

22.2 Bushing terminals shall be provided with terminal connectors of approved type and size for connection to external parts. Terminal connectors offered must have been successfully type tested as per IS-5561.

22.3 All terminal connectors shall be manufactured out of gravity die casting process only and shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off. The aluminum alloy castings, if used, shall conform to relevant IS.

22.4 No part of the clamp shall be less than 12mm thickness.

22.5 All bolts, nuts and washers shall be of Hot Dip Galvanised.

22.6 For bimetallic clamps, bimetallic strip of not less than 2 mm thickness shall be provided.

22.7 Flexible connectors, if provided shall be made from tinned copper sheets.

22.8 Size of terminal (bushing stud)/conductor (ACSR Zebra) for which the clamp is designed and also rated current under site conditions shall be embossed/punched on each part of the clamp, except hardware.

22.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

22.10 Clamps shall be designed corona controlled.

22.11 The nominal current rating and short time current rating of terminal connectors shall match the corresponding rating of respective bushings.

23.0 INSULATING OIL REQUIRED FOR TRANSFORMERS:

23.1 Transformer oil shall be arranged by the Purchaser separately. The Offered Price of transformers therefore, exclude first filling of oil. However, the quantity of oil for first filling and 10% extra should be indicated by the Tenderer in kilo-liters and in kg in the technical questionnaire. The design of the transformer shall be based on the characteristic of EHV transformer oil as per relevant IS.

23.2 Since, oil for the transformer is not included in the scope of supply, it may be noted that the transformer shall be supplied duly Nitrogen gas filled with suitable arrangement to ensure that the pressure of gas is regularly maintained during transit and upto the date of filling of oil. For this purpose, necessary gas cylinders with regulator shall be supplied on non returnable basis. **Additional gas cylinders required for recouping and maintaining of positive Nitrogen pressure upto filling of oil should be supplied by the manufacturer of Transformers and the offered price should take into account this requirement.**

23.3 The quality of the oil used with transformer shall conform to the oil parameters specified in this clause. No inhibitors shall be used in the oil. The oil samples of transformer will be drawn for the oil used at factory & site as follows.

- i. Prior to filling

- ii. Before and after heat run test / pre-commissioning test
- iii. Before energizing.

All tests as per IS:335 (latest version) shall be conducted on oil samples.

23.4 Sufficient quantity of oil necessary for first filling of main tank, coolers, radiators and conservators etc. upto the proper level plus anticipated quantity of wastage of oil during first filling shall be arranged by Purchaser in tankers. Please note, wastage means quantity of oil absorbed during initial filling at works for testing. In addition to the oil needed for first filling, 10% extra quantity of oil for topping up in future, shall also be arranged by Purchaser. Therefore, total quantity of oil required for first filling shall be measured at works at the time of testing on unit subjected to heat run test.

23.5 The supplier shall dispatch the transformer in an atmosphere of pressurised Nitrogen. In this case, necessary arrangement shall be ensured by the supplier to take care of pressure drop of nitrogen during transit and storage till completion of oil filling during erection. A gas pressure testing valve with necessary pressure gauge and adapter valve shall be provided.

23.6 The supplier shall warrant and confirm that oil to be used for the transformer testing at Works is free from **Polychlorinated Biphenyls (PVB/PCB)**. The transformer oil to be used by purchaser for first filling at site shall be new oil of EHV Grade-I having following specification. **Hence Oil to be used by manufacturers at factory for the purpose of testing at their works shall be of similar or better quality having parameters matching with the parameters specified in the specification. Specific approval of oil test results of oil proposed to be used for testing of transformer in factory shall be obtained by the manufacturer from the purchaser before first filling in the unit. MPPTCL shall not accept any other oil for testing purposes having lower parameters than those specified in the tender.**

S. No	Characteristics	Requirement	Method of Test
1.	2.	3.	4.
1.	Appearance	The oil shall be clear and transparent and free from suspended matter or sediment	A representative sample of oil shall be examined in a 100 mm thick layer at ambient temperature.
2.	Density at 29.5°C (maximum)	0.89 gm/cm ³	IS:1448
3.	Kinematics viscosity at 27°C (maximum)	27 Cst	IS:1448
4.	Interfacial tension at 27°C (minimum).	0.04 N/m	IS:6104
5.	Flashpoint Pensky Marten (closed) (minimum).	140°C	IS:1448

S. No	Characteristics	Requirement	Method of Test
1.	2.	3.	4.
6.	Pour point. (maximum)	-6 °C	IS:1448
7.	Neutralization value (Total acidity maximum)	0.01 mg KOH/g	IS:335 Appendix 'A' , IEC 62021
8.	Corrosive Sulphur	Non-corrosive	IS:335 Appendix 'B'
9.	Electric strength (breakdown voltage) (minimum). a. New unfiltered oil (as received condition). b. After filtration	40 KV (rms) 60 KV (rms)	IS:6792
10.	Dielectric dissipation factor (tan delta) at 90°C (maximum).	0.002	IS:6262
11.	Specific resistance (resistivity) a. at 90°C (minimum). b. at 27°C (minimum).	100x10 ¹² ohm.cm 1500X10 ¹² ohm.cm	IS:6103
12.	Oxidation stability a. Neutralisation value after oxidation (maximum). b. Total sludge, after oxidation (maximum).	0.20 mg KOH/g 0.02 percent by weight	
13.	Presence of oxidation inhibitor	The oil shall not contain antioxidant inhibitors .	IS:335 Appendix 'D'
14.	SK value	6% maximum	IS:335
15.	Water content (maximum).	10 ppm	IS:2362
16.	Ageing characteristics after accelerated ageing (open Breaker method with copper catalyst) a) Resistivity i. 27°C ii. 90°C b) Tan delta at 90°C c) Total acidity max. d) Sludge content by	2.5x10 ¹² ohm.cm (min) 0.2x10 ¹² ohm.cm (min) 0.15 (max) 0.05 mg KOH/gm	As per ASTM-D 1934/ IS 12177, IEC 62021

S. No	Characteristics	Requirement	Method of Test
1.	2.	3.	4.
	weight	0.05% (max)	
17.	Oil sample taken from the transformer after the completion of site processing and tested in approved manner shall have the following values before commissioning of the transformer. i. Break down strength ii. Moisture content iii. Resistivity at 90°C minimum iv. Interfacial Tension at 27°C v. Dielectric dissipation factor at 90 °C	Maximum 70 KV withstand Maximum of 10 ppm 35x10 ¹² ohm.cm (min) 0.04 N/M (min) 0.002 (max.)	Tested in accordance with IS :335
18	N-dm analysis CA% CN% CP%	4 –6% 40-43% 51-54%	

24.0 FITTINGS & ACCESSORIES FOR THE POWER TRANSFORMERS

24.1 Only those offers will be considered for evaluation wherein the Tenderers submit a specific confirmation that the transformers will be supplied complete with all fittings and accessories exactly in line with various requirements indicated in Annexure-II and in this technical specification. The basic offered cost must take into consideration cost of all fittings and accessories as under and indicated elsewhere in this specification otherwise the Tender will be treated as non responsive.

24.2 The equipments and accessories furnished with the transformer shall be suitably mounted on the transformer for ease of operation, inspection and maintenance and the mounting details shall be subject to the approval of the purchaser. All valves shall be provided either with blind companion flanges or with pipe plugs for protection.

24.3 Indication, alarm and relay equipment shall have contacts suitable for operation with 110/220 V DC supply. Any other accessories or appliances recommended by the manufacturer for the satisfactory operation of the transformer shall also have 110/220 V DC as input.

a) OLTC and its controls shall be as per clause 17.0.