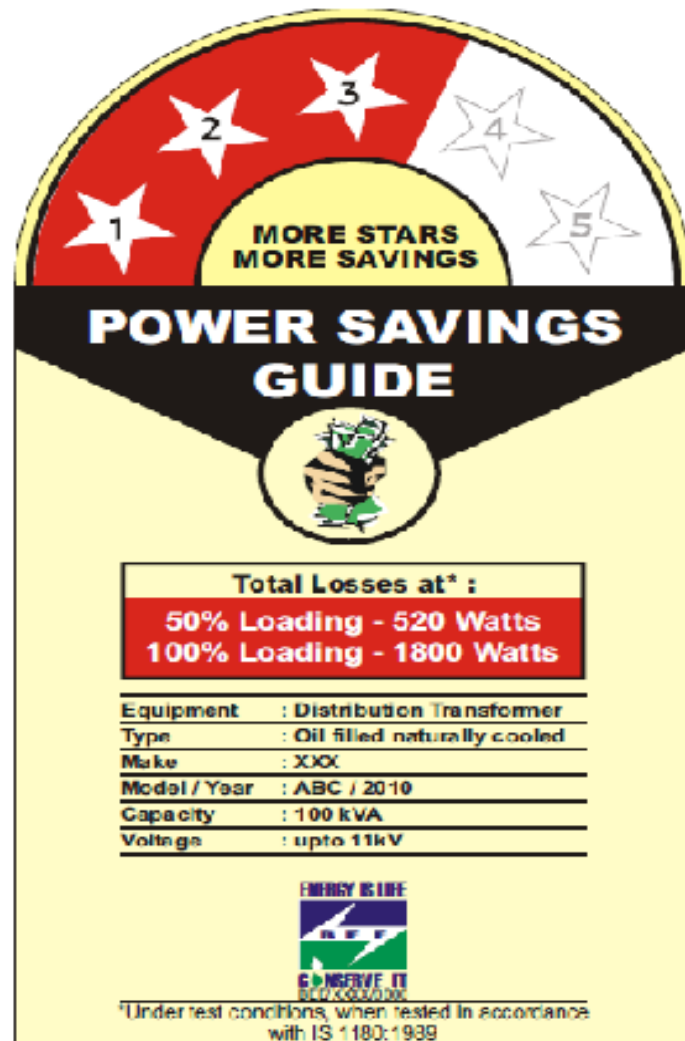
CHD APPD DIRG. NO 03

Note: HT Current referred to LT Side

| | | | | | | | | | | |
|------------|-----|-----|-----|------|------|------|------|------|------|------|
| HT Current | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| LT Current | 254 | 508 | 762 | 1016 | 1270 | 1524 | 1778 | 2032 | 2286 | 2540 |

MUMBAI

ISADHARS



**MORE STARS
MORE SAVINGS**


POWER SAVINGS GUIDE

Total Losses at* :

50% Loading - 520 Watts

100% Loading - 1800 Watts

| | |
|--------------|-------------------------------|
| Equipment | : Distribution Transformer |
| Type | : Oil filled naturally cooled |
| Make | : XXX |
| Model / Year | : ABC / 2010 |
| Capacity | : 100 kVA |
| Voltag | : upto 11kV |

