WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LTD.

TECHNICAL SPECIFICATION OF 315 11/0.433 KV BOTH OUTDOOR TYPE WITH OUDOOR BUSHING AT BOTH ENDS AND INDOOR TYPE WITH CABLE END BOX AT BOTH ENDS : 3 PHASE POLE MOUNTED BIS COMPLIED STACK CORE TYPE; ONAN COOLED; NON SEALED TYPE DISTRIBUTION TRANSFORMER

1.00 SCOPE:-

This specification covers design, manufacture, assembly, testing at manufacturer's works, supply & delivery of three phase 50 HZ, 11/ 0.433 KV, Delta/Star, Vector Group Dyn11, two winding, oil immersed naturally Oil & Air cooled, Stack Core Type 315 KVA Distribution Transformer both with outdoor type Outdoor Bushing and Indoor type with cable End Box Type at both ends along with Off Load Tap Switch on HV side for voltage variation of +5.0% to -7.50% as per details furnished hereafter.

2.00 APPLICABLE STANDARD :

2.01 The transformers covered by this specification shall, unless otherwise specified be built to confirm to the latest Indian Electricity Rules, wherever applicable and the requirements of the latest issues of IS: 1180(Part-I) of 2014 and IS:2026, CBIP Standards and other ISS(All as per latest isuses) some of which are as stated below-

Serial No	Item	IS Number
1.	Specification for Power Transformer	IS:2026
2	Outdoor Type oil immersed Distribution Transformers upto & including 2500 KVA, 33-KV specification	IS 1180(Part-1) of 2014
3.	Specification for Cold Rolled Grain Oriented Electrical Steel	IS:3024
3.	Specification for Aluminium wire rods	IS:5484
4.	Specification for Craft Paper	IS:9335
5.	Specification for Press Board	IS:1576
6.	Specification for Transformer/Mineral Oil	IS:335
7.	Specification for up to 1.1 KV voltage Bushing	For Porcelain Part-IS:3347(Part-I/Section-I) For Metal Part-IS:3347(Part-I/Section-II)
8.	Specification for 17.50 KV Bushing	For Porcelain Part-IS:3347(Part-III/Section-I) For Metal Part-IS:3347(Part-III/Section-II)
9.	Specification for Marking and Relative positions of terminals	IS:2026 (Part-I)
10.	Specification of Gaskets	Type-III as per IS:11149/Type-C as per IS:4253(Part-II)
11.	Specification for colours for ready mixed paints	IS 5
12	Specification for ready mixed paint, brushing Zinc Chromate, priming	IS 104
13	Testing for steel sheets and strips and magnetic circuits	IS 649
14.	Guide for loading of oil immersed Transformers	IS-6600
15.	Specification for Mechanical testing of metals-Tensile Testing	IS 1608:2005

02. In the event of a conflict between the above standard and the specification the later shall govern

2.02 Pre-qualifying requirements for BIS certified transformer manufacturer-

Serial No	Requirements	Documents required to be submitted
1	BIS License	(i) For 315 KVA (copper wound) rating distribution transformers ,the bidding is open to those manufacturers only , who possesses valid ISI License/ Marketing rights for offered ratings for energy efficiency level-II as specified in IS:1180 (Part-I):2014. (ii) ISI marking- The transformer, as per Energy Efficiency Level-2 specified in IS-1180(Part-1):2014, must bear 'ISI' certification mark. In this connection, a certified photocopy of the valid ISI license/marking rights must be submitted either along with the tender. In absence of ISI marking License, the offer shall be liable for rejection. (iii) In absence of ISI marking License, the offer shall be liable for rejection
2	Type test report for tendered rating of transformers.	(i) The certified photo copies of valid type test Reports for 'ISI' mark, losses as per Energy Efficiency Level-2 specified in IS-1180(Part-1):2014, copper wound -315 KVA rating distribution transformer from the Govt. Standard test Laboratory/Govt. Approved Laboratory shall be submitted along with the tender. (ii) The type test certificates for all ratings shall not be more that 5 years old from the date of opening of the tender.

3.00 CLIMATIC CONDITION :

For the purpose of design following climatic conditions shall be considered:-

1. Elevation at mean sea level	: 1000 M
2. Maximum ambient Air temperature (°C)	: 50
3. Maximum daily average ambient (°C)	: 40
4. Minimum Ambient air temperature (°C)	: (-) 5 Deg. C
5. Relative humidity	: 100%
6. Pollution level	: Heavily polluted.
7. Maximum Wind Pressure	: 250 kg/sq. mtr.
8. Annual average rain fall	: 3000mm
9. Average No. of thunder storm day per annum:	100

3.01 APPLICATION :

The equipment shall be installed on double pole structure or plinth at outdoor location any where in West Bengal in the Distribution system of WBSEDCL to effect power supply to the consumer.

4.00 PRINCIPAL PARAMETERS :

4.01 The transformers shall be suitable for outdoor installation with three phase, 50 Hz, 11 KV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage upto plus 12.5% to minus 12.5%.

4.02 The Transformer shall conform to the following specific parameters

1.	System Voltage	12 KV
2.	Rated Voltage HV	11 KV
3.	Rated Voltage LV	0.433 KV

4.	Phase	3 phase
5.	Frequency	50 HZ subject to fluctuation of ± 5%
6.	Connection HV	Delta
7a.	Connection LV	Star (Neutral brought out)
7b.	LV Neutral Earthing	The Neutral point of the secondary (LV) winding shall be brought out in a separate insulated terminal and shall be solidly earthed.
8.	Vector Group	Dyn11
9.	Type of Core	High Grade CRGO material (Stack Core)
10.	Winding	HV & L V winding shall be wound from Double paper Covered copper conductor for 315 KVA
11.	Rating	315 KVA
12.	Type of Cooling	ONAN
13.	Percentage Impedance at 75°C & 50Hz	4.5% ± 10%(IS tolerance)
14.	Maximum Temperature Rise over ambient	i) Top oil temp. rise measured by thermometer - 35°C
		ii) Winding temp. rise measured by resistance method – 40 °C
		Bids not meeting the above limits of temperature rise will be treated as non responsive.
15.	Rated Short Circuit Level	13.1 KA for 3 seconds at 11 KV
16.	Taps	Tapping shall be provided for on HV winding for voltage variation of +5.0% to -7.50% with Tap position no. 3 as Normal.
17.	Audible sound levels in decibel at rated voltage & frequency	i) Upto 50 KVA 48db ii) 51 – 100 KVA – 51db iii) 101 – 300KVA – 55 db iv) 301 – 500KVA – 56 db.
18.	Type	Non-Sealed type

5.00 Losses:

Standard Losses at 75° C will be as follows :

The bidder shall guarantee individually the NO Load Loss and Load Loss at 75 o C within the Maximum allowable value as specified below, but the Total Loss at 50 % & 100% loading at rated voltage and frequency at 75 o C shall not exceed the value as mentioned below. Capitalization of Transformer losses shall be evaluated as per CEA / REC guideline with the guaranteed value of declared losses of a particular type transformer.

