Industrial Transformers
Secondary Substation Transformers

INSTRUCTION BOOK

CARE AND MAINTENANCE OF OIL-IMMERSED
(R-TEMP-OR SILICONE IMMERSED) TRANSFORMERS

TABLE OF CONTENTS

For Technical Support please call:
011-528-156-2582
011-528-156-2168

SHIPPING

Distribution transformers are shipped completely sealed. Core and coils are assembled in a tank with the insulating liquid covering the coils.

This method of construction preserves the quality of insulation, the cooling and insulating liquid by preventing contamination from external sources.

INSPECTION ON RECEIPT

When a transformer is received, a thorough external inspection should be made before the unit is removed from the railroad car or truck. If there is evidence of damage and/or indication of rough handing in transit, and inspector representing the carrier should be requested and the manufacturer immediately notified.

NOTE: An internal inspection is necessary only if internal damage is suspected because of external indications of rough handling.

If the delivering carrier is willing to permit internal inspection of the transformer on the railroad car or truck prior to unloading, without requiring consignee's signature on the delivery slip, a representative of the manufacturer should be called and an internal inspection made as outlined in "Internal Inspection".

If the delivering carrier will not permit internal inspection of the transformer on the railroad car or truck, note on the acceptance slip for the shipment that there are "possible internal and/or hidden damages", and file a claim immediately for possible hidden damage. When the transformer has been removed to the installation site or some other convenient location to permit inspection of the internal assembly for damage in transit, proceed as outlined in "Internal inspection". Request that a representative of the carrier be present during the inspection.

HANDLING

A. COMPLETE TRANSFORMER

The transformer should always be handled in the normal upright position unless information from the manufacturer indicates that it can be handled otherwise. Where a transformer cannot be handled by a crane, it may be skidded or moved on rollers into place, depending upon compatibility of transformer base design and the type of surface over which it is to be moved. During the handling operation, care must be taken to prevent overturning.

When a transformer is shipped it is usually ready to be set in place after the crating and shipping braces are removed. Bushings and accessories which are shipped separately should be thoroughly protected against moisture until they are installed. Proper precaution must be taken during installation of these parts to protect the transformer against moisture.

B. LIFTING WITH SLINGS

Lifting lugs and eyes are designed to be lifted with a maximum sling angle of 30° from the vertical. For lift angles of greater than 30° from the vertical, spreader bars must be used to provide a vertical lift on the lugs.

C. RAISING WITH JACKS

Jack bosses are provided on most transformers so that the transformer can be raised by means of jacks. On those transformers not equipped with bosses, the jacks may be placed under the transformer bottom plate at designated points. The manufacturer's drawings should be consulted.

Do not attempt to raise the transformer by placing the jacks under drain valves, pipe connections or other attachments. It is also recommended that these appendages are not subjected to a man's weight.

INTERNAL INSPECTION

WARNING: Avoid any accident. Be sure to relieve tank pressure or vacuum before

attempting to loosen and remove manhole cover.

A. INSULATING LIQUID

Before opening a transformer, take samples of the insulating liquid from the top and bottom of tank and test the dielectric strength. The dielectric strength should be no less then 27.5 kV. If it is lower, the transformer should not be placed in service until the dielectric strength has been restored by filtration.

B. CORE-AND-COIL ASSEMBLY

Lower the insulating liquid to the top of the core-and-coil assembly and inspect the interior to see if any damage has occurred. If possible, DO NOT allow the coils and insulation to be exposed to the air.

Examine the top of the core-and-coil assembly, all horizontal surfaces and the underside of the cover for signs of moisture. If there are no signs of moisture or damage, proceed with the reassembly of the transformer. If there are signs of moisture inside the tank, steps should be taken to determine the extent of it and the manner in which the moisture entered the transformer. Reassembly should be carried through and the manufacturer of the equipment should be requested to make recommendations concerning further checks and steps for drying out the transformer.

If the transformer appears to have been damaged internally, or if it is desirable to remove the core-and-coil assembly for inspection or drying, the transformer may be untanked as follows:

1. Remove the handhole lid and disconnect high-and low-voltage leads if the bushings are in position. Remove large bushings from cover if any.

2. Small bushings if any may be left on the cover if they are protected and the cover is carefully handled. Remove cover. Remove thermometer, tap changer and liquid gauge and all other accessories and associated wells which project into the tank and which might interfere with untanking operations.

3. Use slings for removing the core-and-coil assembly.

4. Particular care must be taken in handling tools and other loose articles when working with a transformer. Metallic objects, if dropped in the windings and allowed to remain there, can cause a severe fault.

