META
POWER SOLUTIONS

SINGLE-PHASE POLE-MOUNTED TRANSFORMER INSTRUCTION MANUAL

Meta-Power Solutions ®

Contents

Introduction

The design and construction details of overhead distribution transformer units allow them to be mounted on weather-exposed utility poles in single-phase-above-ground power distribution systems. This instruction manual will help guide competent technicians in installing, operating, and maintaining these **single-phase pole-mounted overhead distribution transformers.**

This manual was made after anticipating most normal installation, operation, and servicing problems. However, the instructions do not cover all possible scenarios where equipment or application conditions may vary. In such cases, additional information can be obtained by contacting a factory representative at:

Meta Power Solutions (MPS)
500 S Australian Ave Suite 600, West Palm Beach, FL 33401

Read this manual first!

It is important that a technician reads this manual, understands its contents, and follows all locally approved practices and safety procedures before connecting or operating a single-phase pole-mounted overhead distribution transformer.

Additional information

This instruction manual cannot cover every detail or variation in the equipment, process, or procedure described, nor can it provide directions for meeting all possible contingencies during the equipment installation, operation, or maintenance. Contact your Meta Power Solutions representative for additional information if the need arises.

Safety information

The instructions in this manual are not meant to be used as substitutes for proper training and experience in safely operating the described equipment. Only “competent technicians” should be allowed to install, operate, and service the equipment.

A competent technician should have the following qualifications:

- They are thoroughly familiar with the instructions given here.
- They are properly trained in industry-accepted low-voltage and high-voltage safe operating procedures and practices.
- They are adequately trained and fully authorized to energize, de-energize, ground, and clear power distribution equipment.
- They are properly trained in the care and use of protective equipment such as rubber gloves, face shields, safety glasses, hard hats, clamp-stick, arc flash clothing, hot-stick, etc.

Safety instructions

The following statements are general warning and caution statements that apply to Overhead Distribution Transformers. For specific tasks and procedures, additional warning and caution statements are provided throughout this manual.

Danger

Hazardous voltage. Contact with hazardous voltage can cause severe injuries and even death. Personnel working around low-voltage and high-voltage lines and equipment should follow all locally approved safety procedures and practices.

WARNING:

Carefully read and understand the contents of this manual before installing, testing, operating, or maintaining an Overhead Distribution Transformer unit. Improper handling, operating, or maintenance of the equipment can cause equipment damage, severe injuries to personnel, and even death.

WARNING:

An Overhead Distribution Transformer is not intended for the protection of human life but to distribute power. Locally approved practices and safety procedures should be followed while installing or operating this equipment. Non-compliance with these safety procedures can result in equipment damage, severe injuries to personnel, and even death.

WARNING:

The selection of power distribution and transmission equipment should match its intended application, with installation and servicing conducted by trained and competent personnel who understand safety protocols. These instructions are intended for such personnel and should not replace proper safety training and experience. Failure to correctly select, install or maintain power distribution and transmission equipment can lead to severe personal injury, equipment damage, and even death.

Safety requirements

Before you start work

Check your supplies and tools!

Before starting your work on the transformer, check your supplies and tools, and ensure that the required equipment is available and in good working condition.

While you are working

Protect yourself!

As you work on the transformer, make sure to follow all the safety procedures, practices, and regulations established by your employer. Wear adequate protective gear and clothing like gloves, masks, helmets, goggles, boots, etc., provided by your employer for job safety.

Make sure to follow the manufacturer's instructions, warnings, and precautions when installing an attachment or using an apparatus.

Electrical equipment can be dangerous and should be handled with care and respect. Do not operate or service a system-connected transformer before evaluating the system's circuit and load current conditions.

Take care while lifting and moving the transformer!

First, check the transformer nameplate to find the unit's total weight. Then, check the lifting capacity of all available hoisting and lifting equipment, and only use the cranes and forklifts if their load capacity exceeds the transformer weight. Use only the lifting lugs to lift units from above; do not use the bushings instead of handles. Do not use damaged hooks, slings, or cables. Take care when taking down the unit from the truck so it does not get damaged.

Mount the transformer unit securely!

The transformer unit must be fastened securely to the utility pole at its application site

When you make the system connection

Ensure that the transformer tank is grounded!

Before working on the transformer, ensure the tank is grounded through a permanent, low-impedance ground.