NO POSITIVE TOLERANCE SHALL BE ALLOWED ON THE MAXIMUM ALLOWABLE NO LOAD LOSSES, LOAD LOSSES AT 75°C, TOTAL LOSSES AT 50 % & 100% LOADING at column (4) , (5), (6) & (7) mentioned below.

Sl. No.	Voltage Ratio	Rating in KVA	Max^{m} Total Loss (NLL + LL) at 75 °C		% Imp. Voltage at 50 Hz & 75 °C
(1)	(2)	(3)	50 % Loading (4)	100 % Loading (5)	(6)
2.	11000 / 433 V	315	1025 Watts	3100 Watts	4.50± (IS Tol)

6.00 TERMINALS :

FOR 315 KVA OUTDOOR TYPE WITH OUTDOOR BUSHING DISTRIBUTION TRANSFORMER:

Transformer shall be provided with outdoor type bushing insulators on both H.V. & L.V. Sides. HV & LV bushings shall be located on opposite side of the transformerand may be on the Top Cover also. The Height of the top of the Bushing should be below the minimum oil level marking of the oil level gauge
L.V bushing location should be well above the top yoke.
The electrical characteristic of bushings insulators shall be in accordance with the latest version of IS 2099. Dimensions & type of bushing shall conform to IS: 3347 & shall be as follows :

H.V. Bushing (11 KV Side) : 17.5 KV class

LV bushing (0. 433 KV side) : 1100 V Class

Neutral bushing at L.V. Side : Neutral of L.V. Winding shall be brought out through porcelain bushing similar to LV bushing for connection with earth terminal.

FOR 315 KVA INDOOR TYPE WITH CABLE END BOX AT BOTH ENDS DISTRIBUTION TRANSFORMER:

HV & LV bushings shall be located on opposite side of the transformer, not on the Top Cover. The Height of the top of the H.V Bushing should be below the minimum oil level marking of the oil level gauge.. L.V bushing location should be well above the top yoke.

Suitable size cable end box with Non-magnetic gland plate shall have to be provided at both HV & LV side of transformer. For 11 KV side, 3C X 95 sq. mm XLPE cable and for L.V. side- 1.1 KV grade 1X 3½C 300sq. mm XLPE/PVC cable. The bidder shall ensure the arrangement of HT cable box so as to prevent the ingress of moisture into the box due to rain water directly falling into the box. The cable box on HT side shall be shall be of split type with faces plain and machined and fitted with NEO-K-Texor similar quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut bolt arrangement and MS earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. On the HV side the terminal rod shall have a diameter not less than 12 mm. The material of connecting rod shall be of copper. HT cable support clamp should be provided to avoid tension due to cable weight.
The LV cable box shall have non magnetic type gland plate with gland plate of appropriate size suitable for single compression brass glands on LV side to terminate 1.1KV1.1 KV grade 1X 3½C 300sq. mm XLPE/PVC cable.

The electrical characteristic of bushings insulators shall be in accordance with the latest version of IS 2099. Dimensions & type of bushing shall conform to IS: 3347 & shall be as follows :

H.V. Bushing (11 KV Side) : 17.5 KV class

LV bushing (0. 415 KV side) : 1100 V Class

Neutral bushing at L.V. Side : Neutral of L.V. Winding shall be brought out through porcelain bushing similar to LV bushing for connection with earth terminal.

6.01 INSULATION LEVEL :

The Transformer shall be capable to withstand test voltage as specified below :

Nominal voltage	Highest System voltage	Rated Lightning impulse withstand voltage (In KV peak)	Rated short duration power frequency withstand voltage in KV (r.m.s)
11 KV	12 KV	75	28
433/415 V	-	-	3

Note: The wave shape of Impulse voltage should be chopped on tail

7.00 Cores:

7.01 The cores shall be of stack type only , constructed from low loss Silicon Steel cold rolled grain oriented with inter lamination resistance & rust inhibiting property having Magnate/ Carlite as Inter lamination insulation.

7.02 The maximum flux density in any part of the core and yoke at normal voltage & frequency shall be such that the flux density with +12.5% combined voltage and frequency variation from rated voltage & frequency does not exceed 1.9 Tesla.
The No Load Current at rated voltage and frequency shall not exceed 2% of the full load current and at 112.5% combined variation of voltage & frequency the no load current shall not exceed 5% of full load current.

7.03 The assembled core shall be securely clamped with uniform pressure to minimize noise.

7.04 The M.S. Core clamping frame shall be provided with lifting holes for Tanking & detanking and the core is to be electrically connected by tinned copper strip of adequate section to the core frame for earthing through the tank at two different points to drain off electrostatic potential that may build up.

7.05 The supporting framework of the core shall be so designed , so as to avoid the presence of pocket which would prevent complete emptying of tank or cause trapping of air during filling.

7.06 Adequate provision shall be made to prevent movement of core and winding relative to the task during transport and installation or while in service.

7.07 The core shall conform to: IS : 3024, Electrical sheet steel & IS : 649, Method of test steel sheet . Successful bidder will offer for core for inspection and / or approval by the purchaser during the manufacturing stage.

7.08 The manufacturers call notice in this regard should be accompanied with the following documents as proof towards the use of prime core material.
1) In voice of the supplier 2) Mill's test certificate 3) Packing list 4) Bill of Landing 5) Bill of entry certificate to customs .
Core material shall be procured either from core manufacturer or through their accredited marketing organization of repute.

7.09 Transformer Sl. No. shall have to be punched on the top core - yoke frame.

8.00 Winding:

8.01 The Transformer shall be provided with requisite number of windings and shall be so designed to withstand the electro mechanical stress exerted under short circuit conditions as per ISS : 2026 (Part-5)

8.02 The winding shall be so designed to reduce to a minimum out of balance forces in the transformer.

8.03 The winding shall be so designed that all coil assemblies of identical voltage & KVA rating shall be Interchangeable.

8.04 The winding shall be assembled on the core centrally for magnetic balance & symmetrically for electrical balance. Ducts shall be provided for oil circulation and lowering hot spot temperature in the winding.

8.05 All insulating materials to be used in the transformer shall be of Class A insulation as specified in Indian Standards. The paper insulation shall be Epoxy Dotted Craft Paper and shall be dry and free form puncture and other defects. Solid insulation shall be of best quality. Wooden support, if used, shall be well seasoned and compatible with hot transformer oil.
The test certificate of the raw materials shall be made available by the Transformer manufacturer on request during Inspection & Testing.

8.06 The insulation of Transformer winding & connections shall be free from Insulating materials liable to soften, ooze out , shrink or collapse and shall be non catalytic & chemically inactive to transformer oil during service.

8.07 The details Insulation covering for H . V & L V conductors shall be DPC (Double Paper Cover).

8.08 The number of HV coils per phase per limb for stack core shall be minimum 8(Eight) nos.

8.09 The Inter-leaved Insulating paper between the layers of the winding , shall be Kraft Paper as per IS 9335.

8.10 The clearance between the coils shall be adequate and well co - coordinated.

8.11 The stacks of windings shall receive adequate pre shrinkage treatment before assembly. No tapping are to be provided on the winding.

