Operation & Maintenance Manual

POL-OM200

Single Phase & Three Phase Polemount Liquid Filled Transformer

KVA: Up to 500 KVA
Primary Voltage: Up to 34.5 KV
BIL: Up to 200 KV

Contents

1. **Safety Information:**

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it. These instructions cannot cover all details or variations in the equipment, procedures, or process described, nor to provide directions for meeting every possible contingency during installation, operation, or maintenance.

The following conventions are used to indicate and classify precautions and on product safety labeling. Failure to observe precautions could result in injury to people or damage to property.

HAZARD Statement definition:

This symbol/pictorial is used to identify an ELECTRICAL SHOCK or ELECTROCUTION hazard, all installation, maintenance, or repair should be performed by trained, experienced, and qualified personnel only.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Safety Instructions

WARNING: A potential risk exists if operating instructions are not followed which could result in severe personal injury or death, and equipment damage.

WARNING: The contents of this manual should be carefully read and understood before attempting any test, repair, installation, removal, or operation of this equipment. Severe personal injury and equipment damage can occur from the result of improper handling, maintenance, or operation of this equipment.

WARNING: Transformers should never be opened, serviced, or otherwise tampered with while they are energized, ungrounded or connected to the system. Removing or tampering with any covers, doors, bushings, or seals of an energized transformer may result in death, severe personal injury, and equipment damage.

WARNING: This equipment in not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply with these warnings may result in death, severe personal injury, and equipment damage.

WARNING: This equipment requires routine inspection and maintenance. Failure to properly inspect and maintain this equipment could result in unsafe conditions in and around this unit, which could lead to death, severe personal injury, and equipment damage.

2. General Information:

2.1 Acceptance & Inspection upon Receipt

All VanTran transformers are thoroughly tested and rigorously inspected before shipment from the factory to ensure the highest quality.

Upon receipt:

1. Thoroughly check all materials against the bill of lading.

2. Locate accessory parts that may have been shipped separately.

3. Carefully check the unit and associated components for any signs of damage caused during shipment. A damaged crate or pallet can be an indication of rough handling; if this condition is found, make a close inspection of the base and radiators (if equipped) and verify no damage has occurred.

4. In the event that significant damage to the unit or any associated equipment is noticed, rejection of the shipment should be made before it is unloaded. In the event of minor damages (nicks, scratches, etc.), carefully inspect the unit and note all damage on the carriers copy of the freight receipt.

Note: VanTran ships most units FOB Point of Manufacture, and it is the customer's responsibility to file a claim against the carrier.

Note: If acceptance of the transformer is made and damage to the unit is noticed at a later time, it is extremely difficult to file a claim against the carrier.

2.2 Proper Handling & Unloading

WARNING: Heavy Equipment. Improper handling can cause severe injury, death, or damage to transformer. Before moving the transformer, read the handling instructions provided in this manual.

CAUTION: The transformer weight is shown on the transformer nameplate. Most of the weight is in the tank that holds the core and coil assembly and the insulating liquid. Do not use hoists, cranes, jacks, or forklifts with load capacity less than the transformer weight.

WARNING: Transformer accessories such as bushings, leads, arrestors, etc. should never be used as a handle to move the transformer.

2.2.1 Moving Transformers Shipped on Pallets

Transformers shipped on pallets may be lifted or moved by forklift trucks of proper capacity. When using a forklift, lift with the transformer tank closest to the mast of the forklift since most of the transformer weight is in the tank. Pallet mounted equipment may also be moved by crane or hoist.

2.2.2 **Lifting Transformers by Crane or Hoist**

Lifting lugs, welded to all transformer tanks, are designed and provided for lifting the complete unit as shipped. VanTran recommends lifting by these lugs as the primary means of movement. Care should be taken to ensure straps, chains, and cables used to lift the units are inspected prior to use. All straps, chains, cables, and lifting devices should be in good working order with sufficient capacity to perform the job intended. Straps, chains, and cables should never be looped from one lug to another to form a continuous loop around the unit or even on one side of the unit. Each chain, strap, or cable should be run only to one lifting lug at a time to prevent loss of control of the unit in the event of a failure with one of the lifting devices.