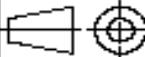


ENERGY IS LIFE
CONSERVE IT

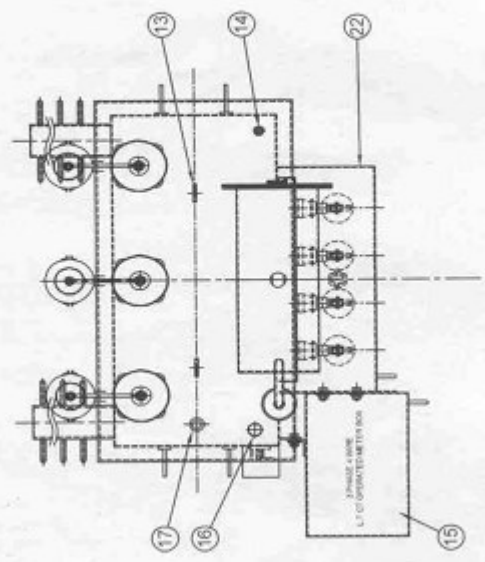
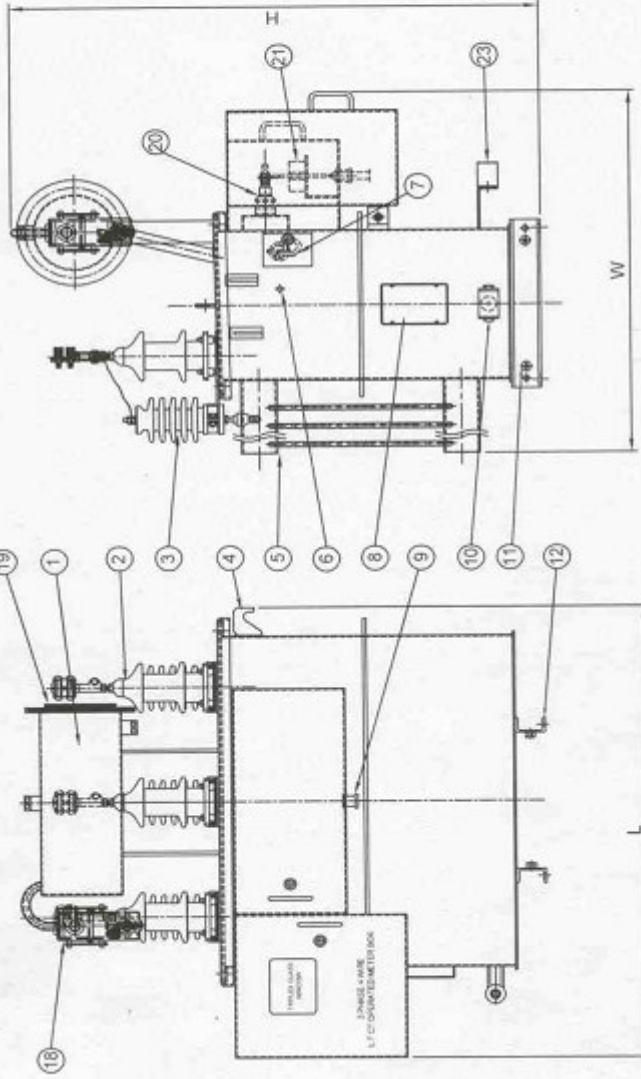
*Under test conditions, when tested in accordance with IS 1180:1939

Note:-

1. Label Design, Manner of Color Scheme, Font and Dimensions are as per BEE Schedule 5 - Distribution Transformer Specification. Revision-2, Date: 21/07/2009 (or latest amendments there of)

| | | | | | | | | | | |
|---|------|---------------------------------------|-------------------------|--|--|--|-----------|---------|--------|--|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| REV | ZONE | DATE | M O D I F I C A T I O N | | | | MODIFIED | CHECKED | APPRD. | |
| | | | | | | | | NAME | DATE | |
| NAME OF THE MANUFACTURE & SYMBOL | | | | | | | DESIGNED | | | |
| | | | | | | | DRAWN | | | |
| | | | | | | | CHECKED | | | |
| | | | | | | | APPROVED | | | |
| | | | | | | | W. D. No: | | | |
| | | | | | | | DRG. NO.: | | | |
| SCALE: NTS | | BEE 3 STAR LABEL | | | | | | | | |
|  | | 100kVA, 11/0.433kV TRANSFORMER | | | | | | | | |

ANNEXURE - V



| NO. | DESCRIPTION | QTY |
|-----|---|-----|
| 1 | CABLE HOLDING CLAMP | 1 |
| 2 | C.T MOUNTING BOX | 1 |
| 3 | CURRENT TRANSFORMER | 3 |
| 4 | LV BUSHING (1.1V/20 A) | 4 |
| 5 | OIL LEVEL GAUGE | 1 |
| 6 | ALUMINIUM DIE CAST SILICAGEL BREATHER | 1 |
| 7 | PRESSURE RELIEF DEVICE | 1 |
| 8 | AIR RELEASE PLUG | 1 |
| 9 | 3 PHASE 4 WIRE L.T. CT DRENATED METER BOX | 1 |
| 10 | THERMOMETER ROCKET WITH CAP | 1 |
| 11 | TOP COVER LIFTING LUGS | 2 |
| 12 | BOTTOM CHANNEL WITH PULLING EYE | 2 |
| 13 | EARTHING TERMINAL | 1 |
| 14 | DRAIN CUM SAMPLING VALVE | 1 |
| 15 | CABLE GLAND FOR 35 CORE CABLE | 1 |
| 16 | RATING AND TERMINAL MARKING PLATE | 1 |
| 17 | CIRCUIT BREAKER OPERATING HANDLE WITH PROTECTION COVER & LOCK | 1 |
| 18 | INDICATION LAMP FOR OVER LOAD | 2 |
| 19 | RADIATOR | 4 |
| 20 | LIFTING LUGS | 4 |
| 21 | LIGHTNING ARRESTER (8A/5 KA) | 3 |
| 22 | HV BUSHING WITH BI-METALLIC CONNECTOR (12KV/25KA) | 3 |
| 23 | CONSERVATOR WITH OIL FILLING PLUG & DRAIN PLUG | 1 |

MAHARASHTRA STATE ELECTRICITY
DISTRIBUTION COMPANY LTD.