8.12 HV / LV lead termination to the stud should be made either by method of brazing / soldering or the free end of The lead wire having considerable length should be bent to form a ring & the ring should be fixed to the bushing stud with suitable nut , bolt and washer.

8.13 The neutral formation point inside the tank should be at a suitable location on the upper portion of the tank and not on the lower side so that it is easily accessible without lifting the core coil assembly.

8.14 WINDING AND CLEARANCE INSIDE THE TANK (For Stack type core)

CONSTRUCTION :

The winding shall be assembled on the core co-axially for magnetic balance and symmetrically for electrical balance.Liberal ducts shall be provide for oil circulation and lowering hot spot temperature in the winding.Spacers, wedges shall be robust & hard insulations are so fitted in the winding that they will neither move, nor permit any relative movement of any part of the winding during normal service and under a terminal short circuit, without causing mechanical injury to any insulation in the winding.

i) The transformer shall have separate H.V. and L.V. windings made of electrical grade Aluminium wires as specified conforming to relevant ISS i.e. IS:191. IS:1897, IS:7404, IS: 12444, IS:13730 & IS:6162 of latest edition.

ii) Number of HV coils per phase/limb shall not be less \than 8 nos.

iii) Minimum clearance between HV coils and/or sections should be 6.4mm and at top/bottom, the minimum clearance should be 12 mm ilcluding 1.5 mm insulating ring.

iv) Minimum inter phase clearance (HV to HV) with 3 mm phgase barriers should be 10 mm up to voltage class of 12 KV.

v) The minimum end clearance (HV to earth) should be 20mm up to voltage grade 12 KV.

vi) End insulations at both ends shall include upto 360 KV grade:-

a) 3mm thick yoke insulation over winding of the phases.
b) 6mm ducts at the top and bottom for circulation of oil in the LV and HV windings.

vii) The minimum radial clearance in the winding will be as follows:-
a) Between core & LV winding 3 mm.
b) Between LV winding and HV winding 10mm including 2.0 mm thick pressboard conforming IS:1576 cylinder where LV winding is 1100V grade and HV winding 12 KV grade.

viii) LV cylinder preferably be made of corrugated insulating press board. Oil ductsneed to be provided between core and LV winding.

ix) Minimum clearance between tank wall and HV windings/live parts, where the HV winding is 12 KV grade, clearance: 25 mm no additional insulating barrier shall be used in between. The dimension in respect of ducts and clearance in the windings shall hold for the assembled windings and core prior to application of pressure for permanent shrinkage of coils.The changes in dimensions in finished condition shall remain within 15% (Fifteen percent).

x) The stack of winding shall receive adequate shrinkage treatment before final assembly. Adjustable devices shall be provided for taking up any possible shrinkage of coils in service. The coil clamping arrangement and finished dimensions of any coil duct shall be such as will not impede free-circulation of oil through the ducts.

xi) All spacers , Axial wedges/runners used in windings shall be made of pre-compressed pressboard –solid, conforming to B 3.1 of IEC 641-3-2. In case crossover coil winding of H.V. all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges/runners shall be properly milled to dovetail shape so that they pass through the desired spacers freely.Insulation shearing, cutting, milling and punching operations shall be carried out in such away, that there should not be any burr and climational variations.

8.15 BRACING OF WINDINGS:

i) The windings and connections of all transformers shall be braced to withstand chocks which may occur during transport or due to switching/ short circuit and other transient conditions during service.

ii) Coil clamping rings, if provided, shall be of steel or of suitable insulating material.Axially laminated material other than Bakelite paper shall not be used.

9.00 TANK :

9.01 Conventional plain tank shall be constructed. The Transformer tank and cover shall be fabricated from good commercial grade low Carbon Steel suitable for welding & of adequate thickness. The tank wall should be of thickness 4.0 mm. Top and bottom plate should be of 6.0 mm thickness. Tolerance as per IS : 1852 shall be applicable.

9.02 Tank design shall be such that core & winding assembly can be tanked or detanked easily.

9.03 The under carriage of the tank shall be made of channel of suitable size & design.

9.04 The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using plates or rails.

9.05 Tank shall be designed to prevent retention of water. Tank cover shall be of adequate strength. It shall be bolted on to flanged rim of the tank with weather proof hot oil resistant Synthetic rubber or synthetic rubberized cork resistant to hot transformer oil conforming to Type III as per IS 11149/Type C as per IS 4253(Part2)of 5 mm thickness and shall be provided with water tight compound between the tank flange and the gasket.

9.06 Horizontal Stiffer shall be provided continuously welded on the tank wall. Vertical stiffener of similar type shall also be provided.

9.07 The thermometer pocket should be welded on tank top cover having threads on projected portion of top cover so that the pocket can be covered by a metallic cap having thread inside. The location of the thermometer pocket should be as near to the centre of the tank top cover.

9.08 One inspection cover with Air release of plug shall have to be provided at the centre of the top cover of the tank. The size of the inspection cover shall be such that the Tap switch connecting leads can be viewed and checked through that inspection cover hole. The inspection cover shall be provided with lifting handle.

9.09 Suitable lifting lugs of adequate thickness are to be wielded at the two diagonally opposite corners of the tank.

9.10 Lifting lugs are to be provided at the two diagonally opposite sides of the tank top cover so that the finished transformer can be lifted by means of a shackle. The top cover for transformers shall also been provided with a lifting handle for lifting the tank top cover.

9.11 The tank shall be designed in such a way that the metallic part inside the H.V bushing shall remain immersed in oil when the oil level is at minimum oil level marking of oil level gauge

Tank cover should have 90° downward bent edges on all sides to protect the gasket under the top cover from direct exposure to weather. The tank cover should have slightly slanted towards HV side so that rain water could not accumulate on the tank cover.

The rating , Sl. No. , P.O No. , year & month of manufacture, guaranteed for five years , property of WBSEDCL etc. Asset Codification no. , Energy efficiency level of Level2 type, marking with standard mark as per clause no. IS 1180 (Part1) of 2014 shall be engraved / Embossed distinctly on the tank body in addition to those provided in the name & rating plate. Adequate care shall be taken so that tank does not get damaged during such engraving.

Alternatively a M.S Sheet of adequate thickness containing those data being engraved in the sheet may be welded at a suitable location of the tank body. Adequate care must be taken so that the main tank/Hot resistant paint inside the tank/Transformer oil do not suffer any damage during the process of welding.

Nuts & Bolts and washers are to be provided for outside use on tank cover & accessories shall be as follows:

a) Size 12 mm or below – Stainless Steel
b) Above 12 mm. – Steel with suitable finish like Electro galvanized with passivation or hot dip galvanized.

9.12 Inside wall of the tank and the M.S. Channel shall be painted with varnish or with hot oil resistance paint. Stiffener shall be continuously welded on the tank wall.

9.13 All the welding of the tank & accessories must be double welded and all welding operations must be done by qualified welders.

9.14 Nuts, bolts, flat washers, spring washers as specified shall be used and suitable space to press the tank cover. Following minimum clearance between top yoke and top cover are to be maintained.

