Kashmir Power Distribution Corporation Ltd.
Office of the Chief Engineer Planning & Procurement,
PDD Complex, Bemina, Srinagar.
Email: ceppkpdcl@gmail.com

TECHNICAL SPECIFICATIONS

OF

Outdoor Type Three Phase Oil Immersed 11kV/433-250V, 50 Hz, Aluminum Wound Distribution Transformers of Energy Efficiency Level-2 as per IS: 1180(Part-1):2014 of rating 25kVA, 63kVA, 100kVA & 200kVA

Prepared by	Checked by	Checked by	Checked by	Approved by
Er.Aijaz Ahmad Mir (AEE) Er. Irtiqa Koul (JE) Er. Wasiya Mushtaq (JE)	Er. Manzoor Ahmad Dar (Executive Engineer) Purchase Officer, Procurement Division.	Er. Muzaffar Mukhtar Shah, Superintending Engineer, Procurement Circle.	Er. Muzaffar Mukhtar Shah, Chief Engineer, Planning & Procurement, Wing, KPDCL, Srinagar.	Techno Economic Committee vide No. MD/KPDCL/ TS-1/3266-72 Dated:06/01/2023
Specification No. **CE/P&P/SPEC/2022/ALUMINUM TRANSFORMER/021**		Date of Issue: **07/01/2023**	Rev 0	

This Tender Specification for procurement of Outdoor Type Three Phase Oil Immersed 11kV/433-250V, 50 Hz, Aluminum Wound Distribution Transformers of Energy Efficiency Level-2 as per IS: 1180(Part-1):2014 of rating 25kVA, 63kVA, 100kVA & 200kVASupplier to submit the Guaranteed Technical Particulars (GTP) and Drawings, after the award of the Contract, for approval of the Purchaser

CLIMATIC AND ISOCERAUNIC CONDITIONS(CIC)

1.	The climatic and Isoceraunic conditions at the site of work are approximately given asunder:	
	Description	Kashmir
i)	Max. temp of air in shade	30.6^0C
ii)	Min. temp of air in shade	-20^0C
iii)	Max. temp of air in sun	45^0C
iv)	Height above sea level (App.)	1600Mtrs.
v)	Max. relative humidity	90%
vi)	Min. relative humidity	15%
vii)	Average no. of thunderstorm days per year	54
viii)	Average rainfall	80cm
ix)	Wind Zone	WZ –3
x)	Average number of rainy days per year	106
xi)	Seismic Zone	SZ–5
xii)	Area of installation	Heavy Snow Zone
2.	**Communication and Transport:** The nearest railway station is Jammu on the broad gauge line and is connected to the Divisional Stores by a metal road. The equipment is required to pass en-route through various tunnels on NH-44 (Nandni, Nashri and Jawahar Tunnel).The weights and maximum dimension of the packages suitable for transportation through tunnel route are as follows:- **1.** Length=7.0 m **2.** Width=3.0 m **3.** Height=4.55 m **4.** Weight=40 MT The supplier shall get the permissible weight and dimensions confirmed from the Highway Authorities before proceeding with the manufacture of the equipment. It will be the responsibility of the supplier to ensure timely and proper delivery of the equipment on door delivery basis, at Srinagar, through road transport. The supplier shall also ensure that the weights and dimension of the packages which are suitable to be carried by road transport up to Srinagar.	
3.	**Additional conditions**	
i	Permitted Noise Level	45dB
ii	Induced Electromagnetic disturbance	1.6kV
iii	Pollution class/Creepage distance	III/ 25mm/kV
iv	Isoceraunic Level (days/year)	50
v	Condensation	Occasional

TECHNICAL SPECIFICATIONS of TECHNICAL SPECIFICATIONS of Outdoor Type Three Phase Oil Immersed 11kV/433-250V, 50 Hz, Aluminum Wound Distribution Transformers of Energy Efficiency Level-2 as per IS: 1180(Part-1):2014 of rating 25kVA, 63kVA, 100kVA & 200kVA

1 SCOPE:

1.1 This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of pre-type-tested outdoor type, oil immersed, ONAN cooling, CRGO M-3 grade (0.23mm) or better, 3-phase, 11kV/433-250V, 50Hz, Aluminium wound distribution transformers of rating 25kVA, 63kVA, 100kVA & 200kVA of Energy Efficiency Level-2 as per IS:1180(Part-1):2014 for outdoor use.

1.2 The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. The equipment offered should have been successfully type tested within the last five years from the date of tender and the design should have been in satisfactory operation for a period not less than one year as on the date of bid opening. This shall be supported by authenticated copies of type test certificates as per relevant IS/IEC conducted within the last five years from any the NABL accredited Lab and shall be valid upto the expiry of validity of offer. The offered equipment shall be complete with all components necessary for their effective and trouble free operation.

1.3 The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

1.4 All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

1.5 The losses exhibited by the transformer shall be as per IS:1180 (Part-1):2014 corresponding to Energy Efficiency Level-2.

2 CODES AND STANDARDS:

3.1 The major materials used in the transformer shall conform in all respects to the relevant/specified Indian Standards and International Standards with latest amendments thereof as on bid opening date, unless otherwise specified herein. Some of the applicable Indian Standards are listed as hereunder:

Indian Standard	Title	International and Internationally recognized standards
IS -2026	Specification for Power Transformers	IEC 76
IS – 1180 (Part-1): 2014	Outdoor distribution Transformer up to and including 2500 kVA	
IS-3024	Grain Oriented Electrical Steel Sheet and Strip	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS-335	Specification for Transformer Oil	BS 148, D-1473, D-1533-1934, IEC Pub 296
IS - 5	Specification for colors for ready mixed paints	
IS - 104	Ready mixed paint, brushing zinc chromate, priming	
IS – 2099	Specification for high voltage porcelain bushing	
IS - 649	Testing for steel sheets and strips and magnetic circuits	
IS - 4257	Dimensions for clamping arrangements	
	for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B – 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS - 6600	Guide for loading of oil Immersed Transformers	IEC 76
IS - 2362	Determination of water content in oil for porcelain bushing of transformer	
IS - 6162	Paper covered aluminium conductor	
IS - 6160	Rectangular Electrical conductor for electrical	
	machines	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical	
	insulating liquids	
IS - 6262	Method of test for power factor and dielectric	
	constant of electrical insulating liquids	
IS - 6792	Determination of electrical strength of insulating oil	
	Radio Influence voltage measurement	IEC-437
	Determination of transformer sound levels	IEC-551
	Galvanization	ISO-1460/BS-729