Ensure that all terminals and bushings are clean before making system connections!

Remove all grease, dust, dirt, or foreign material from the terminal lugs, bushings, and connection points before making connections.

Ensure that the neutral connections are complete before making further system connections!

All the available transformer neutrals and the system neutrals should be connected before making any other types of connections to the system.

Keep the system wiring away from unused leads!

All unused leads must be insulated from the ground, as well as from other connections and leads.

Install attachments by following the manufacturer's instructions!

Install attachments and accessories according to the manufacturer's instructions. Ensure that the chosen connectors have the required ratings for the expected application.

Inspect the insulating fluid level before the transformer is energized!

Only energize the transformer unit if the insulating fluid inside the transformer tank is at the required level.

During operation

The non-load break accessories should only be operated after ensuring that the transformer is properly de-energized.

Tap-Changers

The tap-changer settings should only be adjusted after ensuring that the transformer is properly de-energized.

Multiple-Voltage Switches

The multiple-voltage switch settings should only be changed after ensuring that the transformer is properly de-energized. The correct voltage can be found on the transformer nameplate before re-energizing the unit. Also, the tap-changer position should be confirmed before the transformer is energized with a multiple-voltage switch.

WARNING:

When transformer windings are connected in parallel using multiple-voltage switches, the tap-changer's position must be according to the transformer nameplate information. Generally, transformer tap-changers cannot adjust the voltage ratings of the transformer when its windings are parallelly connected. To get the correct voltages, check the tap-changer settings against the nameplate information, reset the multiple-voltage switches, and re-energize the transformer. Energizing the transformer with the tap switch in an incorrect position can result in equipment failure, personal injury, or death.

Internal fuses

The internal fuses of a transformer can only be serviced after de-energizing and opening the transformer.

WARNING:

Never attempt to open a system-connected, energized transformer. Doing so could result in equipment damage, personal injury, or death.

Operate within transformer ratings!

Verify the transformer ratings by inspecting the transformer nameplate. A transformer unit should never be operated beyond its specified ratings. Some transformers are better suited to bear overload conditions than others. For example, the projected service life of a mineral oil-filled transformer unit is greatly reduced if the unit is operated under overload conditions for prolonged periods. On the other hand, PEAK™ transformers are designed to have extended insulation life. These transformers can withstand operations in overload conditions and offer insulation life that exceeds ANSI® standards. You can contact your MPS representative to discuss the acceptable loading conditions for PEAK™ transformers.

WARNING:

Operating a transformer by exceeding its ratings may result in personal injury and equipment damage.

Receiving

Once it is received, the transformer unit should immediately be inspected for signs of mishandling and damage that might have occurred during the shipment. Notify your MPS representative in case any evidence of a defect or damage is identified, and file your claims for damage with the delivering carrier.

Parts and attachments of the transformer that became loose or damaged during the shipment should be tightened, repaired, or replaced before the transformer is moved.

CAUTION:

First, check the transformer nameplate to find the unit's total weight. Then, check the lifting capacity of all available hoisting and lifting equipment, and only use the cranes and forklifts if their load capacity exceeds the transformer weight. Use only the lifting lugs to lift units from above; do not use the bushings and other accessories in place of handles. Do not use damaged hooks, slings, or cables. Take care when lifting the unit and removing it from the truck so it does not get damaged.

Moving the Transformer

Moving Transformer Shipped on Pallets

If the transformer and other equipment are shipped on pallets, they may be moved using cranes, hoists, and forklift trucks of proper capacity.

WARNING:

Non-palletized transformers and other equipment should not be lifted with forklift trucks because doing so could result in personal injury and equipment damage.

Lifting the Transformer by Crane or Hoist

Lifting lugs should be used to unload the transformer. These are found near the top of the transformer tank. The pull angles for the lifting cable should not exceed 30° from the vertical plane. If they exceed this angle, the lifting cables should be held apart with the help of spreaders to avoid any bending in the lifting hooks or the tank itself. Oblong hooks, links, and other similar lifting hardware should not be used under the lifting lugs because they could compromise the load rating of the lugs. The transformer should not be lifted by looping a chain or cable around the unit or lifting lugs.

WARNING:

Use all the provided lifting pads and lifting lugs to lift the transformer. Using transformer apparatus like cooling fans and radiators for lifting could result in personal injury and equipment damage.

