

SECTION A

General

1.0 GENERAL DESIGN OF APPARATUS

1.1 Compliance with Specifications

1.1.1 Except where otherwise specified or implied herein, the transformers shall comply with the latest edition of Indian Standard 2026 (hereinafter referred to as "IS").

1.2 Design and Standardisation

1.2.1 The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. All apparatus shall also be designed to ensure satisfactory operation under such sudden variations of load and voltage as may be met with under working conditions on the system, including those due to short circuits.

1.2.2 The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment keeping in view the requirements of Indian Electricity Rules.

1.2.3 All material used shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperatures and atmospheric conditions arising under working conditions without undue distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

1.2.4 Corresponding parts liable to be replaced shall be interchangeable.

1.2.5 Cast iron shall not be used for chambers of oil filled apparatus or for any part of the equipment which is in tension or subject to impact stresses. This clause is not intended to prohibit the use of suitable grades of cast iron for parts where service experience has shown it to be satisfactory, e.g., large valve bodies.

1.2.6 All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid pocket in which water can collect.

1.2.7 Means shall be provided for the easy lubrication of all bearings and where necessary of any mechanism or moving part, that is not oil immersed.

1.2.8 All mechanism shall, where necessary, be constructed of stainless steel, brass or gun-metal to prevent sticking due to rust or corrosion.

1.2.9 All taper pins used in any mechanism shall be of the split type complying with IS: 2393 for these items.

1.2.10 All connections and contacts shall be of ample section and surface for carrying continuously the specified currents without undue heating and fixed connections shall be secured by bolts or set screws of ample size, adequately locked. Lock nuts shall be used on stud connections carrying current. All leads from the winding to the terminal board and bushings shall be adequately supported to prevent injury from vibration including a systematical pull under short circuit conditions. Guide pulls shall be used where practicable.

1.2.11 All apparatus shall be designed to minimise the risk of accidental short-circuit caused by animals, birds or vermin.

1.2.12 Provision shall be made to fix safety fence around top cover of transformers of rating 100 MVA and above, for safe working during installation and servicing for large capacity transformers.

1.2.13 In tank on load tap changers shall be located such that the space above the diverter switch chamber will be free of inter connecting pipes etc. for lifting the diverter switch unit for inspection and maintenance purposes.

1.2.14 Dryness of the insulation may be ensured by measuring the water extraction during vacuum drying. The water extraction per tonne of insulation per hour may be limited to 50 grams maximum. Alternatively dryness can be judged by dew point measurement.

1.3 Galvanising

1.3.1 Galvanising where specified shall be applied by the hot-dipped process or by electro-galvanising process and for all parts other than steel wires shall consist of a thickness of zinc coating equivalent to not less than 610 gm of zinc per square meter of surface. The zinc coating shall be smooth, clean and of uniform thickness and free from defects. The preparation of galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material. The quality will be established by tests as per IS: 2633. Alternative to galvanising, zinc spraying or aluminising can also be considered.

1.3.2 All drilling, punching, cutting, bending and welding of parts shall be completed, and all burrs shall be removed before the galvanising process is applied.

1.3.3 Galvanising of wires shall be applied by the hot-dipped process and shall meet the requirements of the relevant Indian Standard. The zinc coating shall be smooth, clean and of uniform thickness and free from defects. The preparation for galvanising itself shall not adversely affect the mechanical properties of the wire.

1.3.4 Surfaces which are in contact with oil shall not be electrogalvanised/cadmium plated.

1.4 Labels

1.4.1 Labels shall be provided for all apparatus such as relays, switches, fuses, contained in any cubicle or marshalling kiosks as shown in Fig. 1.

1.4.2 Descriptive labels for mounting indoors or inside cubicles and kiosks shall be of material that will ensure permanence of the lettering. A matt or satin finish shall be provided to avoid dazzle from reflected light. Labels mounted on dark surfaces shall have white

lettering on a black background. Danger notices shall have red lettering on a white background.

1.4.3 All plates shall be of incorrodible material.

1.4.4 Labels shall be attached to panels with brass screws or with stainless steel screws or these can be stuck with suitable adhesive also.

1.5 Bolts and Nuts

1.5.1 Steel bolts and nuts exposed to atmosphere shall be of following material :

- Size 12 mm or below – stainless steel
- Above 12 mm – steel with suitable finish like electrogalvanised with passivation.