5. PRINCIPAL PARAMETERS:

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

5.2 The transformers shall conform to the following specific parameters:

S.No	Item	11 kV Distribution Transformers
1	Rated KVA (ONAN rating)	25KVA,63KVA,100KVA & 200KVA
2	Rated voltage HV	11 kV
3	Rated voltage LV	433-250 V
4	Frequency	50 Hz +/- 3%
5	No. of Phases	Three
6	Connection HV	Delta
7	Connection LV	Star (Neutral brought out)
8	Vector group	Dyn-11
9	Type of cooling	ONAN
10	Cooling medium	Insulating oil IS:335-2018
11	No of windings	2
12	System earthing	Neutral of LV side to be solidly earthed
13	%ge impedance at normal tap at 75^0 C	4.5(+10% tolerance) (negative tolerance not allowed)
14	Neutral terminal to be brought out	On LV side
15	Max flux density in any part of the core or yoke at rated voltage and frequency with +12.5% combined voltage and frequency	Shall not exceed 1.9 tesla
16	Permissible temperature rise over ambient temperature of 50^0 C	
i)	Of top oil measured by thermometer	35^0 C
ii)	Of winding measured by resistance	40^0 C
17	Mini HV clearance in mm	
i)	Phase to phase	255mm
ii)	Phase to ground	140mm
18	Mini LV clearance in mm	
i)	Phase to phase	75 mm
ii)	Phase to ground	40 mm
19	Bushings and terminals	As per IS 3347 and IS 7421
i)	HV bushings	12KV rating oil filled porcelain type
ii)	Creepage distance	25mm/kv
iii)	LV bushings	1.0KV rating oil filled porcelain type

20	Material of HV and LV conductor	Aluminium
21	Max current density for HV and LV winding for rated current	1.6A/mm^2
22	Insulation level of windings	
i)	Basic Impulse level (BIL)	75KVP
ii)	Power frequency voltage withstand	
a)	HV winding	28KVrms
b)	LV winding	03KVrms
23	Bushing stem for 25 KVA with nuts	
ii)	HV side	12mm(Al)
iii)	LV side	12mm (Cu)
24	Bushing stem for 63KVA with nuts	
ii)	HV side	12mm(Al)
iii)	LV side	12mm(Cu)
25	Bushing stem for 100 KVA with nuts	
ii)	HV side	12mm(Al)
iii)	LV side	12mm(Cu)
26	Bushing stem for 200 KVA with nuts	
ii)	HV side	12mm(AL)
iii)	LV side	12mm(Cu)

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

KVA rating	Audible sound levels (decibels)
0-50	48
51-100	51
101-300	55

6 TECHNICAL REQUIREMENTS

6.1.1 CORE MATERIAL – Cold Rolled Grain Oriented (CRGO)

6.1.2 CRGO Material

6.1.2.1 The core shall be stack / wound type of M3 grade (0.23mm) or HIB grade or higher, cold rolled grain oriented annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the

transformers.

6.1.2.2 The stage inspection of the core and subsequent approval shall be carried out by the purchaser during manufacturing stage.

6.1.2.3 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer provided the maximum flux density in any part of the core and yoke at rated voltage and frequency shall be such that the flux density with +12.5% combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9 Tesla. The design calculation in support of flux density shall be furnished by the manufacturer.

6.1.2.4 No-load current shall not exceed 3% of full load current and will be measured by energizing the transformer at 433 volts, 50 Hz on the secondary. Increase of voltage of 433 volts by 12.5% shall not increase the no-load current by 6% (maximum) of full load current.

6.1.2.5 The unique number shall be punched on the core channel along with the name of the manufacturer to identify all core coil assembly of transformer.

7 WINDINGS:

7.1 Material:

7.1.1 HV and LV windings shall be wound from Super Enamel covered /Double Paper covered, Almunium conductor/ foil for all ratings.

7.1.2 LV winding shall be such that neutral formation will be at top.

7.1.3 Only split type coil design for HT for 25KVA, 63KVA, 100KVA and 200KVA rating transformers shall be acceptable. This is done for more reasons than one

1. In case of inter-turn fault, only that part of coil shall be replaced.
2. The split type design can have inter-changeability facility which can cut down repairing charges of DTs and also will save time.

So the bid of any manufacturer having type test as strip type design on HT side shall be straightaway rejected.

7.1.4 Inter layer insulation shall be Nomex /Epoxy dotted Kraft Paper.

7.1.5 Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted.

7.1.6 Dimensions of winding coils are very critical. Dimensional tolerances for

winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP Schedule).

7.1.7 Current density for HV and LV winding should not be more than 1.6 Ampere per sq mm for Aluminum Conductor.

7.1.8 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

7.1.9 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

8 TAPS:

8.1.1 No Taps are required for transformers up to 200 KVA rating from HV side.

9 OIL:

9.1 The insulating oil shall comply with the requirements of IS: 335-2018. Use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than 2.5×10^{12} ohm-cm at 27 ^{0}C when tested as per IS:6103.

9.2 Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.

9.3 The oil shall be filled under vacuum.

9.4 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

10. INSULATION LEVELS:

S.No	Rated Voltage (kV)	Rated BIL (kV peak)	Power Frequency (kV)
1	0.433	-	3
2	11	75	28

11 LOSSES:

11.1 The manufacturer shall guarantee the total losses at 50% and 100% load condition (at rated voltage and frequency and at 75 ^{0}C).

11.2 The maximum allowable Total losses (no-load + load losses at 75^{0}C) at rated voltage and rated frequency shall not exceed the maximum total loss values

depicted below in tabular form.

Maximum Total Losses for 11kV/0.433KV, Energy Efficiency Level-2 Distribution Transformers as per IS:1180(Part-1):2014				
S.No	**Rating (kVA)**	**Impedance (percent)**	**Maximum Total Losses at 50% Load (Watts)**	**Maximum Total Losses at 100% Load (Watts)**
1	**25**	**4.5**	**190**	**635**
2	**63**	**4.5**	**340**	**1140**
3	**100**	**4.5**	**475**	**1650**
4	**200**	**4.5**	**780**	**2300**

11.3 The above losses are maximum allowable and there would not be any positive tolerance. However, the manufacturer can offer losses less than above stated values.

12 TOLERANCES:

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

13 PERCENTAGE IMPEDANCE:

13.1 The value of impedance of the specified rating transformers at 75^0C shall be 4.5%.

14 TEMPERATURE RISE:

The temperature rise over ambient shall not exceed the limits given below:

For transformers of all ratings;

1	Top oil temperature rise measured by thermometer	35 ^{0}C
2	Winding temperature rise measured by resistance method	40 ^{0}C

The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise.

15 PENALTY FOR NON PERFORMANCE:

15.1 During testing at supplier's works, if it is found that the actual measured losses are more than the values quoted by the manufacturer, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

15.2 Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.

15.3 Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance.

16 INSULATION MATERIAL:

16.1 Electrical grade insulation epoxy dotted Kraft Paper/Nomex and pressboard of standard make or any other superior material subject to approval of the purchaser shall be used.

16.2 All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

17.1TANK:

17.1.1 Transformer tank construction shall conform in all respect to clause 15 of IS 1180(Part-1):2014.The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.

17.1.2 All joints of tank and fittings shall be oil tight and no bulging should occur during service.

17.1.3 Inside of tank shall be painted with varnish/hot oil resistant paint.

17.1.4 The top cover of the tank shall be slightly sloping to drain rain water.

17.1.5 The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle.

17.1.6 Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the Purchaser.