Skidding/Rolling Transformers

The design of MPS transformers allows them to be skidded or rolled into place without needing overhead lifting devices like cranes and hoists. If the unit must be rolled into place, then sufficiently thick and strong rollers must be used to support the weight of the transformer unit. Multiple rollers may be used to ensure the unit's weight is distributed uniformly throughout the moving process. The path to the installation place should be level and free of debris and obstructions.

Storage

Always store a transformer unit with oil in place to prevent moisture absorption and contaminants.

The storage location should be dry and have no radical or rapid temperature changes.

CAUTION:

A transformer should be stored upright on a pallet to give it the necessary elevation to keep it away from standing water, thus preventing the water from damaging the device. Do not stack up multiple devices or store them in places where they might be subjected to damage due to mechanical stress.

Installation

Understand the differences between various equipment and accessories and their functions and purposes. Ensure that you use any protective equipment or clothing required for a task. If possible, you should use a hot stick to perform all disconnect, grounding, reconnect, and testing operations. Remember to treat a transformer unit as an energized device until you verify its actual state and condition.

Pre-service inspection

Brand new transformers and transformers that have been energized after being in storage for some time should only be connected to the system after they are inspected thoroughly.

1. Inspect the transformer exterior for dents, scratches, and nicks. If the weather-resistant finishes on the exterior are damaged, they should be promptly repaired.

2. Inspect the transformer tank cover and cover seals, along with all the seals and gaskets at operating devices, for seepage and leaks of the insulating fluid. The transformer should only be placed into service after all improperly tightened and leaking seals and gaskets are repaired.

3. MPS ships transformers once they are ready for installation, with the insulating fluid inside the tank at the required 25°C level. If a transformer does not have a gauge, the oil-level plug or tank cover can be removed to determine the fluid level.

WARNING:

The oil-level plug or tank cover should be removed only after the transformer tank pressure has been vented to zero. This can be done using a hot stick to manually operate a pressure relief device. The transformer should be properly vented to atmospheric pressure before and after moving the transformer, before the installation of the transformer, and before initiating any inspection or repair processes on the transformer. Failure to do so could result in severe personal injury and equipment failure.

Reconfiguring Factory Low Voltage Internal Connections

If the internal connections of a transformer have been reconfigured and no longer have the original factory settings, then a Turns Ratio Test must be performed before energizing the device. This Test must be performed according to the IEEE Std C57.12.90™ standards to ensure that such transformers continue to produce the correct polarities and output voltages.

WARNING:

The Turns Ratio Test should be performed before the transformer is energized. Failure to do so could result in severe personal injury and equipment failure.

Mounting the transformer

Mount the transformer by making sure that it is upright and level. Ensure the selected mounting pole is strong enough to support the transformer weight without deformation.

WARNING:

The load-bearing capacity and pole condition should be verified before mounting the transformer. Failure to do so could result in equipment damage, personal injury, or death

Non-load-break accessories

The settings for tap-changers and multiple-voltage switches should be adjusted before making any low-voltage or high-voltage connections.

The factory setting of the multiple-voltage switch is typically adjusted to the highest voltage position. Check the switch position. The factory setting of the tap-changer is typically adjusted to the rated nameplate voltage. These tap positions can be referenced from the nameplate. Check the tap-changer position.

WARNING:

Tap-changers and high-voltage switches are examples of de-energized devices that should not be operated when the transformer is in its energized state. Operating them on an energized transformer could result in severe personal injury and equipment failure.

External connections

Transformers connections and operations should be done according to the transformer nameplate information and diagrams. Inspect the transformer terminals and bushings. Clean them and remove all the grease, dirt, dust, and foreign materials from them before making the system connections. Make sure that the cables used to connect to the transformer terminals have sufficient flex to allow for natural cable movement to occur under different weather conditions; otherwise, the bushings may get damaged and fail prematurely.

WARNING:

Check the nameplate information and diagrams to find the connections that can be made for the transformer. Connected the available transformer neutrals to the system neutrals. Ensure to insulate the unused connections and leads from all other leads and ground. Improper connections could result in equipment failure or severe personal injury.