Cable pull angles should never exceed 30° from vertical or damage to the lifting lugs may occur. Spreader beams/bars should be used to hold the cables apart and as close to vertical as possible to minimize the forces on the lifting lugs and lifting devices.

2.2.3 **Skidding/Rolling Transformers**

VanTran transformers are designed to be rolled or skidded into place where accessibility to a crane or other overhead lifting device is limited or not available. If the unit must be rolled, ensure that the area is level, free from obstructions and debris, and is of sufficient strength and thickness to support the load. When rollers are used, use as many as necessary to distribute the weight uniformly.

3. **Storage:**

3.1 **Storage for 90 Days or Less**

All VanTran units have been thoroughly dried at the factory and shipped with oil at the correct level. Transformers should always be stored with oil in place to prevent possible contamination and absorption of moisture.

Transformers should be stored in a dry location with no rapid or radical temperature changes. If possible, the transformer should be stored in its permanent location on the foundation which has been prepared for it. If the permanent foundation is not available, it should be stored in its correct upright position on a level foundation capable of withstanding the weight of the unit without deformation.

CAUTION: Never store a transformer solely under the jacking steps, on jacks, or on temporary blocking. Never store the transformer on rollers. Never store the transformer in or near standing water or in areas with high moisture, salt levels, or corrosive gases in the air.

3.2 **Storage for More Than 90 Days**

All VanTran transformers are shipped with a 2-psi dry nitrogen blanket. During long term storage, it is recommended that this nitrogen blanket be maintained by the addition of a bottle of dry nitrogen, through a regulator, to the transformer tank.

4. Installation:

4.1 Pre-service Inspection

ELECTRICAL SHOCK: Never attempt to change connections on an energized transformer. All installation, maintenance, or repair should be performed by trained, experienced, and qualified personnel only.

New transformers, or transformers which are being activated after a period of storage, should be thoroughly inspected before being connected to the power distribution system to identify damage which may have occurred during storage.

1. The transformer exterior should be inspected for nicks, dents, and scratches. Repair damage to weather-resistant finishes promptly.

2. The tank cover and manhole/hand hole cover seals and all gaskets or seals at bushings, gauges, fuses, operating devices, etc., should be inspected for evidence of insulating liquid seepage. Repair leaking or improperly tightened gaskets and seals before the transformer is placed in service.

3. The liquid level inside the tank must be checked (read directly form gauge on transformers equipped with liquid level gauge).

4. Basic electrical tests should be conducted before energizing a transformer which was stored for a period of 90 days or more. Tests include DC insulation Test and Transformer Turns Ratio (TTR). The results of these tests should be verified with the original factory test results to assure they are still within acceptable limits.

CAUTION: Check with local authorities in the intended installation area to verify compliance of any and all applicable laws.

4.2 Mounting the Transformer

The transformer comes equipped with mounting bracket that is ready to be mounted on a pole.

WARNING: Fire Hazard. Non-level installation of transformer can result in fire and cause severe personal injury or death. Prepare transformer installation site such that transformer does not tilt more than two (2.0) degrees from horizontal while the transformer is in service at the site.

4.3 External Connection

ELECTRICAL SHOCK: Hazardous voltage can cause severe injury, death, or damage to equipment. Ground transformer following industry-accepted safe grounding practices before making other electrical connections. De-energize power distribution wires that will be connected to transformer. Verify that wires are de-energized at the transformer before connecting to transformer.

ELECTRICAL SHOCK: Live front parts should such as cables, bushings and other components must be thoroughly tightened and periodically checked to prevent arcing and overheating.

Clean bushings and terminals before making Connections. Remove dirt, grease, or foreign material. Contamination can cause failure of the bushings. Cables connected to the transformer terminals are to have sufficient flex to allow normal pad movement due to ground freeze/thaw and settling. Insufficient cable flex may cause premature failure of the bushings.

4.3.1 **Ground Connection**

The transformer tank must be connected to a permanent, low-resistance ground. If the tank is not solidly grounded and the transformer is connected to the power distribution system, then the tank should be regarded as energized. An energized tank is extremely dangerous. Contact with an energized tank can shock, burn, or cause death.

VanTran transformers are equipped with ground bosses (Fig. 1) as required.