17.2 PLAIN TANK:

17.2.1 The transformer tank shall be of robust construction rectangular in shape and shall be built up of electrically tested welded mild steel plates of thickness of 3.15 mm for the bottom and top and not less than 2.5 mm for the sides for distribution transformers up to and including 25 kVA, 5.0 mm and 3.15 mm respectively for transformers of more than 25 kVA and up to and including 100 kVA and 6 mm and 4 mm respectively above 100 kVA. Tolerances as per IS1852 shall be applicable.

17.2.2 In case of rectangular tanks above 100 kVA the corners shall be fully welded from inside and outside of the tank to withstand a pressure of 0.8 kg/cm^2 for 30 minutes. In case of transformers of ratings 100 kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.

17.2.3 There must be sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747.

17.2.4 The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.

17.2.5 **Permanent deflection:**

For transformer of all ratings, the plain tank shall be capable of withstanding a pressure of 80kPa and a vacuum of 250mm of mercury for 30 minutes.

The permanent deflection of flat plates, after pressure/vacuum has been released, shall not exceed the values given below:

Length of flat plate	**Permanent deflection**
Up to and including 750 mm	5.0 mm
751 mm to 1250 mm	6.5 mm
1251 mm to 1750 mm	8.0 mm
Above 1751 mm	9.0 mm

17.2.6 Further, there shall be no leakage at any point when the transformer is subjected to an air pressure of 35kPa above atmospheric pressure maintained inside the plain tank for 10 min.

17.2.7 The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

17.2.8 Inside of the tank shall be painted with varnish or oil resistant paint. For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of polyurethane base paint shall be used. Table below shall be referred to for paint thickness.

S.No	Paint Type	Area to be painted	No. of Coats	Total Dry Film Thickness, Minimum (microns)
1	**Thermo setting powder paint**	Inside	01	30
		Outside	01	60
2	**Liquid Paint**			
a	Epoxy (Primer)	Outside	01	30
b	Polyurethane (finish coat)	Outside	02	25 each
c	Hot Oil resistant paint/Varnish	Inside	01	35/10

18 CONSERVATOR:

18.1 The conservator shall be provided on transformers of rating 63kVA and above only.

18.2 In case of conservator, oil gauge and the plain or dehydrating breathing device shall be fixed to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1¼") normal size thread] with cover.

18.3 The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the colour of the silica gel crystals which should be easily visible from a distance. Volume of breather shall be suitable for 500 gms of silica gel conforming to IS 3401.

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

18.5 The cover of main tank shall be provided with an air release plug to enable air trapped within to be released.

18.6 The inside diameter of the pipe connecting the conservator to the main tank should be 25 to 50 mm and it should be projected into the conservator so that its end is at least 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 ^{0}C) should be above the sump level.

19 SURFACE PREPARATION AND PAINTING:

19.1 GENERAL

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

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

19.2 CLEANING AND SURFACE PREPARATION:

19.2.1 After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

19.2.2 Steel surfaces shall be prepared by shot blast cleaning (IS-9954) to grade Sq.2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).

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

19.3 PROTECTIVE COATING:

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

19.4 PAINT MATERIAL:

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

Heat resistant paint (Hot oil proof) for inside surface

19.4.2 For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of synthetic enamel/polyurethene base paint. These paints can be either air drying or stoving.

19.5 PAINTING PROCEDURE:

19.5.1 All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

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

19.6 DAMAGED PAINTWORK:

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

19.6.2 Any damaged paint work shall be made good as follows:

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

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

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

19.7 DRY FILM THICKNESS:

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

19.7.2 Each coat of paint shall be allowed to harden before the next is applied.

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

19.7.4 The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as per table given in Clause 17.2.8 of this document.

19.8 TESTS FOR PAINTED SURFACE:

19.8.1 The painted surface shall be tested for paint thickness.

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

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

20 BUSHINGS:

20.1 The bushings shall conform to the relevant standards specified and shall be of outdoor type. The LT bushings shall be fixed to the transformers on side with straight pockets and in the same plane and HT bushings on top of the tank. The tests as per latest IS 2099 and IS 7421 shall be conducted on the transformer bushings.

20.2 For 11 kV (HV Side), 12 kV class bushings and for 0.433 kV (LV Side), 1.0 kV

class bushings shall be used.

20.3 Bushing can be of porcelain/epoxy material. Polymer insulator bushings conforming to relevant IEC can also be used.

20.4 Bushings of plain shades as per IS 3347 shall be mounted on the side of the Tank and not on top cover.

20.5 Dimensions of the bushings of the voltage class shall conform to the Standards specified in the table below and dimension of clamping arrangement shall be as per IS 4257

Voltage Class	For Porcelain Parts	For Metal Parts
1.0 kV Bushings	IS 3347 (Part-1/Sec-1)	IS 3347 (Part-1/Sec-2)
12 kV Bushings	IS 3347 (Part-3/Sec-1)	IS 3347 (Part-3/Sec-2)

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

Voltage	External (Air) Clearance between bushings	
	Phase to phase	Phase to earth
11 kV	255 mm	140 mm
LV	75 mm	40 mm

20.7 Arcing horns shall be provided on HV bushings.

20.8 Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section – IX.

20.9 The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.

20.10 The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

21 TERMINAL CONNECTORS AND CABLE BOXES:

21.1 The HV bushing stems shall be provided with Aluminium terminal Connectors with eye bolts so as to receive conductor for HV side.

21.2 The LV bushing stem shall be provided with bi-metallic terminal connector of LM-6 Aluminium Alloy and high quality copper (brazed but not bolted or riveted) with thickness as per latest IS. Terminal connectors shall be pad type on one side (Cable side) with four holes and shall be thread type on the other side (bushing side) to be fixed on bushing rod suitable for two circuits of 25kVA, 63kVA, 100kVA and 200kVA so as to receive cable from LT side. The connector shall be rated to carry the bushing rated current without exceeding the standard temperature rise as per relevant IS/guideline. The connectors shall be designed to be carona free at the max. Rated line to ground voltage. Terminal connectors shall be type tested as per IS 5561.

21.3 The LV bushings shall be concealed in a box with detachable base plate. The suitable LV cable box shall have non-magnetic material gland plate with appropriate sized single compression brass glands on LV side to terminate relevant sized LT cable.

22 TERMINAL MARKINGS:

22.1 High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, and 1W and low voltage winding for the same phase marked by corresponding small letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n. Neutral terminal is to be brought out and connected to local grounding terminal by an earthing strip. There shall be common earthing of metal bodies CFT (Core, Frame and Tank) of the transformer. Individual earthing of these metal bodies shall be avoided.

22.2 The transformers shall be provided with a non-detachable rating and terminal marking plate(s) of anodized Aluminium/Stainless Steel material securely fixed on the outer body in visible position. The rating and terminal plate shall be as per Fig.1 & Fig.4 respectively of IS: 1180(Part-1):2014) under Clause 13.1 & 13.2 of the same IS.