WARNING:

You must ground the transformer tank before making any other electrical connections. Treat a system-connected and ungrounded transformer unit as an energized device. Contact with the tank of an energized transformer device is extremely dangerous and can be fatal. Transformers with Wye-Wye windings connections have no Delta windings. These transformers are designed to be used in systems that have grounded-neutral connectors. Windings designed for grounded-neutral operations MUST always be solidly and permanently grounded to the system neutral without any resistance.

Ground Connections

The transformer tank must be permanently grounded through a low resistance before making any other electrical connections. Treat a system-connected transformer unit as an energized device if it is not solidly grounded. Contact with the tank of such an energized transformer device is extremely dangerous and can cause shocks, burns, or even death.

MPS equips its overhead transformers with a grounding nut. This can be used to make the necessary ground connections.

Low-Voltage Connections

MPS's overhead transformers use eye-bolt terminals for their standard low-voltage connectors.

CAUTION:

Overtightened eye-bolt terminals may damage the equipment. Therefore, these terminals should be tightened according to specific standards. The general torque requirements for tightening the eye-bolt terminals are given below:

Eye Bolt Size Torque	Eye Bolt Size Torque
3/8-16 175-200 in-lb	3/8-16 175-200 in-lb
1/2-13 375-425 in-lb	1/2-13 375-425 in-lb

Surge Arresters Connections

If transformers and surge arresters are ordered together, then the surge arresters are typically installed on the transformer at the factory before being shipped. The ground connections for the transformer tank and surge arrestors MUST be completed before connecting the transformer to the high-voltage line. A proper connection will place the arrestor and the transformer insulation in a direct shunt relationship.

High-voltage connections

The assembly of internally clamped bushings and tin-plated eye-bolt terminals provide connection points suitable for aluminum and copper conductors and can be used to make high-voltage connections. Only connect high voltage after all other connections have been made.

Accessories

Accessories are optional, and additional equipment may be installed on a single-phase overhead transformer. They include a variety switches, switches, pressure relief devices, gauges, etc. Accessories are mostly installed at the factory before shipment of the transformer and do not require fieldwork to become operable. Always install attachments and accessories by following the relevant manufacturer's instructions and ensure that all connectors are rated correctly.

Secondary breaker

Some transformers are equipped with secondary breakers designed to protect the transformer against secondary faults. These breakers are not meant to be used as an on/off switch for the transformer nor to protect loads connected to the transformer secondaries.

WARNING:

A voltage may get induced at the load if the low-voltage terminals of the transformer are connected in parallel, and the transformer's secondary breaker is left open. Only work on the load after verifying that no voltage is present, keeping with the industry operating procedures. Working on loads with an induced voltage may result in severe personal injury or death.

Pressure Relief Valve

It is standard for pole-mounted transformers to come equipped with automatic pressure relief valves (Fig. 1). These devices are used to slowly release the transformer tank pressure to prevent it from rupturing.

These valves are installed on the transformer and adjusted within the factory before shipment. They vent the pressure from inside the tank at 5 ±2 PSI. The oil and other components inside the tank naturally contract and expand, even with normal ambient and operational temperature fluctuations. These contractions and expansions inside the tank cause the pressure of the gas-filled headspace to fluctuate as well.

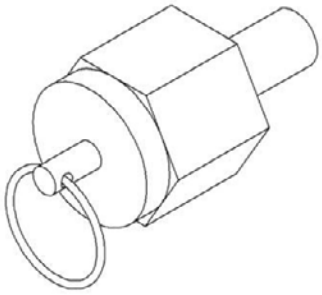

Figure 1: Pressure Relief Valve

Tap Changers

De-energized Tap changers (DETC) (Fig. 2) are externally operated apparatuses that are provided with transformers to change the operating voltage of the transformer. They are provided for all transformers unless specified. Typically, each tap is configured at ±2 X 2.5% of the transformer's rated voltage. This means that the tap-changer can be used to adjust the transformer output voltage in 2.5% increments. Tap-changers generally have hot-stick operable handles

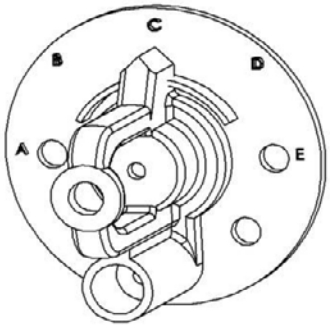

Figure 2: No-Load Tap Changer (NLTC)

WARNING:

Ensure the transformer is de-energized remotely from an upstream source before operating or adjusting the de-energized tap-changers, Delta-wye, and dual-voltage switches.