STORAGE

It is advisable to locate a transformer, complete with liquid, in its permanent location even if it will not be placed in service for some time. It is recommended to check the paint finish and to repair all damaged painted surfaces. If the transformer is shipped and stored in dry inert gas, the gas pressure should be maintained and periodically tested. If an oil-filled, indoor-type transformer is stored outdoors, it should be thoroughly covered to keep out rain. A transformer should not be stored or operated in the presence of corrosive vapors or gases, such as chlorine.

Should it become necessary to store accessories for a long period of time, they should be stored in a clean, dry place or the manufacturer should be contacted for explicit instructions on the storage of individual pieces.

LOCATION

Accessibility, ventilation and ease of inspection should be given careful consideration in the location of transformers.

Self-cooled transformers depend entirely upon the surrounding air for carrying away their heat. For this reason, care must be taken to provide adequate ventilation.

For indoor installation, the room in which the transformers are place must be well ventilated so that heated air can escape readily and can be replaced by cool air. Inlet openings should be near the floor and distributed so as to be most effective. The outlet opening(s) should be as high above the apparatus as the construction of the building will permit. The number and size of air outlets required will depend on their distance above the transformer and on the efficiency and load cycle of the apparatus. In general, about 60 square feet of outlet opening or openings should be provided for each 1000 kVA of transformer capacity. Air inlets should be provided with the same total area as the outlets.

Self-cooled transformers should always be separated from one another and from adjacent walls, partitions, etc., in order to permit free circulation of air about the tanks. This separation should not be less than 30 inches.

SERVICE SET UP

PRELIMINARY INSPECTION: Before any work is done on a transformer in preparation for service, a careful inspection of all external parts is needed to disclose any evidence of mistreatment or damage. This inspection should include a check of all parts required to complete the installation, making certain that all parts have arrived and are in first-class condition. Accessible bolted parts should be checked for tightness. Pressure test should be taken and the liquid checked to determine both its physical level and dielectric strength. Any indication of leaks, which may have resulted in moisture entering the transformer, should be noted and appropriate action taken.

NOTE: Pressurized and sealed at ambient temperature at time of manufacture. It is common that a pressure vacuum gauge, if supplied, could read negative due to lower temperature at the site of installation. This is not an indication of an abnormality, but in fact an indication that the tank is properly sealed.

SERVICE START UP

Before applying voltage to transformer, check the following items:

- ☐ 1.The feeder cables on bus connected to bushing terminals are not stressing the porcelains.
- ☐ 2.The winding neutral terminal is properly grounded or ungrounded as required by system operation.
- ☐ 3.The tank is solidly grounded at grounding pads located near bottom of tank.
- ☐ 4.All current transformers are connected to a load or in short circuit.
  CAUTION: Open secondaries can produce voltages dangerous to humans and connected equipment.
- ☐ 5.The the tap changer is set in desired position to give desired voltage ratio.
- ☐ 6. All tools and foreign objects have been removed from transformer.
- ☐ 7. All openings and joints are sealed
- ☐ 8. Is insulating liquid at proper level in tank? Also level in liquid-filled compartments (if supplied).

☐ 9. Are all fans and control circuits (if supplied) operational?

☐ 10. Is insulating dielectric strength of insulating liquid at least 27.5 kV? If tests are less, filter the liquid.

☐ 11.Are all personnel in the clear?

After energizing, watch transformer closely for the first three hours of operation for evidence of abnormal conditions.

LOADING

Transformers are suitable for full-load operation at rated temperature rise without shortening of useful life, providing the following conditions are met:

1. Ambient temperature does not exceed 40°C or average more than 30°C in one 24-hour period.

2. Installed elevation does not exceed that shown on the nameplate and stenciled on the transformer tank. Consult a representative of the manufacturer for instructions for operating at higher altitudes.

PERIODIC INSPECTION

1. Sample and test insulating/cooling liquid for dielectric strength
CAUTION: If a vacuum is indicated on the pressure vacuum gauge, care must be used to eliminate it prior to insulating liquid sampling. Failure to do so may result in air being pulled into the tank through the drain valve which may lead to insulation failure if energized or upon re-energization. Contact factory for specific instructions.

2. Check level of liquid in main tank and liquid-filled compartments. Add clean liquid if necessary.

3. Check fan operation on Forced Air units.
CAUTION: Before entering a transformer that has been in service, BE SURE to lock open the line switches on both the HV and LV side, then connect a grounded line to transformer terminals in order to discharge any stored energy in the windings.

DO NOT ENTER THE UNIT UNTIL THE GAS SPACE ABOVE LIQUID HAS BEEN PURGED WITH DRY AIR. BREATHING THE NITROGEN ABOVE THE TRANSFORMER LIQUID CAN CAUSE ASPHYXIATION.

MAINTENANCE DURING PERIODS OF SHUTDOWN

The transformer does not generally require particular cares for attendance or maintenance. Anyway, in order to ensure a safe and reliable operation, it will be necessary to effect at regular intervals a series of checks, the frequency of which depends on ambient and operating conditions.