9.15 Explosion vents shall also be welded on the Cover. Air release plug should be provided on the top of the explosion vent.

9.16 Thermometer pocket as per relevant ISS should be provided on top cover for measurement of top oil temperature. The thermometer pocket should be welded on tank top cover having threads on projected portion of top cover so that the pocket can be covered by a metallic cap having thread inside.

9.17 The Inspection cover should be placed on turret so as to eliminate the seepage of rain water from the top cover of the tank. The HV bushings if placed on top cover shall also be placed on turret.

9.18 Silica gel breathers are to be provided on transformers of all ratings. A suitable metallic cover should be provided on the pipe on which the breather is provided at a location just above the breather so that it can protect rain water from falling directly onto the breather. Conservators are to be provided of ratings 63,100 and 160 KVA. The pipe for connecting the breather should be provided with a metallic plate suitable shaped in the form of a canopy and at a point of the pipe beneath which the breather so that the rain water does not fall onto the breather directly. The moisture absorption shall be indicated by a change in the colour of silica gel crystals which should be visible from a distance. The volume of the breather shall be suitable for 500gm. Of silica gel conforming to IS:3401 for transformers upto 160 KVA . The conservator shall be liberally dimensioned such that with the lowest ambient temperature and no load on the transformer. The oil level shall not recede too low with the highest ambient temperature & permissible overload on the transformer, the oil will not spill into the breather pipe or to the exterior to waste. The conservator shall be provided with oil level indicator of prismatic type with minimum, normal & maximum temperature markings. The inside diameter of the pipe connecting the conservator to the main tank shall be within 20 to 50 mm and it should be projected into the conservator in such a way that its end is a approximately 20 mm above the bottom of the conservator.

Conservators of suitable dimension shall have to be provided. The conservator shall have any Drain Plug and. Filling hole with threaded air tight metallic cover shall be provided as usual. Conservator pipe shall be welded on the tap cover.

Conservators along with silicagel breathers are to be provided in the transformers. The conservator shall be liberally dimensioned such that with the lowest ambient temperature and no load on the transformer, the oil level shall not recede too low and with the highest ambient temperature and permissible over load on the transformer the oil will not spill into the breather pipe or to the exterior to waste.

The conservator pipe hole fitted to the tank cover shall be provided with a suitable slanted plate, if required so that while pouring oil into the transformer through conservator, oil does not fall directly on the winding.

Care should be taken so that oil flow is not impeded.

9.19 <u>COOLING ARRANGEMENT:</u>

1. The transformer shall be suitable for loading of 100% continous maximum rating with 'ONAN' cooling without exceeding the thermal limit at all tap positions.
2. The DTR 25 KVA and above may be fitted with round or elliptical cooling tubes bent and welded to tank or radiators Consisting of a series of separate circular or elliptical tubes, or a pressed steel plate assembly formed into elliptical oil channels, welded at their top and bottom to the tank.
3. The round cooling tubes shall be made of mild steel(ERW) having a minimum wall thickness of 1.50 mm and a clean bright internal surface free from rust and scale. They shall be suitably branched to protect them from mechanical shocks normally met in transportation and damp the modes of vibration transmitted by the active part of the transformer in service. The elliptical tubes or elliptical oil channels of pressed steel plate at least of 18 SWG(or 1.25mm thickness).
4. The radiator on the upper side should be placed beneath the LV bushing pocket so that due to oil leakage from the gaskets of LV bushing oil level does not in any way go below the upper side of

top radiator header and in the process effectiveness of the radiators for cooling is not lost.

5. The manufacture will have to provide information regarding wall surface area of tank radiator cooling tubes separately as part of the guaranteed technical particulars.

9.20 PRESSURE TEST :

a) Type Test:

The transformer shall be subjected to air pressure of 80Kpa above atmosphere for 30 minutes and vaccum of 500 mm. 500 mm. of mercury for rating above 200KVA for 30 minutes. The permanent deflection of flat plate after pressure has been released shall not exceed values given below:-

Length Of Plate	Deflection for rating upto 200KVA
Upto 750m	5 mm
751 to 1250 mm	6.5 mm
1251 to 1750 mm.	8.0 mm.
Above 1751 mm.	9.0 mm.

If required, the manufacturers should submit pressure test certificates for the transformer tanks at least for one Tank for each batch either conducted by their fabricators or by themselves. Transformer tanks should be double welded electrically as per the specification.

b)Routine Test:

The transformer tank with bolted cover shall be tested at a pressure of 35 KPa above atmosphere pressure maintained inside the tank for 10 mins. There should be no leakage in any part.

9.21 Oil Leakage Test:

The assembled transformer with all fittings including the bushing in position shall be tested at a pressure equivalent to twice the normal head measured at the base of the tank for 8 hr.There should be no leakage at any point.

9.22 The manufacturers should submit pressure test certificates for the transformer tanks at least for one batch either conducted by them or by their fabricators, for which order is placed with them and edges(both inside and outside) of the transformer tanks should be double welded electrically and scrupulously as per the specification.

9.23 TAP CHANGER/TAPPINGS:-

The OFF load tap changing shall be effected by an external 3 phase gang operated tap changing switch.The operatiing shaft shall be brought out of the tank and provided with hand wheel so that it can be operated at standing height from plinth level and be easily accessible.The tap position should correspond to the voltage variation of (+)5% to (-) 7½% in step of 2.5% at HV side with its normal position at 3.

A visual tap position indicator shall be provided near the operating handle and provision shall be made to pad lock the handle in each tap position.The locking arrangement shall be such that pad lock can not be inserted unless required contacts corresponding to the tap positions are correctly connected with full contact pressure.
All contacts of the tapping shall be silver plated and held in position under strong contact pressure.

Taps shall be provided on high voltage windings. At each tap positions, rated output shall be available within allowable range of voltage variations. The tap position marking should increase in clockwise direction and there should be a stopper in between maximum position i.e. 1 and minimum position i.e. 6.The tap position marking should be such that they are easily visible and permanent.

9.24 BUSHINGS:

All bushings shall conform to the requirements of latest revision of IS:3347 and other relevant standards. Bushings must be well processed, homogeneous and free from cavities and other flaws. Glazing must be uniform in colour and free from blisters, burns and other defects.
The bushing rods & and nuts shall be made of brass m material 12 mm diameter for both HT and LT bushings. The bushings shall be shall be fixed to the transformer on side with straight pockets and in the same plain or on the top cover top cover for transformers above 100 KVA. For transformers of 100 KVA and below the bushing can be mounted on pipes. The tests as per IS 2099 and IS 7321 shall be conducted on the bushings.
The Bushings can be of porecelain/epoxy material. Polymer Insulator bushings conforming to relevant IEC can also be used.
For 33 KV, 36 KV class bushings shall be used and for 11KV, 17.5 KV class bushing and for 0.4 KV, 1.1 KV class bushing shall be used.