Surge Arresters

Pole-mounted transformers have the option to include an additional component known as a Surge Arrester (Fig. 3) to protect the cables and equipment against overvoltage surges.

Under steady-state conditions, the arrestor acts as an insulator, and the nominal line-to-ground voltage appears across its terminals. However, when an overvoltage surge occurs, the arrester immediately limits it to a known level by diverting the surge current through itself in a low-resistance path and thus protects the equipment from damage. The arrestor returns to its initial state after the surge passes, once again blocking any leakage current from passing through it.

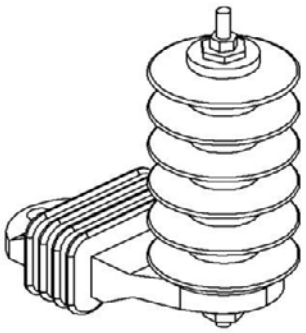

Figure 3: Surge Arrester

WARNING:

Surge arresters may get damaged due to excessive test voltage. Therefore, the surge arresters of a transformer unit should be disconnected from the unit before running applied potential and impulse tests on the transformer.

Factory Testing

The information below is meant to be used as a guideline for transformer testing. For more details, please refer to IEE/ANSI C57.12.90-2006 and ANSI/NETA ATS-2009.

Routine Tests

Ratio Test

The transformer turn ratio measures the relationship between its two windings. It is obtained by taking the ratio of the number of high-voltage winding turns to the number of low-voltage winding turns. If a transformer has taps, turn ratios must be determined separately for every tap position and the full-winding relationship.

NOTE:

The ratio test device can also test transformer phase polarity, sequence, and relation.

Winding Resistance

Measuring the Winding resistance is a fundamentally important task because it allows us to calculate the 2R component of conductor losses. These values are needed to calculate the total temperature of a winding through the temperature rise test.

Excitation Current and Losses

Excitation (no-load) current is the amount of current required to excite the transformer through any given winding when all other windings are left open-circuited. Generally, it is expressed as a percentage of the rated current of the winding under the measure. Excitation (no-load) losses are transformer losses that are caused due to the flow of excitation current through the transformer windings. These losses include dielectric losses, core losses, and the two types of conductor losses that exist due to the flow of excitation currents in the winding and due to the flow of circulating currents in parallel windings, respectively. The Core losses of the transformer core are the primary contributors to the total excitation losses of a transformer. These losses are a function of the applied voltage magnitude and frequency. Excitation losses also vary with temperature and waveforms, which means that the no-load loss measurements show noticeable variations when different test voltage waveforms are used.

Load Losses and Impedance Voltage

The losses of a transformer that specifically vary with the incident load as it is supplied by the transformer are known as load losses. These losses include the 2R losses that arise when the load current flows through the windings and the stray losses that are caused by the flow of induced eddy currents in the tank walls, windings, core clamps, magnetic shields, and other conducting parts due to the action of the leakage flux.

If the two specified transformer windings are connected for their rated voltage operations, and we short-circuit one of them and apply voltage on the other, then the transformer impedance voltage will be the amount of voltage required to cause the rated current to circulate through the non-shorted winding. Impedance voltage is typically expressed per unit or as a percentage of the rated voltage for the winding under-measure.

Routine Tests

Insulation Power Factor Test

The insulation power factor is a parameter used to judge the quality of the transformer insulation. It is obtained by taking the ratio between the power (watts) dissipated within the insulation and the effective power (volt-amperes). Effective power is the product of the effective voltage and current values obtained by testing the transformer response with sinusoidal voltages and controlled conditions.

Insulation Resistance Test

The insulation resistance test is conducted to find the total insulation resistance between individual windings and between individual windings and ground. Its value may be measured in units of megohm or calculated from measured values of applied voltage and leakage current.

Temperature Rise Test

The temperature-rise Test is used to determine the temperature rise above the ambient for each transformer windings by taking temperature measurements at the terminals of the transformer. The measurement results for a given winding or terminal pair give us the average temperature and the average temperature rise for the entire winding. These values do not refer to the temperature values for any specific point on the winding, nor do they refer to the arithmetic average of the measurement results from different terminal pairs.