1.5.2 All nuts, bolts and pins shall be locked in position with the exception of those external to the transformer, under gasket pressure.

1.5.3 All bolts, nuts and washers exposed to atmosphere and in contact with non-ferrous parts which carry current shall be of phosphor bronze.

1.5.4 If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, suitable special spanners shall be provided by the supplier.

1.5.5 Bolts and nuts shall not be less than 8 mm in diameter except when used for small wiring terminals.

1.6 Cleaning and Painting

1.6.1 Before painting or filling with oil or compound, all ungalvanised parts shall be completely clean and free from rust, scale and grease, and all external surface cavities on castings shall be filled by metal deposition.

1.6.2 All blast cleaned surfaces (except machined faces that have to be protected) must be cleaned in accordance with ISO specification no. ISO 8501 Part 1 (This standard specification is based on and now supersedes Swedish Standard SIS 05 59 00) to a minimum standard of 'ASa2½' or 'BSa2½' prior to paint application.

1.6.3 External and internal surfaces of all transformer tanks and chambers and other fabricated steel items shall be cleaned of scale, rust and surface dirt by blast cleaning or other suitable approved method. After cleaning, these surfaces should be immediately covered with paint. Hot oil resistant varnish on white synthetic enamel/epoxy paint is to be used for painting the inside of all oil filled chambers, including transformer tanks. Only one thin layer (\approx 25 microns) of this is to be applied.

1.6.4 Except for hardware, which may have to be removed at site, all external surfaces shall receive at least four coats of paint. The type and thickness of paint shall be chosen to suit pollution level at site.

1.6.5 Selection of paint system for different environmental conditions shall be in line with ISO : 12944.

1.6.6 For rural or mild atmosphere, alkyd enamel primer and finish system may be used in four coats to give a total dry film thickness of at least 80 microns.

1.6.7 For urban or industrial situation two coats of epoxy zinc phosphate or zinc chromate primer topped with two coats of aliphatic polyurethane glossy finish paint is recommended. The total dry film thickness should preferably be between 100 and 130 microns.

1.6.8 In case of highly polluted area, chemical atmosphere or at a place very near the sea coast, paint as above with one intermediate coat of high build MIO (Micaceous iron oxide) as an intermediate coat may be used to give a total dry film thickness of 150 to 180 microns.

1.6.9 All interior surfaces of chambers or kiosks that are in contact with air shall receive at least three coats of paint, of which the topcoat shall be of a light shade. If heaters are not provided in the chamber, then the top coat should be of anti condensation type.

1.6.10 Any scratch, bruise or paint damage incurred during transportation and unloading at site should be made good by the purchaser as soon as the damage is detected. This is to be done by thoroughly cleaning the damaged area and applying the full number of coats as was applied originally. Manufacturer should supply the necessary paint for this touch up painting at site.

1.6.11 One coat of additional paint shall be given at site over all external surfaces, including hardware, after erection by the purchaser. Supplier shall furnish necessary information on the make and grade of the top-coat paint. In general, it is possible to apply enamel paint over epoxy polyurethane coating and the vice versa is not recommended. As far as possible the make and grade of the recoat shall be same as the original coat.

1.7 Oil

1.7.1 The transformers and all associated oil-filled equipment shall normally be supplied alongwith the first filling of oil and 10 percent excess quantity of oil shall also be supplied in non-returnable drums. The oil shall conform to IS : 335. Alternatively, if the purchaser so desires, oil may be supplied in tankers directly from the refinery for transformers which are despatched from factory to site in gas filled condition.

1.8 Prevention of Acidity

1.8.1 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. Special measures, such as nitrogen sealing or the use of inhibited oil shall not be resorted to, unless otherwise specified by the purchaser.

2.0 ELECTRICAL CHARACTERISTICS AND PERFORMANCE

2.1 Type of Transformers and Operating Conditions

2.1.1 All transformers, unless otherwise specified shall be oil immersed and may be either core or shell type and shall be suitable for outdoor installation. Normally oil immersed transformer shall be provided with conservator vessels. Where sealed transformers are specified, there shall be no conservator but adequate space shall be provided for expansion of oil without developing undue pressure. The types of cooling shall be as stated in the relevant specifications.