Dimensions of bushings of the voltage class shall conform to the standards specified .
Arcing horns shall be provided on HV bushings.
Lightning Impulse voltage of H.V bushing shall be 95 KVP and short duration Power frequency voltage shall be 28 KV (RMS). The LV bushing shall have short duration Power frequency voltage shall be 3 KV (RMS).

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The Bushings shall be of reputed make. The Bushing manufacturer shall have credential of supply of Bushings and have testing facility for bushing.
The minimum phase to phase and phase to earth clearance in air in case of outdoor type bushing shall be as follows:

Voltage	Clearance	
	Phase to Phase	Phase to Earth
33 KV	350 mm.	320 mm.
11 KV	255 mm	140 mm.
LV	75 mm for DTR upto 25 KVA and 85 mm. beyond 25 KVA.	40 mm.

The minimum phase to phase and phase to earth clearance in air in case of Cable End Box type bushing shall be as follows:

Voltage	Clearance	
	Phase to Phase	Phase to Earth
33 KV	350 mm.	220 mm.
11 KV	130 mm	80 mm.
LV	45 mm.	20 mm.

10.00 PAINTINGS :

10.01 SURFACE PREPERATION & PAINTING:

i) GENERAL
1. All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brass marks or other defects.
2. All primers shall be well marked into the surface, particularly in areas where painting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendation. However, wher ever airless spray is not possible, convensional spray be used.

ii) 1. After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag, or spatter and other contamination prior to any painting.
3. Steel surfaces shall be prepared by shot blast cleaning(IS 9954).
4. Chipping, scraping, and steel wire brushing using manual or power driven tools can not remove firmly adherent mill-scales. This methods shall only be used where blast cleaning is impractical.

iii) Protective coating:
1. As soon as all items have been cleaned and within four hours of subsequent drying, they shall be given suitable anti corrosion protection.

iv) 1. Following are the types of paint which may be suitably used for the items to be to be painted at shop and supply of matching paint to site.
a) Hot oil resistant(Proof) or varnish paint for inner surface .
b) For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of synthetic synthetic enamel/polyurethane base paint. These paints can be either air drying or stoving.

v) Painting Procedure:
1. All prepared steel surfaces should be painted before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.
2. Where the quality of filmis impaired by excess film thickness(Wrinkle, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As ageneral rule, the dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.

vi) Damaged paintwork:

1. Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.

vii) Dry Film thickness:

1. To the maximum extent practicable the coats shall be applied as a continuous film of uniform Thickness and free from pours. Overspray, skips, runs, sags, and drips should be avoided. The different coats may or may not be of same colour.
2. Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.
3. Particular attention must be paid to full film thickness at the edges.
4. The requirement for dry film thickness (DFT) of paint and the materials to be used shall be as given below:

Sl. No	Paint Type		Area to be painted	No of coats	Total dry film thickness, min(Microns)
1	Thermosetiing Power Paint		Inside	01	30
			Outside	01	60
2	Liquid Piant	a. Epoxy(Primer)	Outside	01	30
		b. Polyurethane(finish coat)	Outside	02	25 each
		c. Hot oil resistant paint/Varnish	Inside	01	35/10

viii) Test for painted surface:

1. The painted surface shall be tested for paint thickness.
2. The painted surface shall pass the cross hatch adhesion test and impact test as acceptance test and salt spray test and hardness test as type test as per ASTM standard.

Note: The paint wok shall also come under the coverage of guarantee period of the equipment.

10.01 Before painting or filling with oil, all un-galvanized parts shall be completely cleaned & free from rust, scale & grease and all external surface on castings shall be filled by metal deposition.

10.02 The interior of all transformer tank & Internal structural steel work shall be thoroughly cleaned of all scale & rust by sand blasting or other approved method. This surface shall be painted with hot oil resisting varnish or paint.

11.00 EARTHING TERMINALS :

Two earthing terminals capable of carrying the full amount of lower voltage , short circuit current of transformer continuously for a period of 5 Sec. shall be provided.

12.00 RATING & DIAGRAM PLATE:

12.01 A rating plate bearing the data specified in the relevant clauses of IS 1180 (Part 1) of 2014 including connection diagram, Tap positions on HV sides mentioning the voltages at different tap positions Vector group, Voltage LV & HV, LV & HV current, percentage Impedance, Loss figure,. Makers name, serial no etc. are to be provided along with the transformer.

12.02 The total weight of finished transformer along with the untanking weight of core & winding is to be mentioned.

12.03 Guaranteed maximum temp rise in oil & winding should be mentioned.

12.04 It should be mentioned that the loss figures of the DTR corresponds to Efficiency Leve2 of IS 1180 (Part !) of 2014.

12.05 The Guaranteed values of Temperature rise of top oil & winding are to be mentioned.

12.06 "Property of WBSEDCL" is also to be mentioned.

13.00 MOUNTING ARRANGAMENT:

The Mounting arrangement shall be as per clause no. 14 of IS 1180 (Part 1) of IS2014 or latest amendment thereof. The 160 KVA ;11/0.415 KV transformer may also be placed on concrete base. However the distance between the centre of hole of base channel for mounting on pole structure shall be 415 mm. without any tolerance.

14.00 DUTY UNDER FAULT CONDITION :

14.01 It is to be assumed that abnormal voltage will be maintained on one side of the transformer when there is a short circuit between phases or to earth on the other side.

14.02 The transformer may be directly connected to an underground or overhead line and may be switched into and out of service together with or without its associated incoming / outgoing line.

14.03 The thermal ability to withstand short circuit shall be three seconds without injury for 3 phase dead short circuit at the terminals. The related calculation is to be submitted.

14.04 Over Load Capacity:

Each transformer shall be capable of carrying sustained overload as stated is IS 6600.

14.05 Mounting Arrangement:

The applicable

15. 00 FITTINGS:-

15.01 The following fittings shall be provided with the Transformers.

i) Name , rating & terminal marking plates

ii) Two nos. earthing terminals.

iii) Two nos. lifting Lugs at two diagonally opposite corners of the tank top cover.

iv) Pole / plinth mounting arrangement.

v) Silica gel breather.

vi) H.V. Bushing with arcing horn. For cable end box type Arcing Horns are not required.

vii) L.V. Bushing for phases & neutrals.

viii) Off load Tap Swich

ix) One no. oil level gauge of prismatic type with Min^m , Normal & Max^m Temperature Markings at suitable location of the conservator.

x) Conservator with oil filling hole at the centre of top of conservator with threaded cover and Drain plug at the bottom.

xi) Drain Valve [REC type with 3/4" plug]

xii) Filter Valve [Wheel valve -- 3/4" size]

xiii) Explosion Vent with Air release plug(for 100 & 160 KVA DTR)

xiv) Air release plug on the tank top cover for 63 , 100 & 160 KVA DTR and thermometer pocket as per specification on tank top cover located right above the centre of top yoke.

xv) Arrangement of earthing with lug of the tank main body.

16.00 Lifting and Haulage facilities :

16.01 Each transformer tank shall be provided with lifting lugs suitable for lifting of transformer complete with oil Suitable holes shall be provided in the base channel of the transformer tank for fixing in the D. P. Structure above ground level of height 4.5 meter approx.