Lightning Impulse Test

Lightning impulse tests are used to test the dielectric strength of the transformer insulation by applying different voltage waveforms (impulses) on the transformer windings without supplying the transformer with excitation voltage or current. In this Test, a reduced full wave, and a full-wave waveform are applied individually. The two waves must match.

Dielectric Strength Test

The dielectric Test of the transformer is a measure of the insulation quality between turns, mainline, and earth, and between line-end and earth. Generally, this Test is performed in two steps: The separately-applied-voltage withstand (Hi-Pot) Test and the Induced-voltage withstand Test.

Audible Sound Level Test (Optional)

The transformer core is the primary source of audible sounds within the transformer's body. From there, this sound travels through the dielectric fluid and the structural supports to the outer transformer shell and other solid transformer surfaces. Here, the vibrations radiate as an airborne sound and can be heard as noise. The frequency spectrum of this audible noise is primarily a combination of the even harmonics of the fundamental power frequency. Thus, for a 60Hz power system, the audible sound is made up of the 120, 240, 360, and 480 Hertz frequencies, and so on. This sound spectrum also contains the combined sounds from the mechanical cooling system for the dielectric fluid: from the broadband fan, the fan blade passage frequency, and its harmonics. In some cases, the transformer windings may also become a source of sound and noise under rated load conditions. However, these sounds and noise have a different makeup which is not discussed here.

Maintenance

Exterior maintenance

Inspect all the exposed transformer surfaces periodically to look for evidence of damage, battered metal, tampering, etc. Any dents and deformities on these surfaces should be repaired at once. Weathered and scratched paints and protective coatings should be reapplied promptly. The transformer area should be kept clean of dirt and grease. No equipment or tools should be stored on or against the transformer.

Inspect the different plugs and switches. Look around the tank-wall gaskets, seals, etc., for evidence of seepage and leaks of the insulation fluid. If leaks are found, the seal or gasket in the tank wall may need replacing. This process may require the tank to be opened and the insulating fluid lowered to an appropriate level.

Cover removal

Perform the following steps to remove the transformer tank cover:

1. Clean the cover thoroughly by removing all grease, dust, dirt, and moisture from it.

2. Vent the transformer tank to atmospheric pressure by using a pressure relief valve. If no pressure relief valve is installed on the transformer tank, then slowly remove the vent plug to relieve the internal pressure of the tank. This plug is typically located near the top section of the tank. Make sure to stand out of the way of the venting tank.

3. Loosen the cover band to remove it and remove the ground strap from its connection.

4. Finally, gently remove the cover by lifting it vertically away from the rest of the tank to prevent the removal process from damaging the cover, the bushings, or the tank gaskets. The high-voltage bushing leads are slackly connected and become disconnected when the cover is lifted sufficiently away from them.

WARNING:

The transformer tank should be vented until its pressure drops to zero. Only then should the tank cover be removed; otherwise, severe personal injuries may occur due to the remaining pressure.

Internal inspection

Internal defects and damage can be found through internal inspections to help prevent improper transformer operations.

You should inspect for:

1. Moisture on the underside of the cover.

2. Shifted, loose, and damaged parts. For example, fuse holders, bushings, etc.

3. Loose and broken connections.

4. Contaminations in the insulating fluid. For example, sediment in the bottom of the tank, air bubbles and dust particles suspended in the fluid, etc.

NOTE:

In case a transformer unit has been stored outdoors for a long period, samples of its insulating fluid should be collected and checked for moisture content.

CAUTION:

The presence of moisture in a transformer's insulation can greatly affect its life. Excess moisture in the transformer insulation fluid can accelerate the insulation's breakdown, eventually leading to equipment failure. Therefore, if the seal is broken upon inspection, regardless of the cause, the transformer should be resealed carefully to prevent moisture from entering the transformer.

Handling insulating fluid

Mineral Oil-Filled Transformers

It is a type of non-PCB insulating fluid (less than 1 ppm). Additional guidelines for testing and handling this insulating oil can be found in the IEEE Std C57.106™ standard, "Guide for Acceptance and Maintenance of Insulating Oil in Equipment".

Envirotemp™ FR3™ Fluid-Filled Transformers

It is a type of non-PCB insulating fluid (less than 1 ppm) with a high fire point. Additional guidelines for testing and handling this insulating fluid can be found in the IEEE Std C57.147 standard, "Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers".