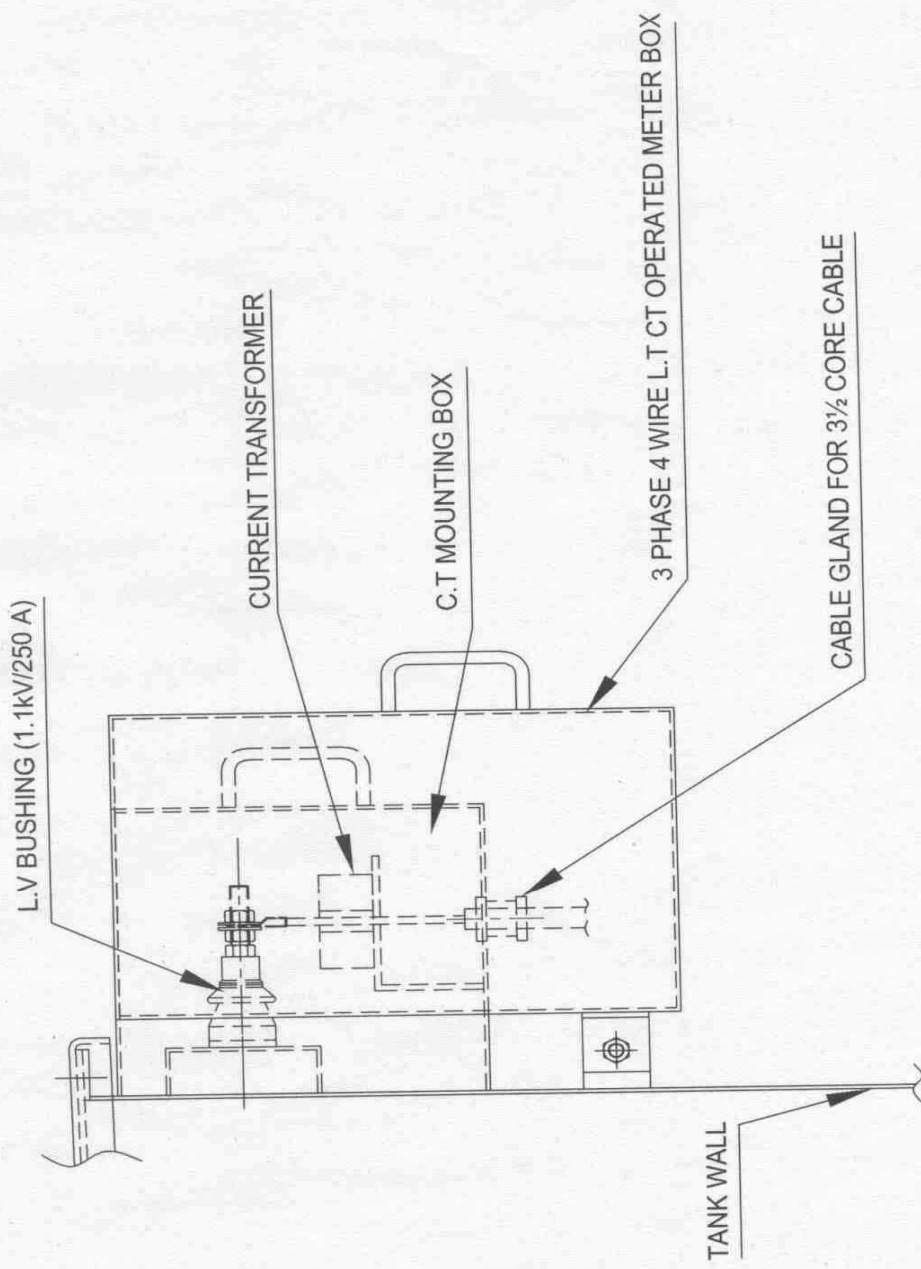
LOA NO. SPTT-

TITLE : OUTLINE GENERAL ARRANGEMENT
FOR 63 & 100KVA DISTRIBUTION TRANSFORMER
DRAWING No : MSEDCL/MM II/63-100 DT/01

| SCALE | NTS | DRAWN | CHECKED | RECOMMENDED | APVD |
|-------|-----|-------------|-------------|-------------|-------------|
| 1:1 | | [Signature] | [Signature] | 10/9 | [Signature] |
| | | | | | |