Clean any contamination from bushings.

Rotate the tap hanger handle back and forth a few times. This will clean the contacts. Be sure to return the handle to its original position if no change in voltage ratio is desired.

CHECKING FOR LEAKS:

Check pressure vacuum gauge daily the first week of transformer operation. If pressure-vacuum gauge stays at zero reading, it indicates a faulty seal. If transformer cannot be de-energized, be careful to not come into contact with live parts such as bushing terminals and leads.

Slowly add nitrogen or dry air AT LOW PRESSURE until gauge reads 5 PSI. Apply with a paint brush soapy water or detergent to all seals above liquid level. Small bubbles will indicate the location of the leak.

After leak is repaired, add sufficient dry air or nitrogen to provide 0.5 PSI gauge pressure at 25 °C (top liquid temperature). Refer to curve for normal pressure at other top liquid temperatures.

ACCESSORIES

PRESSURE RELIEF DEVICE

When required by the specifications, a mechanical automatic resealable type pressure relief device can be supplied. This device requires no adjustment after it operates. After relieving the pressure due to the gas build-up in the tank, it automatically recloses and reseals. Alarm contacts are available if specified

PRESSURE-VACUUM BLEEDER DEVICE

When required by the specifications, a pressure-vacuum bleeder can be supplied. This device is designed to protect transformer from a slow build-up of pressure. It will either admit air or exhaust internal gases to maintain a safe level of pressure/vacuum.

BUSHINGS

Porcelain is used as the major insulation in sidewall bushings and upon receipt, an inspection should be made for chips and cracks. If there is evidence of damage or rough handling, file a claim with the transportation company promptly and notify the nearest Sales Office of the General Electric Company. If it becomes necessary to replace a porcelain, the change can be made externally after the liquid level has been lowered below the bushing.

DETACHABLE-CABLE TYPE

To remove the porcelain on a detachable-cable type bushing, bend locking collar back and remove it along with hex-head nut. Remove nuts, washers and clamp. Porcelain can be removed and stud will remain attached to the transformer leads from inside the tank. When installing a new porcelain, be sure gasket stop is in position, and torque nuts from 10 to 17 foot-pounds (13.6 to 23 Newton meters).

STUD TYPE

To replace the porcelain on a stud type bushing, remove hex-head nut and flat washer. Remove nut, lock and flat washers, and clamp. Porcelain can then be removed leaving terminal stud attached to the winding leads. When installing a new porcelain be sure gasket stop is in position, and torque nuts from 10 to 17 foot-pounds (13.6 to 23 Newton meters).

FORCE AIR-COOLING EQUIPMENT FOR LIQUID-FILLED TRANSFORMERS

CAUTION

THE EQUIPMENT COVERED BY THESE INSTRUCTIONS SHOULD BE INSTALLED, OPERATED, AND SERVICED ONLY BY COMPETENT TECHNICIANS FAMILIAR WITH GOOD SAFETY PRACTICES, AND THESE INSTRUCTIONS ARE WRITTEN FOR SUCH PERSONNEL AND ARE NOT INTENDED AS A SUBSTITUTE FOR ADEQUATE TRAINING AND EXPERIENCE IN SAFE PROCEDURES FOR THIS TYPE OF EQUIPMENT.

INTRODUCTION

Fans are used on transformers to increase the rate of heat dissipation and thus provide additional transformer load capacity. They are normally shipped separately and must be properly installed before attempting to operate the transformer at the forced-air-cooled rating shown on the nameplate. Fans are to be used only on those transformers designed to operate with a forced-air-cooled rating.

DESCRIPTION

Fans are available in 12-, 20-, and 24- inch sizes. Mounting Arrangements differ according to the particular application as outlined under "Installation". All fans used on any transformer are the same size and their motors ratings are given on the motor nameplate. Ratings are also shown on the transformer Outline drawing, along with the fan catalog number. Fan motors are equipped with a thermal protector to prevent overheating due to overloads or failure to start. When a motor is shut off by the thermal protector, it will start again automatically after cooling.

CONTROL

One or more switches are furnished to permit manual operation of the fans for test purposes or automatic control by a thermal relay. Two types of thermal relays are available, those which respond to changes in top liquid temperature and those which respond to an equivalent of the winding hot-spot temperature. The temperature at which the fans operate and detailed information concerning the thermal relay are contained in separate instructions covering that device. A magnetic contactor will be included if the connected load exceeds the rating of the thermal switch or if three-phase motors are used. Refer to the transformer Connection Diagram for details.