Steps to Lower the Level of Insulating Fluid

1. Prepare a dry and clean storage container so it can be used to receive the collected fluid.

2. Use hoses and pumps that have not been in contact with dissimilar fluids and hence will not contaminate the fluid. Use a metallic or a non-rubber hose to pump out the insulating oil because oil can damage a rubber hose by dissolving the sulfur in it.

3. Place the pump intake line inside the tank and the output line nozzle on the bottom of the receiving container.

4. Make sure the fluid does not splash into the container because doing so could introduce moisture and air bubbles into the collected fluid.

Steps to Restore the Level of Insulating Fluid

1. Pump the fluid from the bottom of the temporary storage tank. Prevent the intake line from sucking in the air along with the fluid.

2. Direct the fluid stream parallel to the core clamp along its upper surface. This will help in preventing the aeration of the fluid at the outflow.

3. Pump the fluid out of the storage tank slowly until the transformer tank fluid reaches the required 25°C level, as indicated by a stamp on the tank wall.

4. Give sufficient rest time to the fluid after refiling to allow any unwanted gas bubbles to dissipate from the fluid. Energize the transformer after this rest period.

NOTE:

Some of the insulating fluid may get lost in the pumps and lines, and it may become necessary to compensate for this loss by using a reserve supply to add extra fluid to the storage container. This extra fluid also prevents air from entering the replacement fluid at the intake.

Contaminated Insulating Fluid

If there is evidence of the presence of moisture and contaminants inside the transformer tank and the insulating fluid, then a fluid sample should be collected from the bottom of the tank for analysis. If the tests confirm the presence of moisture in the fluid, the transformer should be dried out. You can contact your MPS representative for special instructions to initiate the dry-out and other decontamination processes.

NOTE:

Take the required samples of the transformer insulating fluid from the bottom of the tank when the transformer is running warmer than its surrounding air. This will help you avoid any moisture condensation on the fluid.

Take a clean and dry bottle to collect the samples. Rinse this bottle three (3) times with the fluid whose samples are needed. Ensure that the collected test samples of the fluid adequately represent the fluid inside the transformer.

Allow the fluid to settle for some time before taking the test samples. The settling period could vary between several hours and several days, depending on the size of the transformer and the temperature of the fluid. For example, cold insulating fluids and fluids within large transformers take longer times to settle.

Disposal of Transformer

Transformers and their insulating fluids should be disposed of by following relevant state and federal regulations and standards on the disposal of oil-filled electrical equipment.

Reinstallation of the Transformer Cover

Reassemble the cover, cover band, and nut-bolt assembly of the transformer immediately after performing maintenance to avoid any risk of contamination. Tighten the cover band and nut-bolt assembly as per the standard torque requirements.

Contaminated Insulating Fluid

Perform the following steps to remove and replace transformer bushings:

1. Open the transformer tank and lower the insulating fluid level until the transformer bushings are exposed.

2. Disconnect all external and internal leads and cables and note the position of the nuts, spring washers, flat washers, etc., as you remove them. Release the bolts holding the internal bushing clamp to remove the clamp and the bushing and gasket.

3. Install the new bushing and gasket. The removed gasket may be reused unless it has cuts or is pinched. To get an effective seal, center the bushing and gasket and install the interior bushing clamp over them. Install and tighten the clamp bolts to hold the new bushing and gasket in place.

4. Reconnect all external and internal leads, cables, and connections by installing and tightening the nuts, spring washers, flat washers, etc., in their original positions.

5. Restore the insulating fluid in the transformer tank to the required 25°C level. Now, inspect the seal between the tank and bushings for seepages and leaks. Repair this seal as required. Close the tank and reseal it.

CAUTION:

The presence of moisture in a transformer's insulation can greatly affect its life. Excess moisture in the transformer insulation fluid can accelerate the insulation's breakdown, eventually leading to equipment failure. Therefore, if the seal is broken upon inspection, regardless of the cause, the transformer should be resealed carefully to prevent moisture from entering the transformer.

Spare Parts

MPS has expertise in manufacturing custom transformers and only makes a limited number of units based on a single design. MPS also makes replacement parts on a case-by-case basis. If a unit needs a replacement part, the customer should contact the MPS factory and provide all the unit's nameplate data.