17.00 Insulating Oil :

A. The oil shall be specified in Is:335-1980 and it shall free from moisture and have uniform quality throughout.
B. Use of recycled oil is not acceptable.
C. Oil shall be filtered and tested for breakdown voltage (BDV) and moisture content before filling.
D. The oil shall be filled under vacuum.
E. The design of the materials and processes used in the manufacture of transformer, shall be such as to reduce to a minimum the risk of development of acidity in the oil.
F. The transformer oil is to be procured from reputed manufacturer only. During inspection of transformer the manufacturer will have to submit the complete test report as collected from the oil manufacturer, whenever asked, failing whch the transformer will not be accepted.
G. The manufacturer will have the facility of the following test at their works:
   1. Breakdown Voltage
   2. Acidity test
   3. Moisture content test
   4. Resistivity test at 27°C and at 90°C

   Note: The manufacturer will have to submit test certificates for the above test in respect of oil sample collected from the transformer at the time of inspection.

18.00 Internal Earthing Arrangement:-

18.01 All metal parts of the transformer with the exception of the individual core lamination , core bolts and associated clamping plates shall be maintained at same fixed potential & core should be earthed at two points.

ROUTINE & TYPE TEST AND OTHER COMMON DETAILS FOR 16-100 KVA DISTRIBUTION TRANSFORMER

19.00 Testing & Inspection : -

19.01 Routine Test :

All transformers offered shall be subjected to routine tests and one transformer out of each offered lot shall also be subjected to Temperature Rise Test at lowest tap position at the manufactures works.

The following tests are to be carried out :

a) Measurement of winding resistance at all Tap position

b) Ratio at all tap positions, polarity and phase relationship

c) % Impedances voltage at 75°C and at 50 Hz

d) Load losses at 50% & at 100% loading at 75°C and load loss at 100% loading at lowest tap position for Temperature Rise Test.

e) No load loss at 50 Hz and no load current at rated voltage & 112.5% voltage.

f) Insulation resistance.

g) Induced over voltage withstand.

h) Separate source voltage withstand

j) Unbalance current : The maximum value of unbalance current in transformer shall not exceed 2% of full load current as per CBIP for transformer.

k) Magnetising current at rated voltage & frequency & 112.5 % of rated voltage & frequency should not exceed the limit as per IS: 1180 (Part – I) 1989 Cl . 22.6 .

l) Temperature Rise Test will be conducted on one transformer of each offered lot and the test will be conducted at lowest Tap position.

m) Pressure Test: As per Clause no. 21.5 of IS 1180 (Part-1) 2014

n) Oil leakage Test: As per Clause no. 21.5 of IS 1180 (Part-1) 2014

Note: To facilitate testing, arrangement should be made for carrying out Heat Run tests for at least two transformers simultaneously.

19 . 02 Type test :-

In addition to the routine tests, the following type tests, are to be carried out at CPRI/ NABL Accredited third party Laboratory or any other Govt. recognized Test House. Transformers for such tests are to be manufactured as per relevant technical specification and approved drawing and should be offered for preliminary testing like routine and temperature rise test at lowest Tap position prior to type tests, by WBSEDCL's testing wing. After successful completion of preliminary tests, transformers will be sent for type tests. After successful completion of Type tests the transformer will be sealed by WBSEDCL Testing Wing. The transformer with the sealing are to be preserved at the manufacturer's works for comparison with the transformers to be offered in future.

a) Dynamic short circuit withstand test to be conducted as per IS 2026(Part 5)
b)Lightning Impulse voltage withstand test to be conducted as per IS 2026(Part 3) The Impulse voltage wave shape should be Chopped on tail..

19.03 The manufacturer will have to submit thermal calculation of short circuit withstand ability for 2 seconds and 3 seconds.

19.04 Performance under external short Circuit condition and limit of temperature rise.

19.05 All transformers shall be capable of withstanding , without damaging the thermal and mechanical effects of short circuit at the terminal of any winding for 2 secs. The temperature in the winding after 2 secs of over current must must not exceed 200^{o}C for Al and 250^{o}C for cu windings.

19.06 Variation % reactance :

The transformer so tested shall not exhibit more than 2 percent variation in percentage reactance for stack core after the short circuit test from the original measured value before testing according to clause 16.11.5.4 of IS:2026(Part-I),1977..

20.00 Inspection & Testing : -

20.01 Inspection & Testing of the equipment / materials shall be subjected to routine & other acceptance test as per provisions in the relevant I.S.

20.02 WBSEDCL reserves the right to send its Engineers if so,desired to witness manufacturing process and to reject either raw materials or finished products found to be not complying with requirement of the specification and also shall have the right to select any / all equipment from the lot offered for tests.

20.03 The manufacturer shall give at least fifteen(15)days advance notice regarding readiness of such Inspection and testing and shall submit seven(7) sets of work test certificates of the materials/equipment offered for Inspection and testing indicating probable date of Inspection and testing.

20.04 The supplier shall arrange all possible facilities for such Inspection and testing at any time during the course of manufacturing , free of cost.

20.05 The transformer may be stage inspected at the factory of the manufacturer. The manufacturer shall intimate in advance in writing to the purchaser about the stages of manufacture & subsequent readiness of the transformers to enable the purchaser to carry out stage inspection & final inspection and testing of the finished transformers.

20.06 The stage inspection will be carried out at the discretion of the purchaser during the process of manufacturing of the transformers. The manufacturer need not stop the process of production because of the programme of stage inspection of the Purchaser.

20.07 While offer for final inspection the following point should invariably be taken care of

i) Name plates should be welded on the tanks of the transformer.
ii) The bolts connecting the top cover of the transformer with the tank at the two opposite comers are to be provided with holes at their lower portions which would go beyond nuts so that the transformers may be sealed by inserting sealing wire in these holes.
iii) The transformers should be offered along with factory routine test certificate as per I.S.

21.00 Test Certificates:-

21.01 Seven Copies of Test Certificates i.r.o offered transformers are to be furnished to WBSEDCL for acceptance before issuance of instruction for dispatch of the equipment.

22.00 Drawings & Manuals :-

22.01 The following drawings and manuals shall be furnished in triplicate along with tender.

i) General Arrangement outline drawing with plan , elevation and end view showing various dimension of transformer and its vital equipment including height of the bottom most portion of bushing from the bottom of base channel and also indicating thereon physical center line & position of center of gravity.

ii) Cross sectional drawing showing various parts, including Core - coil assembly.

iii) Drawing for rating & diagram plate, complete list of fittings, Net weight of core, winding, tank, oil, total weight, fixing arrangement of transformer in structures.

22.02 The following drawings in four sets shall be submitted for approval within 10 (ten) days from the date of placement of L.O.I. / Order.

1. As stated in clause 21.01 above.
2. Cross sectional details with Plan, Elevation, End view showing all internal clearance.
3. Property plate drawing.

23.00 Guaranteed Technical Particulars:-

23.01 Tenders shall be furnished with guaranteed technical particulars of equipment offered as per Schedule . Performance guarantee shall be based on guaranteed technical particulars.