THIS IS AN INDICATIVE DRAWING

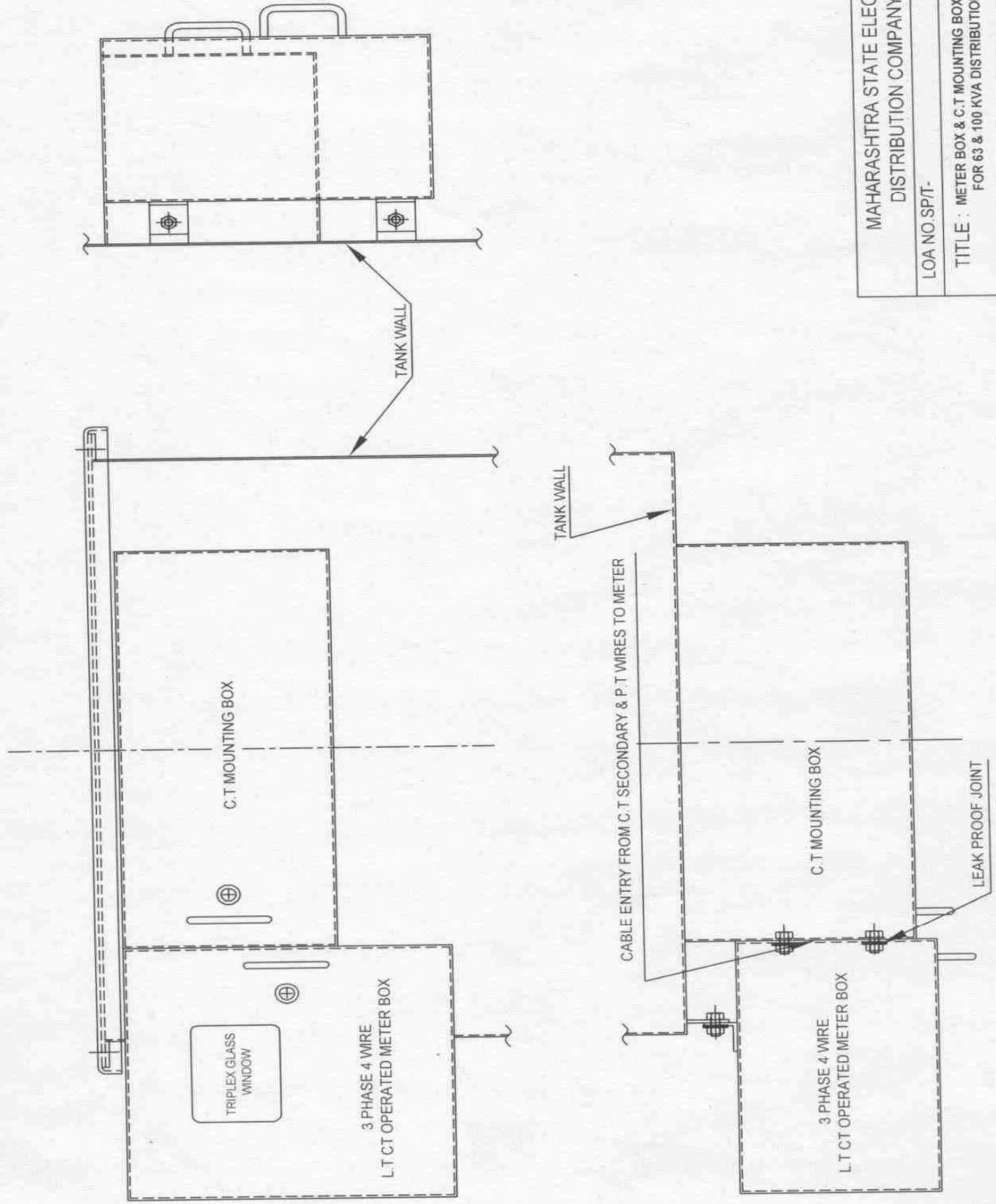
ANNEXURE - V



| | | | |
|---|---------|---------|-------------|
| MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY LTD. | | | |
| LOA NO SPT/ | | | |
| TITLE : METER BOX & C.T MOUNTING BOX ARRANGEMENT FOR 63 & 100 KVA DISTRIBUTION TRANSFORMER | | | |
| DRAWING No : MSEDCL/MM II /63-100 DT/02 | | | |
| SCALE : NTS | DRAWN | CHECKED | RECOMMENDED |
| APPROVED | 10.9.07 | 10.9 | APVD |

THIS IS AN INDICATIVE DRAWING

ANNEXURE - V



MAHARASHTRA STATE ELECTRICITY
DISTRIBUTION COMPANY LTD.

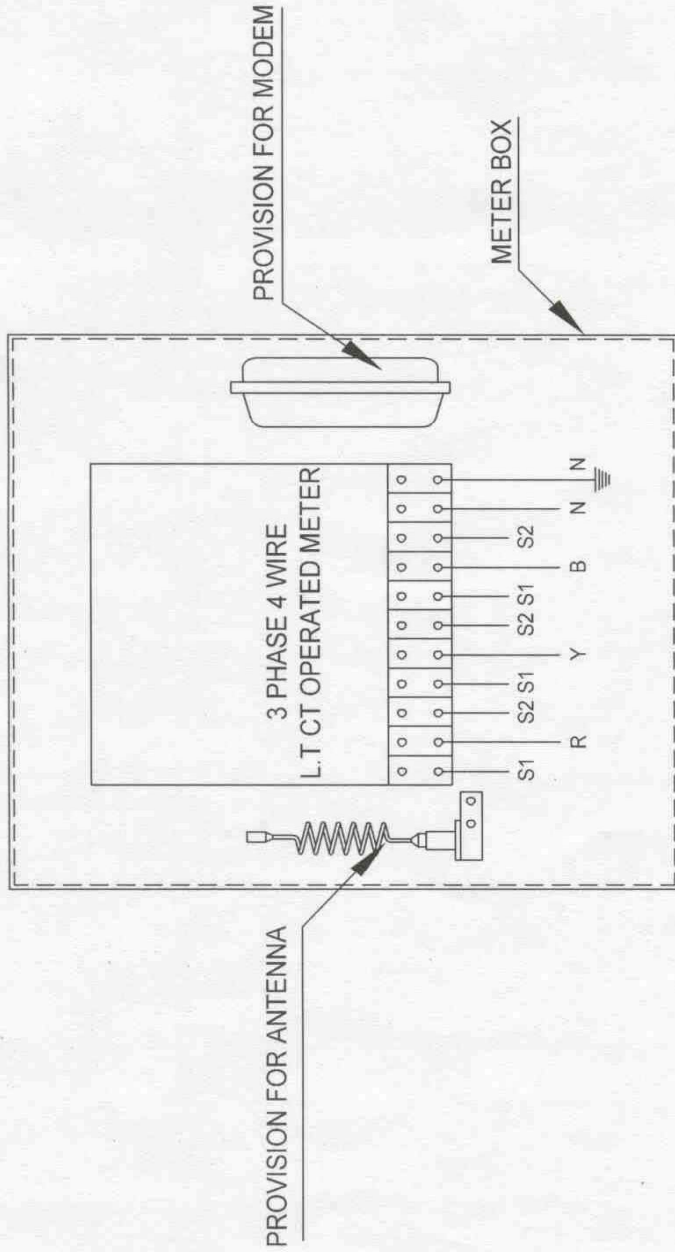
LOA NO.SPT/-

TITLE : METER BOX & C.T MOUNTING BOX ARRANGEMENT
FOR 63 & 100 KVA DISTRIBUTION TRANSFORMER

DRAWING No. : MSEDCL/MMM II / 63-100 DT/03

| | | | | |
|------------|---------------------------|-----------------------------|---------------------------------|--------------------------|
| SCALE: NTS | DRAWN: <i>[Signature]</i> | CHECKED: <i>[Signature]</i> | RECOMMENDED: <i>[Signature]</i> | APVD: <i>[Signature]</i> |
| | 10-9-07 | | | |

THIS IS AN INDICATIVE DRAWING



MAHARASHTRA STATE ELECTRICITY
DISTRIBUTION COMPANY LTD.

LOA NO SP/T-

TITLE : METER BOX WITH METER FOR 63 & 100
KVA DISTRIBUTION TRANSFORMER

DRAWING No : MSEDCL/MM II / 63-100 DT/04

| | | | |
|--------------------|--------------------|--------------------|--------------------|
| DRAWN | CHECKED | RECOMMENDED | APVD |
| <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> | <i>[Signature]</i> |
| SCALE : NTS | | | |
| | | 10.9.07 | |

THIS IS AN INDICATIVE DRAWING