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1. GENERAL

The necessity for regular purification of electrical insulating fluids in electrical apparatus has been recognised for a very long time. Moisture, solids and gaseous contaminants can seriously affect the function of electrical insulating fluids as a coolant and insulator.

This specification describes the equipment as supplied by Filterall for the processing (de-gasification, dehydration, filtration and de-acidification) of transformer insulating oil. Filterall purifiers are designed for processing transformer oil in workshops or in the field, in storage tanks, drums or directly in transformers. Purification of oil in transformers can be carried out **off-load** or **on-load** depending on customer's preference. For purification of oil in the field, a mobile type purification plant, mounted on a roadworthy trailer and covered by a weatherproof canopy, is recommended.

2. SCOPE OF SUPPLY

The scope of supply of this specification shall include the design, fabrication and factory testing of Vacuum Oil Purifier Type E. Equipment will be mounted on a common base or in a trailer and supplied in the form of a pre-piped and pre-wired package and shall provide a fully workable unit in accordance with this specification when received by the purchaser.

3. DUTY AND PERFORMANCE

Performance in a **single pass** through the purifier at a full flow rate shall be as follows:

Water Removal:- From 50 ppm down to less than 5 ppm in a **single pass** and down to 3 ppm after **two passes** as measured by the **ASTM Method D-1533**.

Gas Removal:- From fully saturated with air (10 to 12% by volume)down to less than 0.1% by volume as measured by the **ASTM Method D-2945**.

Particulate Matter Removal:- 98% of particles over 0.5 micrometre, or over 1 or 5 micrometre at customer's preference.

Tan Delta Improvement:- With the addition of an optional **Activated Clay Filter** , the Tan Delta value 90°C can be improved to 0.005. The Tan Delta correction pertains to polishing new/regenerated oil and is not recommended for used/old oil.

Dielectric Strength:- Improvement in dielectric strength up to 70 kV with new oil.

4. PROCESS DESCRIPTION

Filterall's process of oil treatment is based on the latest available technology:

Spreading of Oil:- Which is vital for easy release of moisture and gaseous containments is accomplished by porous media cartridge, called a ***coalescer***. In this process, heated or unheated oil passes through the layer of bonded fibreglass, where millions of sharp edges shear oil and expose it to the effect of the vacuum. **Spreading of oil** by passing through porous media is so efficient that oil can be treated at temperatures as low as 20°C.

Filtration:- Of oil is by **filtration cartridges** constructed of non-migration type cellulose material featuring a large surface area and dirt holding capacity. Obvious advantage of cartridge type filters is the low cost of filtration, easy and fast change of filter cartridges and no loss of oil or time for back washing etc...

The flow diagram shows the main components of a typical unit for Oil Purification of electrical insulating oils. Insulating oil is drawn in by an **inlet pump** , and is heated up in the **heater** and filtered by the **fine filter** before it reaches the **processing chamber** where water and gases contained in oil are thoroughly exposed to vacuum by efficient spreading and removed through a **vacuum pump** .

Operation & Maintenance:- Filterall purifiers combined maximum simplicity with high safety standards. A number of sensing devices are built in, continually monitoring all vital parameters (***see Alarms and Interlocks***.). If any of these parameters deviate from normal operation, the purifier will shut down, positively preventing inlet or outlet of oil, and a diagnostic light will remain on to inform the operator what corrective action is required.

5. MAIN COMPONENTS

Inlet Strainer:- Solid particles over 90 micron are retained in the **inlet pump**, preventing damage to the inlet pump and other components.
Inlet Pump:- One positive displacement gear type pump complete with mechanical seal direct driven by TEFC motor.
Electric Heater:- A low watt density heater (max. 1,7 watts/cm) is used to prevent heat degradation of oil. Heater elements are encapsulated in steel tubes thus completely insulated from oil to prevent fire hazard and to provide uniform heating of oil. Heaters are controlled by heavy-duty contractors and a failsafe electronic type temperature controller.
Fine Filter:- Solid contaminants are retained by a cartridge type filter, featuring easy and fast replacement of cartridges.
Processing Chamber:- Shell and all internal parts are made of carbon steel construction. Vacuum chamber features heavy-duty design, suitable for mobile installation.
Vacuum Pump:- Mechanical vacuum pump rotary vane type is air-cooled,direct driven by electric motor and is sized to maintain vacuum of less than 1 mbar in vacuum chamber during last pass.
Oil Discharge Pump:- A centrifugal pump featuring high suction capability removes oil from processing chamber and discharges it through a flow meter back into the transformer. Pump is direct driven by TEFC motor mounted on a common base.

6. INSTRUMENTATION

Instrumentation and electrical controls are located in a dust proof enclosure. A mimic panel is provided for the convenience of the operator showing the functions of the main components of the plant by way of pilot lights. Although the Purifier features fully automatic operation, a manual override of various functions is provided as standard. Even with manual override vital plant protection such as oil overflow are still in force.

Standard instrumentation and controls compromising of:

Temperature Controller (1):- An electronic type, highly sensitive featuring fail safe operation. Therefore a separate high temperature cut out is not required.
Vacuum Indicator (1):- Absolute (capsule type) has a measuring range of 0-25 mbar.
Pressure Gauges (2):- Before and after filters with measuring range of -100 to 0 kPa.
Vacuum Gauges (2):- Before and after coalescers with measuring range of 0-400 kPa.
Flow Meter (1):-With totalizer up to 999 990 Litres.
Level Control (1):- Continuously maintains level in vacuum chamber within 10 mm of normal.
Flow Control (1):- Manually adjustable from 10 to 100% of normal flow or intermittently down to 0%.
Foam Control (1):- Occasional frothing or foaming oil can develop, especially if oil contains high amount of moisture or during initial heat up stage. If high foam is detected, vacuum will be reduced automatically and foaming reduced to acceptable level. Plant operation is not affected, unless severe foaming conditions persist for more than 3 seconds. After that the plant will shut down (see ***Alarms & Interlocks***)

7. ALARMS & INTERLOCKS - mounted in instrument panel

Heater:-Heater switches on only when flow of oil is positively ensured.
Foam / Overflow:-Foam or oil overflow to vacuum pump positively prevented by photoelectric sensor.
Vacuum Break:-Automatic break in vacuum chamber to pressurize and to protect vacuum pumps.
Low Level Alarms:-Indicates absence of oil and will shut down plant.
Overloads:-All motors are protected by overloads.
Sound Alarm:-In the form of a panel-mounted siren is provided.
Shut Down:-Automatic and tight plant shut down in the case of any alarm situation.

The following alarms and interlocks ensure simple and safe operation of purifier. In addition to direct alarms, a number of interlocks are incorporated for safe operation :

Low Level / High Level Alarm:- If the level control system fails, either the **High or Low Level Alarm** will be activated and will shut down the plant. In the case of the **inlet or discharge valve** being closed during start-up or operation, no over pressure

condition can occur, since **High Level Alarm** will be activated and will shut down the plant.

8. OPTIONAL EQUIPMENT & ACCESSORIES

Activated Fuller's Earth Filter (Option C):- Fuller's Earth filters are used to remove a multiple of contaminants from transformer oils. **NOTE:- Activated Fuller's Earth filter option is not designed to be used for regeneration/reclamation of transformer oil but for oil polishing. Activated Fuller's Earth cartridges are of the disposable type and are easy to change. They are only used for small quantities of oil. If the application is for large quantities of oil for regeneration/recycling, a regeneration plant is recommended. Please ask for Specification S211.**

Mobile Installation (Option M):- Is on a roadworthy trailer. Single axel (up to 7000 liter/hour capacity) or a double axel trailer for higher capacities, is of steel weatherproof construction. The trailer is equipped with a 2 ball or pin tow hitch and an override brake as standard. Access to the machinery is through two double doors at the rear end of the trailer and side doors are fitted where required. Internal illumination is provided for lighting up the working area.
On **mobile** purifiers, an extra precautions is taken to prevent incorrect rotation of equipment by means of a **Phase Sequence Relay** and automatic interlock. Plant will be supplied with a spare wheel, which will be mounted under the trailer.

Portable Installation (Option P):- Similar to mobile installation, two swivel and two fixed castors are used to move the purifier around the factory floor.

Vacuum Booster (Option B):- For transformer evacuation and dry out, **Vaccuum Booster (Roots Rotary Blower)** is recommended. Vacuum booster and pump combination is less sensitive in pumping large amounts of water vapour which is the case in transformer dry outs. Oil over flow device is incorporated to prevent oil from transformers entering into the booster . **NOTE:- If this option is taken the backing vacuum pump size is then reduced. Please refer to the Flow Schematic.**

PLC Controls(Option PLC):- The purifier can also be equipped with a simple PLC (Programmable Logic Controller) to control the operation of the plant. The operator will simply push the **"Start"** button and the PLC will sequentially start the plant. If the operator pushes the **"Stop"** button, the plant will sequentially shut down after a 5 minute period to cool the heaters. Further facility exists that the plant can still be controlled manually by operator selecting **"Manual Control".** Even in manual control the PLC will look after all alarm functions in the plant. PLC type used is **Omron**.

Power Cable (Option E):- Plant will be supplied with a 20m four-core flexible trailing cable.

Water Sensor (Option WS):- The plant can be equipped with an in line water in oil monitor. The monitor will display water content in thetransformer oil in ppm (parts per million).

9. COMMISSIONING

A Commissioning Engineer will be available for start-up service and training for client's operators at an extra cost. Since Filterall purifiers are very easy to operate, commissioning is not usually required.

10. GUARANTEES

Mechanical Guarantee:-
FILTERALL guarantees the machinery supplied under this specification against defects in material and workmanship under normal use and service for a period of **12 months** from date of shipment. FILTERALL's obligation under this warranty is limited to repairing or furnishing without charge, F.O.B. Point of manufacture similar part to replace any part, which within warranty period is proven defective. FILTERALL shall not in any event be held responsible for any specials, indirect or consequential damages.
Performance Guarantee:- FILTERALL guarantees that the performance of the equipment will be within limitations as detailed **"Duty and Performance"** in this specification.

10. DOCUMENTATION

One copy of the **Operating and Maintenance Manual** is supplied with each purifier in CD format.

11. TYPICAL TRANSFORMER OIL PURIFICATION PLANT PICTURE

Model: E7000-BM
Double Axle

FILTERALL RESERVES THE RIGHT TO CHANGE ANY PART OF THIS SPECIFICATION WITHOUT NOTIFICATION