24.00 Performance Certificate as pre-requisites :-

24.01 Copies of performance certificates of similar equipment supplied to various organization shall have to be furnished in triplicate along with the tender.

25.00 Credentials as pre-requisites:-

25.01 Tenderer shall furnish document along with bid , in support of supply, delivery at consignee stores (e.g copy of P.O. , SRV , Challan etc) of identical type & rating transformer and also higher capacity with same voltage Ratio and type, to the Govt. & Power Utility, indicating thereon names of the Organization, quantity ordered, quantity supplied along with the tender. Credentials for Purchase orders shall be within last 3(three) financial years from the date of opening of bid (If opening date extended, the 1st mentioned date for opening , shall be considered for submission of credential).

26.00 Type Test & special test Report as pre-requisites : -

The certified copies of valid type test reports for ISI clauses as per Energy Efficiency Level-2 specified in IS: 1180(Part-I):2014, copper wound 315 KVA rating distribution transformer from the Govt standard test Laboratories/Govt. approved laboratories/NABL accrediated third party laboratory shall be submitted along with the tender.

The type test certificates for all ratings shall not be more than 5 years old from the date opening of the tender.

26.01 The bidder should submit Test Report of Short circuit Test and Lightning Impulse voltage test report etc.for the rating they are offering along with drawing conducted from CPRI, NABL accredited laboratory of third party /Govt. approved laboratories carried out within Five years along with their offer having identical rating and type as that of the tendered item as pre-requisites mentioned in GCC, failing which their offer may not be technically accepted.

27.00 Deviations :-

27.01 All deviations from the specification , shall be recorded in the ' Deviation Sheet ' with reference to respective clauses of the specification by drawing specification for the same. Unless deviations are recorded in the deviation sheet and submitted with the offer, it will be taken for granted that the offer is made in conformity with specification.

28. 00 Validity Period :-

28. 01 Validity period of the offer shall be reckoned from the next date of opening of tender provided it is

technically & commercially complete one . Otherwise , it will be counted from the date of receipt of complete information.

28. 02 Anything not covering by this specification, will be as per relevant CEA/ REC specification & ISS/CBIP manual.

29.00 Store Testing :-

Store testing of supplied DTR at WBSEDCL/vendor store may be done at the discretion of WBSEDCL

30.00 Asset Codification no. –

Asset codification no . for the ordered quantity shall be communicated to the supplier after placement of order. Necessary Engrave / Embossing (cold punch) shall be done on the main tank with 28 no. font size , DTR name and diagram plate with font size not less than that used for marking KVA rating of the DTR.

If cold punch on the tank is not possible then separate property plate (details marking of the plate shall be submitted with the transformer drawing for approval) shall be welded to the tank with the following details:-

1. Ratings :
2. Manufacturer's Sl.No. :
3. Manufacturer's Name :
4. P.O. No. :
5. M o n t h / Year of Manufacturing:
6. Guaranteed for 5 Years
7. Property of : WBSEDCL
8. Energy Efficiency Level2 as per IS 1180 (Part-1) of 2014
9. Asset Code Number : (10 digit alpha numeric numbers as allotted by the purchaser) Again the following points shall have to be noted
   a) Front Size of letter shall be 28 i.e. 7 mm x 5.5 mm
   b) Letters shall be distinctly engraved by cold Punch
   c) Plate size shall be minm 125mm X 170mm and shall be electrical run Welded be throughout its perimeter
   d) Material of Plate shall be Mild Steel and not less than 3mm thick.
   e) Plate shall be welded on the transformer tank at visible position and height. and height.

31.00 Testing Equipments : -

i) KV Meter (0 - 30 KV) for 11 KV system .
ii) Volt Meter (0 - 1000 V) .
ix) Milli ammeter for leakage current (0 - 100 ma) .
ix) Power Analyzer of reputed make (should display 3 – phase current , voltage , watt and ∑ 3 – Ø Power
ix) Megger - 2 . 5 KV
vi) Thermometer (preferably Digital) 0 - 100^0 C
vii) TTR Meter
viii) Winding Resistance measurement (Preferably ELTEL or reputed make)
ix) Digital Multimeter
x) Clamp on ammeter (0 - 300 A)
xi) Instrument for measuring the thickness of different layers of painting.
xii) Instrument/Equipments required for testing of painting as per IS 1180 (Part 1) of 2014.
Xiii) Equipment for pressure test as per Clause no. 21.5 of IS 1180 (Part-1) 2014
xii) Equipment for Oil leakage test as per Clause no. 21.5 of IS 1180 (Part-1) 2014
xiii) Test set for measuring Break Down voltage of transformer oil.
xiv) Test kit for measurement of acidity of transformer oil.
xv) Test Set for measurement of Moisture content of transformer oil.
xvi) Test Set for measurement of resistivity at 27 ^oC and at 90 ^oC**.**

ALL THE ABOVE TESTING EQUIPMENTS SHALL BE AVAILABLE IN THE TESTING LAB AND SHOULD BE CALIBRATED FROM NABL ACCRIDATED LABORATORY. COPY OF CALIBRATED CERTIFICATES AS PER GCC CLAUSE NO. 8 SHALL BE AVAILABLE WITH THE BIDDER AS AND WHEN REQUIRED .

Note : To facilitate testing , arrangement should be made for carrying out Heat run test of two Transformers simultaneously.

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WEST BENGAL STATE ELECTRICITY DISTRIBUTION CO. LTD

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

SCHEDULE-A

(To be furnished and singed by the tenderer for each category of Transformer)

Sl. No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
1	Name of the manufacturer & Factory address	::	
2	Country of origin	::	
2(a)	Whether the manufacturer has the BIS certification for manufacturing the item offered? If yes, Energy efficiency level for which BIS certification is Submitted?	:: ::	
2(b)	Whether the manufacturer has uploaded Type, Special & other test reports required for BIS certification for manufacturing the item offered?	::	
3	Applicable standard	::	
4	Maximum continuous rating in KVA	::	
5	No load voltage ratio (In KV/KV)	::	
6	Rated frequency (in HZ)	::	
7	Number of phases	::	
8	Type of Cooling	::	
9	Connections		
	(i) H.V. Winding		
	(ii) L.V. Winding		
10	Vector Symbol		
11	(i) Temperature also under normal operating condition above ambient temperature	::	
	(a) Top oil (in ^{0} C.)	::	
	(b) Winding (in ^{0} C)	::	
	(ii) Maximum hot spot temperature of winding (in ^{0} C)	::	
12	Magnetizing current referred to H.V. at rated frequency	::	