23. The distribution transformers supplies shall be marked with the ***"STANDARD MARK"*** governed by the provisions of the Bureau of Indian Standards Act,1986 and the rules and regulations made thereunder. The licence for the use of ***"STANDARD MARK"*** may be obtained from the Bureau of Indian Standards and shall be submitted along with the bid.

24 RATING PLATE:

The rating plate shall be provided as described above in Clause 22.2 of this document.

25 In addition to above plate the following details shall be punched on a mild steel plate of size 150x150x3mm and this plate shall be welded firmly on the transformer tank just above the rating plate in a visible position:

i) Name of the firm

ii) Warranty period/ date of manufacture

iii) ***CE-P&P-KASHMIR POWER DISTRIBUTION CORPORATION LIMITED*** and Order Details under the space ***Order Number***.

iv) Serial No. of transformer

26 FITTINGS

26.1 The following standard fittings shall be provided:

i. Rating and terminal marking plates, non-detachable.

ii. Earthing terminals with lugs - 2 Nos.

iii. Lifting lugs for the complete transformer as well as for core and winding assembly.

iv. Terminal connectors on HV/LV bushings (for bare terminations only.)

v. Thermometer pocket with cap - 1 No.

vi. Air release device

vii. HV bushings - 3 Nos.

viii. LV bushings - 4 Nos.

ix. Pulling lugs reinforced up to the stiffener level.

x. Stiffener

xi. Radiators - No. and length may be mentioned (as per heat dissipation calculations)/ corrugations.

xii. Arcing horns on HT side - 3 no.

xiii. Prismatic oil level gauge.

xiv. Drain cum sampling valve.

xv. One filter valve on the upper side of tank.

xvi. Silica gel breather

xviii. The under-base of all the transformers up to 100 kVA ratings shall be provided with two 75 mm × 40 mm channels, 460 mm long as shown in Fig. 6 against Clause 14.2 of IS:1180(Part-1):2014. and the under base of 250kVA transformers shall be as per Fig.7 shown against Clause 14.2 of IS:1180(Part-1):2014.

xix. Pressure relief device or explosion vent.

xx. Plain breathing device

xxi. Oil level guage indicating oil level at minimum, 30°C and maximum operating temperature. Minimum and maximum positions correspond to the operating temperature of –5°C and 90°C respectively

xxii. Unidirectional flat rollers

xxiii. Inspection hole.

27 FASTENERS:

27.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.

All bolts/nuts/washers exposed to atmosphere 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.

27.2 All nuts and pins shall be adequately locked.

27.3 Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

27.4 All ferrous bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising, except high tensile steel bolts and spring washers which shall be electro-galvanised/plated. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

27.5 Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

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

27.7 Taper washers shall be provided where necessary.

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

28 OVERLOAD CAPACITY:

28.1 The transformers shall be suitable for loading as per IS 6600.

29 TESTS:

29.1 The transformers shall be fully type tested by the manufacturer as per IS: 1180(Part-1):2014 and the valid type test reports/certificates shall be submitted by the manufacturer. The type tests must have been conducted at any of the NABL accredited laboratory of National repute/CPRI Bhopal or Bangalore/ERDA Vadodara/ERTO lab. Following type testes shall be conducted on the transformers.

29.2 Routine tests shall also be carried out as per the relevant standards.

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

29.4 The test certificates for all type tests for the transformers and also for the bushings and transformer oil shall be submitted by the manufacturer.

29.5 The procedure for testing shall be in accordance with IS:1180(Part-1):2014 & IS:2026 as the case may be.

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

29.7 All the routine tests and inspection shall be carried out at the place of manufacturer unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer all reasonable facilities to the purchaser, without charges to satisfy him that the material is being furnished in accordance with the specification. In order to ensure that quality of raw materials used during manufacturing of transformers is as per the requirement of relevant IS, the inspecting officer shall check the quality of raw material, obtain necessary invoices in proof that raw materials used are of desired quality.

29.8 The purchaser has the right to have any or all type/special tests carried out by an independent NABL Accredited agency whenever there is dispute regarding the quality of supply. In case the material fails to pass the test as per specification, the testing charges along with the other charges which were actually incurred for arranging the testing through independent agency shall be recovered from the supplier. In addition to this, action as deemed fit, may be taken against the Supplier.

30 ROUTINE TESTS: (To be conducted on all units)

The following shall constitute the routine tests.

30.1 Measurement of Winding Resistance [IS:2026(Part-1)]

30.2 Measurement of Voltage ratio and check of phase displacement [IS:2026(Part-1)]

30.3 Measurement of Short Circuit Impedance and Load loss at 50% and 100% load [IS:2026(Part1]

30.4 Measurement of no-load loss and current [IS:2026(Part-1)]

30.5 Measurement of Insulation resistance [IS:2026(Part-1)]

30.6 Induced over-voltage withstand test [IS:2026(Part-3)]

30.7 Separate-source voltage withstand test [IS:2026(Part-3)]

30.8 Pressure Test [IS:1180(Part-1):2014]

30.9 Oil Leakage Test [IS:1180(Part-1):2014]

31 TYPE TESTS (To be conducted on one unit)

The following shall constitute the type tests:

31.1 Temperature rise test as per IS:2026(Part-2).

31.2 Lightning Impulse voltage test with chopped wave as per IS:2026(Part-3). Basic Insulation level (BIL) for 11 kV shall be 75 kVp.
Following sequence of impulses shall be applied
i) Reduced impulse wave (50% of 75KVp)
ii) 100% full impulse wave (75KVp)
iii) Reduced chopped impulse wave (50% of 110% KVp)
iv) 110% of full impulse wave twice
v) 100% full impulse wave twice

31.3 Short Circuit Withstand test as per IS:2026(Part-5)

31.4 Pressure Test as per IS:1180(Part-1):2014

32 ACCEPTANCE TESTS:

32.1 At least 10% transformers of the offered lot (minimum of one) shall be subjected to the following routine/ acceptance test in presence of purchaser's representative at the place of manufacturer before dispatch without any extra charges. The testing shall be carried out in accordance with IS:1180(Part-1):2014 and IS:2026.

32.1.2 Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP and contract drawings.

32.1.3 Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report. Sample size criteria shall be as follows

100 Nos. –	1No.
101-200 Nos. –	2Nos.
201-300 Nos. –	3Nos.

32.1.4 Temperature rise test on one unit of the total ordered quantity.

33 TESTS AT SITE:

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

i) Megger Test
ii) Ratio test

34 INSPECTION :

34.1 In respect of raw material such as core stampings, winding conductors, insulating paper and oil, supplier shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The manufacturer shall furnish following documents in respect of the raw materials mentioned above, failing which the documentation shall be treated incomplete:

i. Invoice of supplier of all raw materials particularly of core with grade details/specifications.
ii. Mill's certificate.
iii. Packing list.
iv. Bill of landing.
v. Bill of entry certificate by custom.

35 INSPECTION AND TESTING OF TRANSFORMER OIL:

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

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

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

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

35.4 After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection a few assembled core shall be dismantled to ensure that the CRGO laminations used are of good quality. Further, as and when the transformers are ready for dispatch, an offer intimating

about the readiness of transformers, for final inspection for carrying out tests as per relevant IS shall be sent by the firm along with Routine Test Certificates. The inspection shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection. ***Further, the bolts connecting the top cover of the transformer with the tank at the two opposite corners are to be provided with holes at their lower portions which would be beyond nuts so that transformers may be sealed by inserting sealing wire in these holes by the inspecting team.***

35.5 In case of any defect/defective workmanship observed at any stage by the purchaser's Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial measures. Further processing should only be done after clearance from the Inspecting Officer/ purchaser.

35.6 All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the Inspector representing the Purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as Active Part Inspection during Acceptance/Routine Tests.

35.7 The manufacturer shall provide all services to establish and maintain quality of workman ship in his works and that of his sub-contractors to ensure the mechanical /electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

35.8 Purchaser shall have every right to appoint a third party inspection to carry out the inspection process.

35.9 The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality supplied. Purchaser has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser have every right to reject the entire lot or penalize the manufacturer, which may lead to blacklisting/ recovery of test costs among others.

36 QUALITY ASSURANCE PLAN:

36.1 The manufacturer shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

38.2 Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in the presence of manufacturer's representative, copies of test certificates.

38.3 Information and copies of test certificates as above in respect of bought out accessories.

38.4 List of manufacturing facilities available.

38.5 Level of automation achieved and list of areas where manual processing exists.

38.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.

38.7 List of testing equipment available with the manufacturer for final testing of equipment along with valid calibration reports. These shall be furnished with the bid. Manufacturer shall posses 0.1 accuracy class instruments for measurement of losses.

38.8 Quality Assurance Plan (QAP) with hold points for purchaser's inspection.

38.9 The successful manufacturer shall within 30 days of placement of order, submit following information to the purchaser along with call for stage inspection.

38.9.1 List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

38.9.2 Type test certificates of the raw materials and bought out accessories.

38.9.3 The successful manufacturer shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

37 DOCUMENTATION:

37.1 The manufacturer shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings on ***at least A3 size (420 x 297) mm paper.***.

37.2 Dimensional tolerances.

37.3 Weight of individual components and total weight.

37.4 An outline drawing front (both primary and secondary sides) and end-elevation and plan of the tank and terminal gear, wherein the principal dimensions shall be given.

37.5 Typical general arrangement drawings of the windings with the details of the insulation at each point and core construction of transformer.

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

38 PACKING AND FORWARDING:

38.1 The packing shall be done as per the manufacturer's standard practice. However, it should be ensured that the packing is such that, the material would not get damaged during transit by Rail / Road / Sea.

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

39 MANADATORY SPARES:

39.1 Mandatory spares shall be supplied as per the requirement.

40 GUARANTEE

40.1 The manufacturers of the transformer shall provide a guarantee of 18 months from the date of receipt at the stores of the Utility or 12 months from the date of commissioning, whichever is earlier. In case the distribution transformer fails within the guarantee period the purchaser will immediately inform the supplier who shall take back the failed DT within 15 days from the date of the intimation at his own cost and replace/repair the transformer within forty-five days of date of intimation with a roll over guarantee.

40.2 The outage period i.e. period from the date of failure till unit is repaired/ replaced shall not be counted for arriving at the guarantee period.

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

41 SCHEDULES:

41.1 The manufacturer shall fill in the following schedules which will be part of the offer. If the schedule are not submitted duly filled in with the offer, the offer shall be liable for rejection at the discretion of Purchaser keeping in view the interest of the department.

Schedule-1A & 1B:	Guaranteed Technical Particulars/Additional Details

42 DEVIATIONS:

42.1 The manufacturers are not allowed to deviate from the principal requirements of the Specifications. However, the manufacturer is required to submit with his bid in the relevant schedule a detailed list of all deviations without any ambiguity. In the absence of a deviation list in the deviation schedules, it is understood that such bid conforms to the bid specifications and no post-bid negotiations shall take place in this regard.

42.2 The discrepancies, if any, between the specification and the catalogues and / or literatures submitted as part of the offer by the manufacturers, shall not be considered and representations in this regard shall not be entertained.

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

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

43 Drawings

43.1 The manufacturer shall furnish the 4 sets following drawings for approval from the purchaser on A3 size paper describing the transformer in detail

i) Cross section of the core
ii) General assembly of the transformer
iii) Name plate rating and diagram plate.
iv) Delta and star connection.
v) Sectional side view.
vi) LT box lay out
vii) Assembly of 12KV HV bushings
viii) assembly of 1.0KV LT bushings.

43.2 All the important dimensions shall be given in detail in mm. the drawings shall be given in accordance with type test.

44. Submittals of technical Data.

44.1 The manufacturer shall furnish following technical data sheet calculation sheets for perusal from the purchaser

i) Type test report
ii) No-load and Load losses calculation sheet.
iii) Flux density calculation sheet at rated voltage and frequency.
iv) flux density calculation sheet at 112.5% of combined rated voltage and rated frequency.
v) Heat dissipation calculation sheet.
vi) Thermal ability withstand calculation sheet.
viii) Current density calculation sheet for both HV and LT side.

45. Name Plate:

Each transformer shall be provided with name plate of weatherproof material showing following details

i) Name of manufacturer
ii) Year of manufacture
iii) Type of transformer (Level II)
iv) Rating of transformer in KVA
v) Rated frequency in Htz
vi) Rated Voltage in KV(11/.433KV)
vii) Number of phases (3)
viii) Type of cooling (ONAN)
ix) Vector group symbol DY11)
x) Impulse Voltage Withstand Level (75 KVp)
xi) Power frequency withstand voltage (28KVrms on HT side and 3KVrms on LT side)
xii) Impedance voltage at 75^{o}C at normal tap
xiii) Measured load losses (100%) in KW at rated current and at 75^{o}C.
xiv) Measured load losses (50%) in KW at rated voltage and frequency
xv) Total weight in kg with complete oil filled
xvi) Total weight of transformer without oil
xvii) Wiring connection diagram
xviii) Volume of oil in litres.
xix) Name of purchaser
xx) Weight of core and winding
xxi) Serial number of transformer
xxii) BIS

Annexure – I

PROFORMA FOR STAGE INSPECTION OF DISTRIBUTION TRANSFORMERS

(A) GENERAL INFORMATION:

1. Name of firm : M/s.
2. Order No. and Date :
3. Rating-wise quantity offered :
4. Details of offer
   a) Rating
   b) Quantity
   c) Serial Numbers
5. Details of last stage inspected lot:
   a) Total quantity inspected
   b) Serial Numbers
   c) Date of stage inspection
   d) Quantity offered for final inspection of
      (a) above with date

(B) **Availability of material for offered quantity** :

Details to be filled in

(C) **Position of manufacturing stage of the offered quantity** :

a) Complete tanked assembly

b) Core and coil assembly ready

c) Core assembled

d) Coils ready for assembly

(i) HV Coils

(ii) LV Coils

Note: (i) A quantity of more than 100 Nos. shall not be entertained for stage inspection.

(ii) The stage inspection shall be carried out in case :-

(a) At least 25% quantity offered has been tanked and

(b) core coil assembly of further at least 30% of the quantity offered has been completed.

(iii) Quantity offered for stage inspection should be offered for final Inspection within 15 days from the date of issuance of clearance for stage inspection, otherwise stage inspection already cleared shall be liable for cancellation.

Sl. No	Particulars	As offered	As observed	Deviation and Remarks
(D)	**Inspection of Core** : (I) **Core Material** (1) Manufacturer's Characteristic Certificate in respect of grade of lamination used. (Please furnish test certificate)			
	(2) Remarks regarding Rusting and smoothness of core.			
	(3) Whether laminations used for top and bottom yoke are in one piece.			
	(II) **Core Construction** :			
	(1) No. of Steps			
	(2) Dimension of Steps			

	Step No.	1	2	3	4	5	6	7	8	9	10	11	12
	As offered:												
	W mm												
	T mm												
	As found:												
	W mm												
	T mm												

	(3) Core Dia (mm)		
	(4) Total cross Section area of core		
	(5) Effective cross Sectional area of core		
	(6) Clamping arrangement		
	(i) Channel Size		
	(ii) Bolt size and No.		
	(iii) Tie Rods size and No.		
	(iv) **Painting**		

	(a) Channels			
	(b) Tie Rods			
	(c) Bolts			
	(7) Whether top yoke is cut for LV connection.			
	(8) If yes, at 7 above, whether Reinforcement is done.			
	(9) Size of Support Channels provided for Core base and bottom yoke (Single piece of channels are only acceptable)	.		
	(10) Thickness of insulation provided between core base and support channel.			
	(11) core length (leg center to leg center)			
	(12) Window height			
	(13) Core height			
	(14) Core weight only (without channels etc.)			
(E)	**INSPECTION OF WINDING**			
	(I) Winding material			
	(1) Material used for			
	(a) HV winding			
	(b) LV winding			
	(2) Grade of material for			
	(a) HV winding			
	(b) LVwinding			
	3) Test certificate of manufacturer (enclose copy) for winding material of:			
	(a) HV			

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

	b) Turns / coil			
	c) Total turns			
	(9) Method of HV Coil Joints			
	(10) Total weight of coils of			
	a) LV winding (kg)			
	b) HV winding (kg)			
(F)	**INSULATION MATERIALS** :			
	(I) **MATERIAL** :			
	1) Craft paper			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy).			
	2) Press Board			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy).			
	3) Material used for top and bottom yoke and insulation			
	(II) **Type and thickness of material used** : (mm)			
	a) Between core and LV			
	b) Spacers			
	c) Inter layer			
	d) Between HV and LV winding			
	e) Between phases			
	f) End insulation			
(G)	**CLEARANCES** : (mm)			

	(I) **Related to core and windings**			
	1) LV to Core (Radial)			
	2) Between HV and LV (Radial)			
	3) (i) Phase to phase between HV Conductor			
	(ii) Whether two Nos. Press Board each of minimum 1 mm thick provided to cover the tie rods.			
	4) Thickness of locking spacers between LV coils (mm)			
	5) Axial wedges between HV and LV coils / phase (Nos.)			
	6) No. of radial spacers per phase between HV coils			
	7) Size of duct between LV and HV winding (mm)			
	(II) **Between core - coil assembly and tank** : **(mm)** 1) Between winding and body:			
	a) Tank lengthwise			
	b) Tank Breadth wise			
	2) Clearance between top cover and top yoke upto 200 kVA. e			
(H)	**TANK** : (I) **Constructional details** : 1) Rectangular shape 2) Thickness of side wall (mm) 3) Thickness of top and bottom plate (mm) 4) Provision of slopping top cover towards HV bushing.			
	5) I) Tank internal dimensions (mm)			

	a) Length			
	b) Breadth			
	c) Height			
	i) On LV side			
	i) On LV side			
	II) General details :			
	1) Inside painted by varnish/ oil corrosion resistant paint (please specify which type of coating done).			
	2) Gasket between top cover and tank			
	i) Material			
	ii) Thickness (mm)			
	iii) Jointing over laps (mm)			
	3) Reinforcement of welded angle (specify size and No. of angle provided) on side walls of tank.			
	4) Provision of lifting lugs:			
	a) Numbers			
	b) Whether lugs of 8 mm thick MS Plate provided			
	c) Whether reinforced by welded plates edge wise below the lug upto re- enforcing angle of the tank done.			
	5) Pulling lug of MS Plate			
	a) Nos.			
	b) Thickness (mm)			
	c) Whether provided on breadth side or length side			
	6) Provision of air release plug			
	7) Provision of galvanized GI Nuts Bolts with 1 No. Plain and 1 No. spring washer.			
	8) Deformation of length wise side wall of tank when subject to:			
	a) Vacuum of (-) 0.7 kg/sq cm for 30 minutes.			
	b) Pressure of 0.8 kg/sq cm for 30 minutes.			
(I)	**RAIDATORS** :			
	1. Fin Radiators of 1.25 mm thick sheet			
	a) Dimension of each fin			

	(LxBxT)			
	b) Fins per radiator			
	c) Total No. of radiators			
	2. Verification of manufacturer's test certificate regarding Heat dissipation (excluding Top and Bottom) in w/sq m			
	3. Verification of position of radiator with respect to bushing.			
(J)	**CONSERVATOR** :			
	1. Dimensions (L x D) (in mm)			
	2. Volume (m^3)			
	3. Inside dia of Conservator tank pipe (mm)			
	4. Whether conservator outlet pipe is projected approx. 20 mm inside the conservator tank.			
	5. Whether arrangement made so that oil does not fall on the active parts.			
	6. Whether die cast metal oil level gauge indicator having three positions at (- 5° C, 30 ° C and 98 °C) is provided .			
	7. Whether drain plug and filling hole with cover is provided.			
	8. Inner side of the conservator Tank painted with-			
(K)	**BREATHER** :			
	1. Whether Die cast Aluminium body breather for silica gel provided.			
	2. Make			
	3. Capacity			
(L)	**TERMINALS** :			

	1. Material whether of Brass Rods/ Tinned Copper.			
	a) HV			
	b) LV			
	2. Size (dia in mm)			
	a) HV			
	b) LV			
	3. Method of Star connection formed on LV side of 6mm thick (Should use Al./Cu. Flat bolted/ brazed with crimped lugs on winding alternatively for 63 and 100 kVA ratings brazing is done covered with tubular sleeve duly crimped). - Please state dimensions of Al/ Cu flat or tubular sleeve used. (mm)			
	4. Method of Connection of LV winding to LV Bushing (end of winding should be crimped with lugs (Al/Cu) and bolted with bushing stud).			
	5. Method of Connection of HV winding to HV bushing (Copper joint should be done by using silver brazing alloy and for Aluminium, brazing rod or with tubular connector crimped at three spots).			
	6. Whether SRB Ptube/insulated paper used for formation of Delta on HV.			
	7. Whether Empire sleeves used on the portion of HV winding joining to HV bushing.			
	8. Whether neutral formation is covered with cotton tape			
(M)	**BUSHINGS** :			
	1. Whether HV bushings mounted on side walls.			

	2. Whether sheet metal pocket used for mounting bushing (pipe are not acceptable)			
	a) H V			
	b) L V			
	3. Whether arrangement for studs for fitting of HV Bushing are in diamond shape (so that Arcing Horns are placed vertically).			
	4. Position of mounting of LV bushings.			
	5. Bushing Clearance: (mm)			
	a) LV to Earth b) HV to Earth c) Between LV Bushings d) Between HV Bushings			
(N)	**TANK BASE CHANNEL / ROLLERS** :			
	1. Size of channel (mm)			
	2. Whether channels welded across the length of the tank			
	3. Size and type of roller (mm)			
(O)	**OIL** :			
	1. Name of supplier			
	2. Break down voltage of oil: (kV)			
	i) Filled in tanked transformer			
	ii) In storage tank (to be tested by Inspecting Officer).			
	3. Supplier's test certificate (enclose copy)			
(P)	**ENGRAVING** : 1. Engraving of Sl. No. and name of firm.			
	i) On bottom of clamping channel of core-coil assembly. ii) On side wall and top cover			

	of tank along with date of despatch.			
(Q)	i) MS plate of size 125x125 mm welded on width side of stiffner			
	ii) Following details engraved (as per approved GTP): (a) Serial Number (b) Name of firm (c) Order No. and Date (d) Rating (e) Name of Inspecting Officer (f) Designation (g) Date of dispatch			
(R)	**NAME PLATE DETAILS** :			
	Whether Name Plate is as per approved drawing			
(S)	**Colour of Transformer**			
	1. Tank body with dark Green colour			
	2. Conservator with white colour			
(T)	**CHECKING OF TESTING FACILITIES**:			
	(Calibration certificate also to be checked for its validity)			
	TESTS :			
	1. No Load Current 2. No Load Loss 3. % Impedance 4. Load Losses			
	5. Insulation Resistance Test 6. Vector Group Test (phase relationship)			
	7. Ratio and Polarity test relationship 8. Transformer Oil Test (Break Down Voltage) 9. Magnetic Balance 10. Measurement of winding resistance (HV and LV both) 11. Induced over voltage withstand test (Double voltage and Double frequency)			

	12. Separate source power frequency withstand test at 28 kV for HV and 3 kV for LV (one minute).			
	13. Air pressure/ Oil leakage Test			
	14. Vacuum test			
	15. Unbalanced current test			
	16. Temperature rise (Heat Run) test.			
(U)	We have specifically checked the following and found the same as per G.T.P./deviations observed as mentioned against each:			
	i) Rustlessness of CRGO laminations used			
	ii) Core steps			
	iii) Core area			
	iv) Core weight			
	v) Winding cross sectional area			
	a) LV			
	b) HV			
	vi) Weight of windings			
	vii) Clearance between winding and wall of tank (mm)			
	a) Length-wise			
	b) Breadth-wise			
	viii) Clearance between top of yoke to tank cover.			
	ix) Details of Neutral formation			
	x) Connections to bushings:			
	a) LV			
	b) HV			

	xi) Slope of tank top			
	xii) Position of mounting of bushings			

COMPANY'S INSPECTING OFFICER FIRM'S REPRESENTATIVE

DATE OF INSPECTION:

Annexure-II

PROFORMA FOR PRE-DELIVERY INSPECTION OF

DISTRIBUTION TRANSFORMERS

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

A) ACCEPTANCE TESTS TO BE CARRIED OUT

Sl. No.	**PARTICULARS**	**OBSERVATIONS**
1.	(a) Ratio Test	AB/an
		BC/bn
		CA/Cn
	(b) Polarity Test	
2.	No load loss measurement	
		W1

		W2
		W3
	TOTAL	
	Multiplying Factor	
	CT	
	Watt meter	
	Total x MF	
	NET LOSS	
3.	Load loss measurement	
		W1
		W2
		W3
	Total	
	Multiplying Factors:-	

	CT	
	Watt meter	
	PT	
	Total x MF	
	Loss at ambient temperature (watt)	
	Loss at 75^0 C (with calculation sheet) (watt)	
4.	Winding Resistance :	
	H.V. (In Ohms)	
	(a) At ambient temperature of _____ ^{0} C.	A-B
		B-C
		C-A
	(b) Resistance at 75 ^{0} C.	A-B
		B-C
		C-A
	L.V. (In Ohm)	
	(a) At ambient temperature of _____ ^{0} C.	a-b
		b-c
		c-a

	(b) Per Phase resistance at 75 ^{0} C.	a-n
		b-n
		c-n
5.	Insulation Resistance (M ohm) :	HV-LV
		HV-E
		LV-E
6.	Separate Source Voltage withstand test voltage:	
	HV	28 kV for 60 secs.
	LV	3 kV for 60 secs.
7.	Induced over-voltage withstand test at double voltage and double frequency	100 Hz, 866 volts for 60 seconds.
8.	No load current at	
	90% volts	
	110% volts	
9.	Unbalance current	
10.	Vector group test	Diagram and readings be shown in separate sheets

11.	Percentage Impedance at 75^{0} C (Please furnish calculation sheet)		
12.	Transformer oil test (Break down voltage)		
13.	Oil leakage test		
14.	Heat run test	To be carried out once against the order	
15.	Bushing clearance (mm)	**HV**	**LV**
	(a) Phase to Phase		
	(b) Phase to Earth		
16.	Comments on compliance by the firm on the modifications done as per stage inspection clearance letter issued		

17.	Whether fittings of the order have been verified.
18.	Whether aluminium die cast silicagel breather with tin container is fitted on the transformers offered.
19.	Whether engraving of Sl.No. and Name of firm on core clamping channel, side wall and top cover of tank has been verified.
20.	Whether MS Plate of size 125 x 125 mm welded on with side of stiffner.
21.	Whether engraving of name of firm, Sl. No. and Rating of transformer, Order No. and date and Date of Despatch on MS Plate.
22.	Copy of calibration certificates of metering equipments be enclosed.

(B) POINTS TO BE SEEN / DIMENSIONS TO BE NOTED AT THE TIMEOF DISMANTLING OF TRANSFORMERS :

Sl. No.	**PARTICULARS**	**OBSERVATIONS**
1.	Details of the transformer dismantled for physical verification	
	(a) Rating (kVA)	
	(b) Sl. No.	
2.	Whether GI Nut Bolts with one spring one plain washer provided for tightening the tank cover.	
3	Details of gasket used between top cover and tank Material :	
	(i) Thickness (mm) (ii) Type of joints	
4	Whether core is earthed properly with copper strip (one end should be tightened in between the core laminations and other end bolted on core clamping channel).	
5	Connections from winding to bushings (describe the manner in which it has been done)	
	(a) HV (b) LV (c) Formation of Star connection on LV side.	
6	Winding wire dia and cross sectional area : (a) **HV** (i) Dia (mm)	

	(ii) Area (sq mm)	
	(b) **LV** (i) L x W x Nos. of layer (ii) Area (sq mm)	
7.	Thickness of press board (s) provided between HV coils to cover the tie rods	
8.	Whether painted with oil and corrosion resistant paint / varnish (a) Inside of the tank (b) Inside of the conservator tank (c) Core clamping and core base channels (d) Tie rods (e) Core bolts	
9.	Whether tie rods and core bolts insulated, if yes, material of insulation.	
10.	Whether flap on inner side of top cover provided to prevent direct falling of oil on core- coil assembly.	
11.	Method of joints	
	(a) Between HV Coils (b) Between tap coils	
12.	Whether engraving of Sl. No. and name of firm done on bottom channel of core coil assembly.	
13.	Diameter of copper wire, used for formation of delta (should not be less than 1.5 times the dia of conductor). (mm)	
14.	Whether empire sleeves provided upto the end portion of HV winding joining to bushing	
15.	**HV** Coils :	
	(a) Inner dia (mm)	
	(b) Outer dia (mm)	
16.	**LV** Coils :	
	(a) Inner dia (mm)	
	(b) Outer dia (mm)	
17.	Core dia	
18.	Core height including base channel and insulation in between (mm)	

19.	Leg Center of core	
20.	Clearances between	
	(a) Core and LV (mm)	
	(b) HV and LV (mm)	
	(c) Phase to phase of HV coils (mm)	
	(d) Core coil assembly and tank body (mm)	
	(i) Length-wise	
	(ii) Width-wise	
	(e) Top of yoke and top cover (mm)	
21.	Weight of core only (kg)	
22.	Weight of windings (kg)	
	(a) LV	
	(b) HV	
23.	Whether core laminations are in one piece, used for (a) Bottom yoke (b) Top yoke	
24.	Specific remarks regarding smoothness and rusting of core used.	
25	Volume of oil filled (to be done once against the order)	
	(a) In conservator tank (b) In tank of the transformer	
26	Weight of transformer (inclusive of all fittings, accessories, oil etc. complete)	
27	Inner dimensions of the tank	
	(a) Length (b) Width (c) Height	

	(i) LV side (ii) HV side	
28	Remarks, if any :	

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

SIGNATURE OF INSPECTING OFFICER
(with name and designation)

SIGNATURE OF FIRM'S REPRESENTATIVE
(with name and designation)

DATE OF INSPECTION : _____

Annexure-III

SOURCE OF MATERIALS/PLACES OF MANUFACTURE, TESTING AND INSPECTION

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

SCHEDULE 1A

GUARANTEED AND OTHER PARTICULARS FOR DISTRIBUTION TRANSFORMERS

(To be furnished by the Manufacturer/Supplier)
(Shall be duly filled and signed failing which the bid is liable to be rejected)

Sl.No.	Description
1.	Make
2.	Name of Manufacturer
3.	Place of Manufacture
4.	Voltage Ratio
5.	Rating in kVA
6.	Core Material used and Grade: a) Flux density b) Over fluxing without saturation (Curve to be furnished by the Manufacturer in support of his claim)
7.	Maximum temperature rise of : a) windings by resistance method b) Oil by thermometer
8.	Core loss in watts : a) Normal voltage b) Maximum voltage
9.	Full load losses (watts) at 75 ^{0}C
10.	Total Losses at 100% load at 75 ^{0}C

11. Total Losses at 50% load at 75 ^{0}C

12. Current density used for : (Amper/sq mm)

    a) HV Winding

    b) LV Winding

13. Minimum Clearances in air : (mm)

    a) HV Phase to Phase

    b) HV Phase to Earth
    c) LV Phase to Phase
    d) LV Phase to Earth

14. % Impedance at 75 ^{0}C

15. Flash Test :

    a) HV 28 kV / 50 HZ for 1 minute

    b) LV 3 kV/50 Hz for 1 minute

16. Over potential Test (Double Voltage and

    Double frequency for 1 minute)

17. Impulse test

18. Mass of : (kg)

    a) Core lamination (minimum)

    b) Windings (minimum)

    c) Tank and fittings

    d) Oil

    e) Oil quantity (minimum) (litre)

f) Total weight

19. Oil Data :

1. Quantity for first filling (minimum) (litre)
2. Grade of oil used
3. Maker's name
4. BDV at the time of filling (kV)

20. Transformer:

a) Overall length x breadth x height (mm x mm x mm)

b) Tank length x breadth x height

c) Thickness of plates for

Side plate (min)

Top and bottom plate (min)

d) Conservator Dimensions

21. Inter layer insulation provided in design for :

a) Top and bottom layer

b) In between all layer

c) Details of end insulation

d) Whether wedges are provided at 50% turns of the HV coil

22. Insulation materials provided

a) For Conductors

(1) HV

(2) LV

b) For Core

23. Material and Size of the wire used

1) HV Dia (mm) (SWG)

2) LV

a) Strip size

b) No. of Conductors in parallel

c) Total area of cross section (sq mm)

Note:

The following shall be specifically confirmed:

1) Whether the offer conforms to the limits of impedance mentioned in the specification (Yes/No)

2) Whether the offer conforms to the limits of temperature rise mentioned in the specification. (Yes/No)

3) Whether the losses of the transformers offered are within the limits specified. (Yes/No)

4) Whether the transformer offered is already type tested for the design and test reports enclosed. (Yes/No, If "Yes" please write Reports enclosed, if "No", specify the reasons)

Signature and Seal of the Manufacturer: _____
Name: _____
Designation: _____

SCHEDULE 1B: ADDITIONAL DETAILS

S. No.	Description	Units
1	Core Grade	
2	Core Diameter	mm
3	Gross Core Area	Sq cm
4	Net Core Area	Sq cm
5	Flux Density	Tesla
6	Mass of Core	Kg
7	Loss per Kg of Core at the Specified Flux Density	Watt
8	Core window height	mm
9	Center to center distance of the core	mm
10	No. of LV turns	
11	No. of HV turns	
12	Size of LV conductor bare/covered	mm
13	Size of HV conductor bare/covered	mm
14	No. of parallels	

15	Current Density of LV Winding	A/sq mm
16	Current Density of HV Winding	A/sq mm
17	Weight of LV winding for transformer	Kg
18	Weight of HV winding for transformer	Kg
19	No. of LV coils per phase	
20	No. of HV coils per phase	
21	Height of LV windings	mm
22	Height of HV windings	mm
23	ID/OD of LV winding	mm
24	ID/OD of HV winding	mm
25	Size of the duct in LV winding	mm
26	Size of the duct in HV winding	mm
27	Size of the duct between HV and LV	mm
28	HV winding to LV winding clearance	mm
29	HV winding to tank clearance	mm
30	Calculated impedance	%
31	HV to Earth creepage distance	mm
32	LV to Earth creepage distance	mm

Signature and Seal of the Manufacturer: _____
Name: _____
Designation: _____