INSTALLATION

In order to obtain the forced-air-cooled rating given on the transformer nameplate, the type, number, and location of the fans must be as indicated on the transformer Outline (or Supply Parts Assembly) drawing. Before mounting, make an inspection for shipping damage and check for proper blade alignment. All three sizes can be mounted on the side of the cooling tubes or radiators. In addition, the 12- inch fans may also be mounted. Install the fans in the positions shown on the Outline, paying particular attention to the support bracket spacing and hardware assembly in order to obtain a secure mounting. Vibration problems may be encountered if the fans are not mounted properly.

When installing the fans, make sure they blow air *toward* the transformer cooling tubes. If it should be necessary to change the direction of rotation of a three-phase fan, this can be done by interchanging any two motor leads.

TUBE MOUNTING

To install a 12" or 20" fan on the side of the cooling tubes, determine its center line and locate the mounting brackets in relation to those center. Assemble parts and using washers over each mounting bolt, attach the fan using clamps and lock nuts.

To install a 24" fan, determine its center line and locate the mounting brackets in relation to the center lines. Dimensions to be used will be determined by the location of the fan with respect to the tube header. Assemble parts and using washers over each mounting bolt, attach the fan using clamps and locknuts.

Position 20- and 24- inch fans with their weep holes at the bottom to allow draining of any condensate within the motor housing and to prevent the entrance of free water. (This will place the motor capacitor at the top on single-phase fans).

HEADER MOUNTING

Depending on the size of the transformer and the configuration of cooling tubes, 12-inch fans may be mounted above the top headers blowing downward. In the case of

certain Supply jobs for older transformers, 12-inch fans may also be mounted below the bottom headers blowing upward. On those mounted under the headers, a swivel-type bracket is provided in order to permit installation of the fan on the required center line.

WIRING

After the fans are mounted, the fan wiring is to be installed as indicated on the Outline drawing and Connection Diagram. When the fans are divided into two or more banks, separate cabling will be provided for each bank. Make sure water-tight seals are established where cables enter the various fittings. Cables are to be clamped to the cooling tubes and fan guards.

MAINTENANCE

A periodic inspection should be made of the forced-air cooling equipment to be sure it is in satisfactory operating condition. Motor bearings are permanently lubricated and sealed at the factory and require no maintenance.

Do not paint fan blades. Doing so except under controlled conditions will frequently cause the blades to become dynamically unbalanced. When placed in operation, the imbalance will then set up excessive vibration which can eventually lead to destruction of the blade.

TAP CHANGER

GE-PROLEC small power transformers use de-energized tap changers that are used to change the voltage ratio when the transformer is de-energized.

The tap changer is provided with stop notches, a position indicator for avoiding faulty positions and a hole for a lock to prevent un-authorized operations. It is shipped in place, and is set on the position corresponding to the rated voltage shown on the transformer nameplate.

THERMOMETER

A dial-type thermometer is standard equipment on most transformers. It is mounted in a well in the transformer and therefore can easily be removed. The thermometer reads top-oil temperature.

The thermometer also has a drag pointer which indicates maximum temperature reached. This drag pointer is reset by drawing the magnet (chained to the thermometer) across the face of the thermometer.

A thermometer with alarm contacts is an optional extra. These contacts can be used to sound an alarm, control fans and/or actuate circuit breakers when preset temperatures are reached.

LIQUID-LEVEL INDICATOR

The magnetic liquid-level gauges are composed of two subassemblies. The internal float mechanism and flange is first bolted to the tank flange with a gasket seal. The bezel assembly which contains dial and pointer is next screwed to the flange. Motion of the float inside the tank is transmitted from internal shaft to the pointer shaft by polarized magnets, located each side of the flange. Because of the seal, no liquid or gas is lost even if gauge glass is broken.

The liquid-level gauge can also be provided with microswitch for alarm circuits.

METHOD OF DRYING TRANSFORMERS

Excess moisture can curtail transformer life. GE-PROLEC removes moisture from the insulating system during manufacturing by loading the core and coil assembly into a drying oven and baking it for over 12 hours maintaining the internal temperature at 120°C. This process takes part prior to the vacuum and liquid filling process.

FILLING WITH INSULATING LIQUID

A. CHECKING INSULATING LIQUID

Check the dielectric strength of the insulating liquid while it is still in containers. If free water is present, drain off the water before putting the liquid through the filter press. Continue passing liquid through the filter press until the prescribed dielectric strength is met.

B. NON-VACUUM FILLING

Although it is not recommended, in cases where vacuum filling is not required, the tank should be filled through the main drain valve. A second opening at the top should be provided to relieve the air being displaced. Full voltage may not be applied to the transformer for a period of 24 hours.

C. VACUUM FILLING

Entrapped air is a potential source of trouble in all transformers. In general, therefore, it is desirable to fill transformers with liquid under as high a vacuum as conditions permit. Particularly it is essential to vacuum-fill high-voltage transformers shipped in nitrogen or dry gas in order to develop their full insulation strength before they are energized.