	(a) At 90% rated voltage (in Amps)	::	
	(b) At 100% rated voltage (in Amps)	::	
	(c) At 112.5% rated voltage (in Amps)	::	
13	Power factor of magnetizing current at 100% rated voltage & frequency	::	
14	No load current at rated voltage and rated frequency (in Amps)	::	
15	Max^{m} No load loss in watt at rated frequency & voltage	::	
16	Max^{m} Load loss in Watt at 75 ^{0}C. at rated output and frequency	::	
17	Max^{m} Total Loss (including NLL & FLL) at 50 % loading at 75 ^{0}C	::	
18	Max^{m} Total Loss (including NLL & FLL) at 100 % loading at 75 ^{0}C	::	
19	Percentage Regulation at full load at 75 ^{0}C	::	
	(a) At unity power factor	::	
	(b) At 0.8 power factor lagging	::	
20	Efficiencies at 75 ^{0} C (in percentage)	::	
(a)	At full load	::	
	(i) At unity power factor	::	
(b)	At ¾ full load	::	
	(i) At unity power factor	::	
	(ii) At 0.8 power factor lagging	::	
(c)	At ½ full load		
	(i) At Unity power factor		
	(ii) At 0. 8 Power factor lagging		
21	Impedence voltage on rated kVA base at rated current and frequency at 75 ^{0} C (in percentage)	::	
22	(a) Resistance voltage at rated current and frequency at 75 ^{0}C (in percentage)	::	
	(b) Reactance voltage at rated current and frequency at 75 ^{0}C (in percentage)	::	

23	Resistance at H.V. base at 75 ^{0} C a) HV (between lines) (ohms) b) LV (between lines) (ohms)	::	
24	Reactance at H.V. base at 50 c/s	::	
25	Withstand time without injury for three phase dead short circuit at terminal (in seconds):	::	
26	Short time current rating for short circuit with duration	::	
	(a) H.V. Winding (in K Amps)	::	
	(b) L.V. Winding (in K Amps)	::	
	(c) Duration in seconds)	::	
27	Permissible over loading with time at max amb temp a) 125% load after running with 50% load with steady temp rise. (hrs.) b) 120% load after running with 100% load with steady temp rise. (hrs.)	::	
28	Core :		
(i)	Material Type :		
(ii)	Whether stack core / wound core type :		
(iii)	Flux density of Core and yoke : (a) At rated voltage at 50 HZ (in line/sq cm)	::	
	(b) At 112.5% rated voltage at 50 HZ (in line/sq cm)		
(iv)	Thickness of Stampings (in mm)	::	
(v)	Type of Insulation between core lamination	::	
(vi)	Approximate area of Cross Section of Core and yoke (in sq.mm)	::	
(vii)	Material of Core clamping plate	::	
(vii)	Thickness of Core clamping plate (in mm)	::	
(viii)	Insulation of Core clamping plate	::	
(ix)	Describe location/Method of Core grounding	::	
(x)	Please specify the use of primary core material in the offered transformer		
(xi)	Whether the proof of use of prime core material is enclosed.		
29	Terminal Arrangement :	::	

	(i) high voltage	::	
	(ii) low Voltage	::	
30	Positive Sequence Impedance between HV & LV winding on rated KVA base at rated current and frequency at 75 ^{0}C. Winding temperature (in percent).	::	
31	Zero Sequence Impedance at reference temperature of 75 ^{0}C (in percent)	::	
32	Details of windings :	::	
	(i) Type of Winding : (ii) Joints in the windings soldering / brazing but in any case crimping is not allowed	::	
	a) High Voltage ;	::	
	i))No. of Tap positions and it's range mentioning the normal Tap position	::	
	c) Low Voltage	::	
	(ii) Material of the winding conductor	::	
	(a) High Voltage :	::	
	(b) Low Voltage :	::	
	(iii) Conductor Area	::	
	(a) High voltage (in sq.mm)	::	
	(b) Low Voltage (in sq.mm)	::	
	(iv) Current density of winding at rated KVA	::	
	(a) High Voltage (Amp per sq.cm)	::	
	(b) Low voltage (Amps per Sq.cm)	::	
	(v) Insulating material used for	::	
	(a) High Voltage Winding	::	
	(b)) Low Voltage Winding	::	
	(vi) Insulating material used between	::	
	(a) High voltage and low voltage winding	::	
	(b) Low Voltage winding and Core	::	
33	Insulation withstand Test Voltages	::	

	(i) Lightning Impulse withstand test voltage (KV Peak)	::		
	(ii) Power frequency withstand test voltage (in KV rms for 1 mtn)	::		
	(iii) Induced over voltage withstand test voltage (in KV rms)	::		
34	Current in the winding at rated KVA	::		
	(I) Low voltage (in Amps)	::		
	(ii) High Voltage (in Amps)	::		
35	Voltage per turn (KV per turn)	::		
36	Ampere turn	::		
37	Number of turns	::		
	(i) Low Voltage	::		
	(ii) High Voltage	::		
38	Bushing	::	High Voltage	Low Voltage
	(i) Make	::		
	(ii) Type	::		
	(iii) Applicable standard	::		
	(iv) Insulation withstand test voltage	::		
	(a) Lightning Impulse withstand test voltage (1.2 x 50 micro seconds (in KV Peak)	::		
	(b) Power frequency withstand test voltage (in KV for 1 min)	::		
	i) Dry	::		
	ii) Wet	::		
	(v) Creepage distance in air	::		
	(i) Total (in mm)	::		
	(ii) Protected (in mm)	::		
	(vi) Minimum height of the bushing			
39	Minimum clearance (in mm)	::		
	Between live conductive parts and live conductive parts to earthed structure		In Oil	In Air

			Between Phases	Phase to Ground	Between Phases	Phase to Ground
	(i) H.V.	::				
	(ii) L.V.	::				
40	Approximate weight of Transformer (in Kgs)	::				
	(i) Core with clamping	::				
	(ii) Coil with Insulation	::				
	(iii) Core and winding	::				
	(iv) Tank and fitting with accessories	::				
	(v) Untanking weight	::				
	(vi) Oil required for the transformer	::				
	(vii) Total weight with Core, Winding, oil and fittings	::				
41	Details of Tank	::				
	(i) Type of tank	::				
	(ii) Approximate thickness of Sheet (in mm)	::				
	(a) Sides	::				
	(b) Bottom	::				
	(c) Cover	::				
	(iii) Vacuum withstand capacity	::				
	(iv) Dimension of base channel (in mm x mm)	::				
42	Oil quality	::				
	(i) Applicable standard	::				
	(ii) Total quality of oil (in litres)	::				
43	Approximate overall Dimensions (in mm)	::				
	(a) Length	::				
	(b) Breadth	::				
	(c) Height	::				
	(d) Minimum height of bottom most portion bushing from bottom of base channel	::				

44	Minimum clearance height for lifting tank cover (in mm)	::	
45	Whether Type Test Report, Credential, Performance Certificate submitted as Pre-requisites as mentioned in respective clauses .		
46	Marking : whether agreeable to a) Punching of transformer Sl. No. on the Top yoke. b) Transformer Rating and Diagram plate along with Asset codification number shall be welded on the tr. Body.		
47	Whether they have facility for painting and test in line with the technical specification at their works		
48	Whether they have facility for carrying out Tank Pressure & Oil leakage test test in line with the technical specification at their works		
49	List of testing equipments available in the testing lab. of manufacturer in line with Cl. No. 31 . 00		

Signature:

Name:

Designation:

Company Seal: