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भारतीय मानक **मसौदा**

ऊष्मा रोधन तेल अनुकूलन संयंत्र — विशिष्टि

(आई एस 6034 का *दूसरा पुनरीक्षण)*

Draft *Indian Standard*

INSULATING OIL CONDITIONING PLANTS — SPECIFICATION

(*Second Revision* of IS 6034)

ICS 75.200

Chemical Engineering Plants and Related Equipment Sectional Committee, MED 17	Last date for receipt of comments is **02 February 2025**

FOREWORD
(*Formal clause would be added later on*)

Insulating oil conditioning plants are used for the purification of oils used in transformer and switchgear by drying, deaeration and removal of particulate contaminants. If the oil is heavily aged, mere purification, dehydration and degasification will not restore to the desired properties and polishing will have to be additionally resorted to. The oil conditioning plant can used for drying transformers prior to putting them into service.

For regeneration of both oil and insulation, the basic oil conditioning plant will have to be supplemented with a regeneration column containing Fuller's Earth or Activated Alumina.

Insulating oil for transformer and switchgear are subject to deterioration or contamination in storage, handling, or service. The Impurities contaminating the insulating oil essentially consist of:

a) Moisture dissolved;
b) Dissolved gases or air;
c) Sludge as a result of oxidation;
d) Suspended dust;
e) Drum scale, rust, or presence of other material; and
f) Adventitious solids, such as carbon products formed due to arcing.

These impurities not only reduce the di-electric strength but also induce a considerable ageing of the insulators. They also cause overheating by settling on heat transfer surfaces.

A periodic and effective removal of these impurities becomes necessary to ensure:

a) Safety of the transformer;
b) Increased longevity; and
c) Prevention of fast deterioration of the insulating oil.

This standard was first published in 1971 and revised in 1989. In this revision of the standard, Committee felt a need to revise the standard with a view to update the standard based on the experience of last three decades and on the currently available data. Following changes have been incorporated in the current revision:

a) Constructional requirement has been modified;
b) Performance requirements has been modified to include few performance parameters; and
c) Marking requirements has been modified.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft *Indian Standard*

INSULATING OIL CONDITIONING PLANTS — SPECIFICATION

(*Second Revision*)

1 SCOPE

This standard prescribes the performance requirements of the insulating oil conditioning plant used for purification, drying and deaeration of oils used in transformer and switchgear keeping in view the extreme variation of climatic condition. The plant may employ unused or in service oil treatment.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

IS No.	*Title*
IS 12615 : 2018	Line operated three phase a.c. motors (IE code) "Efficiency classes and performance specification" (*third revision*)

3 CONSTRUCTION REQUIREMENTS

The plant shall be suitable for treating oil by first heating it and then passing it through specially designed filters and then subjecting it to vacuum treatment, which dehydrates, and degasifies the oil.

3.1 The plant manufactured shall be skid or portable or with mobile pneumatic wheel. The equipment shall be with enclosure for outdoor application along with four numbers lifting hooks arrangement.

3.2 All the components shall have adequate strength and rigidity to withstand normal condition of handling, transport and usage. There shall be free from edge or corners to avoid injury to operating personal during normal condition of use. The design of the plant shall be such that if required the parts can easily be replaced.

3.3 Tubes and wires, connected to resiliently mounted components shall be properly fixed, so that vibrations are reduced to a minimum and fatigue failure is avoided.

3.4 The plant shall be designed for high vacuum and low temperature processing of oil for achieving better results.

3.5 Materials used in the construction of the filters shall comply with Indian Standards wherever applicable. They shall be free from defects, which are liable to cause undue deterioration or failure. Under normal conditions of use, the materials used shall not shrink or warp.

4 OIL CONDITIONING SYSTEM

The insulating oil conditioning system consists of a heater with heating elements, filter cartridges or bag filter or basket filter, vacuum chamber, vacuum pump, outlet discharge pump, valves and other accessories. It may also have inlet feed pump.

4.1 Heater

4.1.1 Heaters shall be provided in protection tubes to avoid localized overheating, hot spot and breaking of oil. The heater shall be capable of heating oil to 80 °C. However, temperature during degassing and dehydration for good results shall be in the range of 60 °C to 70 °C. Heaters shall be divided into equal individual groups, to increase the efficiency of heat transfer while eliminating localized overheating. Necessary baffles shall be provided in the heater vessel for this purpose.

4.1.2 Heater elements shall be inserted in a suitable arrangement, which is located in protection tubes. Construction of the heater shall be such that the replacement of the heater is easy and does not require any special tools. The heater tank will be adequately thermally insulated or painted to minimize loss of heat. Heater surface density shall not be more than 20 kW/m^2. The skin temperature of the heating vessel shall be ± 7 °C with respect to ambient temperature.

4.1.3 Machine manufacturer may employ heat exchanger. The option of a direct immersed heater in oil may also be used with surface density distribution of heat transfer of less than 15 kW/m^2. The system shall be designed to take care of hot spot in the heating chamber. On selection of direct immersed heater exchanger design, the heater replacement shall be carried out on drainage of oil from the heater exchanger.

4.1.4 In case of use of special heat resistant paint as an insulating media instead of glass wool with aluminum cladding, the body/skin temperature of heating unit shall not be more than 8 °C.

4.2 Filter System

The filtration system shall consist of the following:

4.2.1 *Preliminary Filter cum Magnetic Strainer*

The main function of this filter is to prevent any damage to the inlet pump. The filter shall have strainer capable of retaining all particles above 1 mm size including all magnetic particles. Incoming oil will pass through this filter. It shall be easy to clean the strainer without dismantling the filter from the pipeline.

4.2.2 *Coarse Filter*

Coarse filter shall consist of cartridge/bag/basket filter. Filters shall be easily replaceable and it shall be suitable for removal of particles bigger than 10 microns. A drain plug shall also be provided for the filter.

4.2.3 *Fine Filter*

Non-hygroscopic throwaway type cartridge/bag/basket filter of suitable quality shall be provided. The cartridge/bag/basket filter shall have large dust holding capacity. The replacement of cartridge/bag/basket filter shall be easy. The housing vessel shall be suitable for high vacuum and pressure application. Proper pressure gauge/switch shall be provided in the filter vessel for inlet pressure to ascertain the condition of filter elements. Aeration valve shall be provided on the filter vessel, for aeration during oil draining through a drain valve provided at the bottom of the vessel. The chamber may be single stage or double stage and shall be designed to ensure the final oil parameters for moisture and gas content.

4.3 Degassing and Dehydration Chamber

4.3.1 The degassing chamber shall function as degasser and dehumidifier. It shall be capable of removing dissolved gases and moisture from the oil. The material of degassing chamber shall be of mild steel and shall have welded construction. The chamber shall be able to withstand the high vacuum to which it will be subjected.

4.3.2 Raschig rings shall be properly placed and spread in the degassing columns. The surface area offered by the raschig rings shall be sufficient to form a thin film of oil, facilitating removal of dissolved gases and moisture at the rated flow rate of oil. Sight glass with illuminating lamps shall be provided for observation of the flow of oil.

4.3.3 Oil Level and oil foam sensor shall be provided to take care of oil, during processing of oil in degassing chamber.

NOTE — Vacuum level and capacity of vacuum pump are dependent on the efficiency of degassing and the same would be dependent on the specific design.

4.4 Vacuum Pumping System

The vacuum pump provided shall have adequate capacity to maintain the required level of vacuum in the vacuum chamber to attain the specified final oil parameters. The vacuum pump of different combination shall be used with adequate capacity to maintain the required level of vacuum in vacuum chamber to attain the specified final oil parameters at the end of cycle. The rotary vacuum pump if used, shall have a gas ballast valve on the pump, which will allow to operate system in two modes:

a) Ballast open mode; and
b) Ballast close mode.

In case of use of the roots pump along with rotary vacuum pump in combination as per the manufacturers design, the roots pump shall have an automatic by-pass valve arrangement to take care of an accidental rise in pressure in-between the two pumps. The root pump selection and its

suitability shall be backed up by the pump manufacturer's technical catalogue to prove its selection reliability.

NOTE — The use of roots pump along with rotary in combination depends upon.

a) Final oil result required;
b) Capacity of machine;
c) Manufacturer design; and
d) Number of passes for final oil result.

4.5 Oil Inlet Pump (Optional)

4.5.1 One number of positive displacement pump with mechanical seal shall be provided to take care of vacuum and pressure during continuous operation. The pump shall be thoroughly tested for vacuum and shall be suitable for continuous trouble-free operation. The pump shall be provided with automatic protection against over pressure build up.

4.5.2 For adjustment of flow rate through filter, a flow control valve shall be provided across the gear pump. The suction head of the inlet feed pump at inlet shall be in the range 4 to 5 m of oil and shall maintain the constant output.

4.6 Discharge Pump

4.6.1 Discharge pump shall be of centrifugal/positive discharge with mechanical-seal with the required capacity suitable for sucking oil from chamber held under vacuum. This shall be fully tested for pressure and vacuum leak rate.

4.6.2 To avoid dry running of pump, respective arrangement shall be made in the filter plant. The discharge head of the discharge pump will be minimum 10 m.

4.7 A visual indicator or sight glass together with the necessary controller device for regulating the level oil in degassing chamber, shall be provided. It is preferable to use the foam sensor than an optical device, which shall be free of any mechanical wear and tear and, suitable for sensing and controlling foam and oil level.

4.8 A thermostat shall be provided to each group of heaters to control individual temperature. Additional safety thermostat shall be provided to take care of any accidental rise of temperature of oil and shall put off the heater in that eventuality. A drain plug for the heater tank shall be provided at the lowest position of the tank to drain oil completely.

4.8.1 Two digital or analogue thermometers shall be provided on the plant, one at the inlet of filter plant and other at the discharge of heater tank.

4.8.2 Digital vacuum gauge with minimum range from atmospheric (1.013×10^5 Pa) to less than 133.32 Pa shall be provided in the suction line connecting the degassing chamber and vacuum pump.

4.9 Necessary interlock shall be provided between the inlet pump and heater in such a way that unless the inlet pump is 'ON' and oil flows through the line, heater shall not be switched 'ON'.

4.10 Pressure reducing valve of suitable rating shall be provided on the heater chamber to take care of any accidental pressure increase in the heater vessel.

4.11 Control Panel

4.11.1 All electric control gear main isolation arrangement, motors, starters, contractors, pilot lamp, back up protection MCB (Miniature Circuit Breaker), relays, indicating lamps, interlocking shall be housed in compact control panel which shall be free of fuse bank. A main switch on the board shall be provided to isolate the complete supply to the panel. The main switch shall be of appropriate capacity suitable to the total load of the plant

4.11.2 All wiring shall be neatly routed, and all wire termination shall be suitable identified with ferrules. The plant shall be suitable for operation on 415 V, 3-phase 50 Hz a.c. supply.

4.11.3 In case of fully automatic plant, PLC (Programmable Logic Controller) with HMI (Human-Machine Interface) of minimum 7 inches (0.1778 m) screen shall be used. The electrical circuit drawing shall be laminated and pasted inside control panel. The control panel box shall be equipped with IP 55 standard with operational manual storage rack, laptop charging switch, exhaust fan along with filter arrangement.

4.12 Motor

Electric motors shall conform to IS 12615. The motor shall be adequately protected against overload.

4.13 The whole unit may be stationery or mobile as required. In case of filters for outdoor use, all components of the plant shall be suitably housed in weather proof enclosure. The casing shall be provided with large doors for easy access to the various components.

4.14 If it is for the purpose of towing over roads, the plant shall be mounted on pneumatic tyred trailer with springs, towbar and automatic mechanical over-run brakes. Reflector tale lamp and mud flap protection shall also be used.

4.15 The nitrile lined rubber oil hose pipes supplied along with the plant shall be suitable for handling hot transformer oil and meet the functional requirements. A minimum of one pair of 10 m long hose pipe with required end fitting shall be supplied along with the plant.

5 PERFORMANCE GURANTEE

5.1 Plant Warranty

The plant shall be guaranteed by the manufacturer or supplier against defects in materials and workmanship under normal use and service for a period of one year from the date of dispatch.

The above guarantee is not applicable for cartridge/bag/basket filter and electrical items, as the life of these items depends on various factors, which are beyond the control of the manufacturer or supplier.

NOTE — The life of the cartridge/bag/basket filter for instance, is dependent on initial contamination of the oil and this cannot be quantified. The life of electrical control gear depends on the consistency of the power supply and if the voltage variation at site is beyond the permissible limits, the life would be unpredictable.

5.2 Performance Requirement

The manufacturer or supplier shall guarantee the ability of the oil conditioning plant to upgrade the quality of the oil from the initial values to the final values after 1-2 passes as given in Table 1.

Table 1 Performance of the Plant
(*Clause* 6.2)

Sl No.	**Property**	**Initial values**	**Final values**		
			Highest Voltage for equipment		
			Less than 220 kV	220 kV to 400 kV	above 400 kV
(1)	(2)	(3)	(4)	(5)	(6)
i)	Appearance	—	Clear, free from sediment and suspended matter		
ii)	Breakdown Voltage (kV)	≤ 20	> 60	> 65	> 75
iii)	Water content (mg/kg)	≥ 50	≤ 8	≤ 3	≤ 2
iv)	Gas content (percentage volume)	≥ 10	≤ 1	≤ 0.1	≤ 0.05
v)	Particles	—	Minimum NAS 9	Minimum NAS 9	Minimum NAS 5

6 MARKING

6.1 Each plant shall have the following information marked on a name plate in a permanent and liable manner in a location where it is accessible and easily visible after installation:

a) Manufacturer's and/or supplier's identification;
b) Capacity of the unit;
c) Serial number; and
d) Electrical supply details such as voltage of the supply circuit, normal operating current and power requirements of the plant.

6.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the Bureau of Indian Standards Act, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

7 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

Manufacturer or supplier shall furnish the following data relating to the plant:

a) Rated output of the plant in litres per hour;
b) Minimum suction head in meters at rated output;
c) Full-load heater rating in kW;
d) Power requirements of the motor used; and
e) Quality of oil in liters required for the filling.

At the time of supply, the manufacturer or the supplier shall also provide the operation and maintenance instruction manual together with flow diagram, wiring diagram and general assembly drawing.