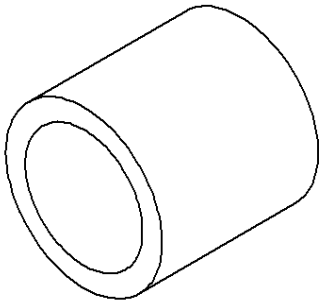


Fig.

4.3.2 **High Voltage Connection**

Top mounted or side mounted high voltage bushings are typically provided for Polemount transformers.

Diagrams and information supplied on the nameplate must be followed for making any connections.

4.3.3 **Low Voltage Connection**

Eye bolt terminals are typically provided for low voltage connection to Polemount transformers, however they can be substituted for spade terminals.

5. Accessories:

5.1 Pressure Relief Valve

Automatic Pressure relief valve (Fig. 2) is standard on all VanTran transformers and is intended to slowly release pressure to prevent rupture of the transformer tank. These valves are factory adjusted to vent at 5 ±2 PSI. Normal operation and atmospheric temperature fluctuations cause the oil and components in the tank to naturally expand and contract causing the gas filled head space inside the tank to fluctuate in pressure.

CAUTION: Before performing any kind of service that may include, but is not limited to, opening the tank or inspection cover, removal of fuses, removal of bushings, opening drain or fill valves, or any other similar operation, the pressure inside the tank must be safely vented manually.

CAUTION: Do not open the transformer in the presence of rain, fog, snow, or if there is condensation on the exterior components of the unit or when the outside air temperature is higher than the temperature of the unit. Even small amounts of moisture that are allowed to enter the transformer tank can decrease the dielectric strength of the insulating fluid and compromise the integrity of the unit.

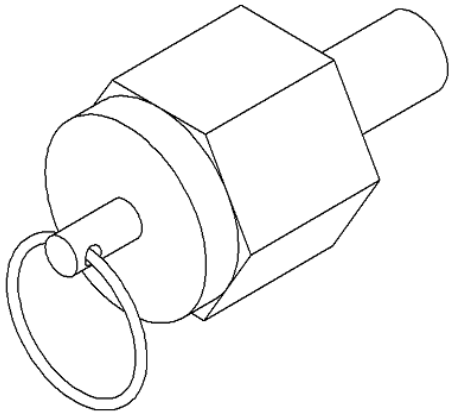


Fig.

To manually vent the tank, pull the ring supplied on the valve (Fig. 2) until all pressure or vacuum is relieved.

5.2 **Radiators**

Radiators (Fig. 3A) are provided for cooling of the transformer oil.

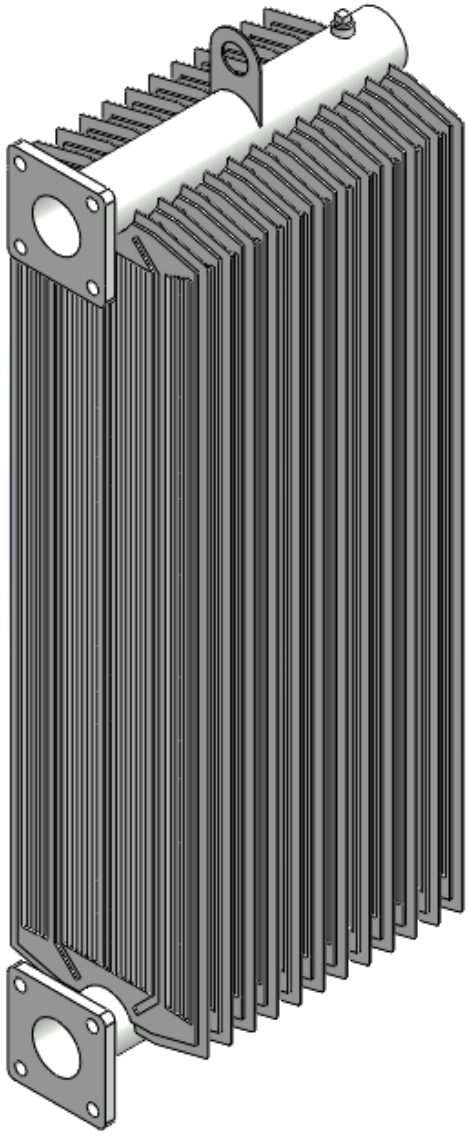


Fig. 3A

5.3 **Radiator Shut-off Valve**

Radiator shut off valve (Fig. 3B) is welded to transformer main tank for removal the radiators without oil drainage when the transformer is shipped without radiators.

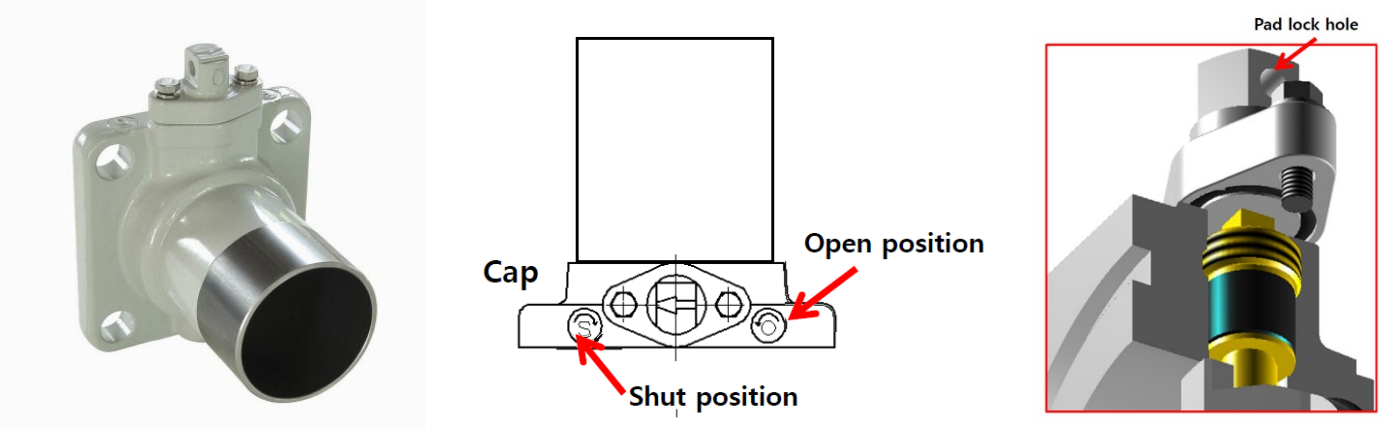
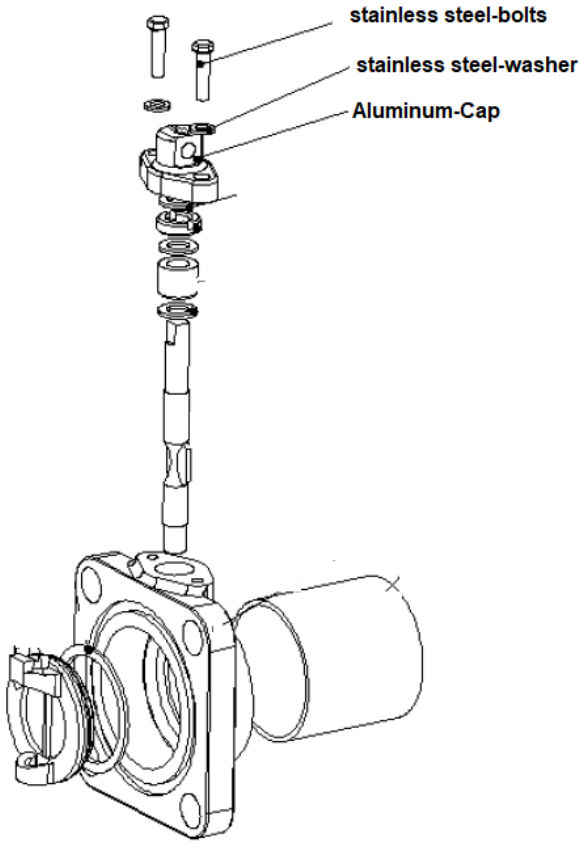


Fig. 3B

To Open/Close the Valve:

1. Remove the two stainless steel 7/16” bolts and washers.
2. Using a ¾” or adjustable wrench, place the wrench on the aluminum cap and rotate counterclockwise. Note the arrow on top of sealing cap should be pointing at the “O” open indicator and “C” close indicator.

Recommended torque to tighten the valve is 35lbf.ft.
DO NOT OVERTIGHTEN



6. Switching & Protection Devices:

ELECTRICAL SHOCK: Can cause severe injury, death, or damage to equipment. De-energize transformer from a remote upstream source before operating no-load tap-changers, dual-voltage switches, or Delta-wye switches.

6.1 Tap Changers

Externally operated No-Load Tap changer (NLTC) (Fig. 4) is provided for all transformers, unless otherwise specified, to change from one operating voltage to another. Typical taps are configured at ±2 X 2.5% of rated voltage; this means that the output voltage of the transformer can be adjusted in 2.5% increments.

Tap-changers will have a hot stick operable handle.

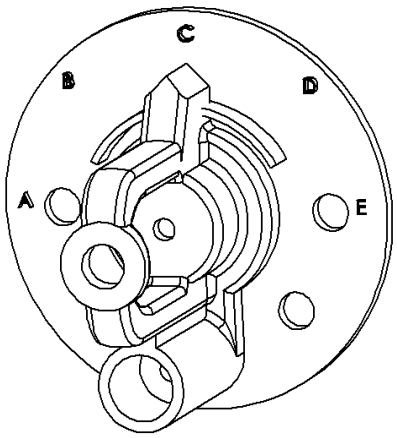


Fig. 4

Note: Please refer to Name Plate and other supplied information for more details.

6.2 **Live Front Surge Arresters**

ELECTRIC SHOCK: Can cause severe injury, death, or damage to equipment. De-energize transformer from a remote upstream source before servicing or operating surge arresters or disconnect switches. Check that all transformer terminals and bushings have zero voltage. Ground transformer following industry accepted safe grounding practices.

CAUTION: Excessive test voltage can damage surge arresters. Disconnect surge arresters before running impulse or applied potential tests on the transformer.

A live front surge arrester (Fig. 5) is a polymer that houses a metal oxide Varistor to provide over-voltage system protection and provided optionally in Polemount transformers.

During steady state conditions, line-to-ground voltage is applied continuously across the arrester terminals. When surges occur, the arrester immediately limits the overvoltage to the required protective level by conducting the surge current to ground. Upon passage of the surge, the arrester returns to its initial state, conducting minimal leakage current.

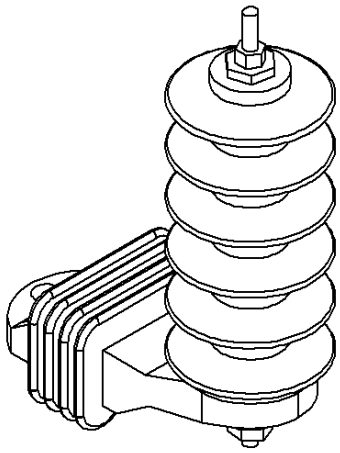


Fig. 5

7. Dielectric Fluid:

7.1 Type II Mineral Oil

Polemount transformers filled with mineral oil that complies with ASTM D-3487, TYPE II.

Typical Physical and Chemical Properties

pH: N/A
Auto ignition temperature: > 315C˚
Relative density (H2O = 1): 0.89
Pour point: -54°C
Evaporation rate (butyl acetate = 1): N/A
Volatile organic compounds: < 0.001 g/L
Miscibility: mixes with other dielectric fluids except silicone
Appearance and odor: Clear bright liquid with Mineral odor

Closed cup flash point: >145°C
Boiling point: >238°C
Vapor pressure (mm Hg): < 0.01 @ 20°C
Vapor density (air = 1): N/A
Solubility in water: negligible; < 0.1%
Viscosity: 9.3 TO 9.5 CsT at 40°C

7.2 High Fire Point Dielectric Fluid

Polemount transformers filled with High Fire Point Dielectric fluid typically use Envirotemp FR3 fluid which complies with ASTM D-6871.

FR-3 is a natural ester derived from renewable vegetable oils – providing improved fire safety and environmental benefits that are superior to mineral oil.

Typical Physical and Chemical Properties

pH: neutral
Auto ignition temperature: 401 − 404°C
Relative density (H2O = 1): 0.92
Pour point: -18 to -24°C
Evaporation rate (butyl acetate = 1): nil
Volatile organic compounds: < 0.001 g/L
Miscibility: mixes with other dielectric fluids except silicone
Appearance and odor: clear light-green liquid with slight vegetable oil odor

Closed cup flash point: 320 − 330°C
Boiling point: >360°C
Vapor pressure (mm Hg): < 0.01 @ 20°C
Vapor density (air = 1): N/A
Solubility in water: negligible; < 0.1%
Viscosity: 32 − 34 CsT at 40°C

8. Factory Testing:

CAUTION: The information below is not intended to be as a guideline for testing transformers. Please refer to IEE/ANSI C57.12.90-2006 and ANSI/NETA ATS-2009 for more details.

8.1 Routine Tests

8.1.1 Ratio

The turn ratio of a transformer is the ratio of the number of turns in the high voltage winding to that in the low voltage winding. When the transformer has taps, the turn ratio shall be determined for all taps and for the full winding.

Note: The ratio test can also be used to test polarity, phase relation, and phase sequence.

8.1.2 Winding Resistance

Resistance measurements are of fundamental importance for the calculation of the I^2R component of conductor losses and calculation of winding temperatures at the end of a temperature rise test.

8.1.3 No Load & Excitation Current

No-load (Excitation) losses are losses that are incident to the excitation of the transformer. No-load losses include core loss, dielectric loss, conductor loss in the winding due to excitation current, and conductor loss due to circulating current in parallel windings. These losses change with the excitation voltage.

Excitation current (no-load current) is the current that flows in any winding used to excite the transformer when all other windings are open-circuited. It is generally expressed in percent of the rated current of the winding in which it is measured. The no-load losses consist primarily of the core loss in the transformer core, which is a function of the magnitude, frequency, and waveform of the impressed voltage. No-load losses also vary with temperature and are particularly sensitive to differences in waveform; therefore, no-load loss measurements will vary markedly with the waveform of the test voltage.

8.1.4 Load Losses & Impedance Voltage

The load losses of a transformer are losses incident to a specified load carried by the transformer. Load losses include I^2R loss in the windings due to load current and stray losses due to eddy currents induced by leakage flux in the windings, core clamps, magnetic shields, tank walls, and other conducting parts.

The impedance voltage of a transformer is the voltage required to circulate rated current through one of two specified windings when the other winding is short-circuited, with the windings connected as for rated voltage operation. Impedance voltage is usually expressed in per unit or in percent of the rated voltage of the winding across which the voltage is applied and measured.

8.1.5 Dielectric Strength

The dielectric test of the transformer is intended to check the ability of main insulation to earth, inter turn and line end insulation to earth. It is generally performed in two different steps, likewise, separate applied voltage withstands test (Hi-Pot) and induced voltage withstand test.

8.2 Special/Design Tests

8.2.1 Insulation Power Factor (Tan δ)

The insulation power factor is the ratio of the power dissipated in the insulation in watts to the product of
The effective voltage and current in volt-amperes when tested under a sinusoidal voltage and prescribed conditions.

8.2.2 Insulation Resistance

Insulation resistance tests are made to determine the insulation resistance from individual windings to ground or between individual windings. Insulation resistance tests are commonly measured in mega ohms or may be calculated from measurements of applied voltage and leakage current.

8.2.3 Temperature Rise

A temperature-rise test is defined as a test to determine the temperature rise above ambient of one or more of the transformer's windings, as measured at the terminals. The result for a given terminal pair or winding is the average value of the temperature of the entire circuit; it is not the temperature at any given point in a specific winding.

The term average temperature rise refers to the value determined by measurements on a given terminal pair of the winding. It does not refer to the arithmetic average of results determined from different terminal pairs of the transformer.

8.2.4 Lightning Impulse

Lightning impulse tests shall consist of and be applied in the following order: one reduced full wave, two chopped waves, and one full wave. The time interval between applications of the last chopped wave and the final full wave should be minimized without intentional delays, to avoid recovery of dielectric strength if a failure were to occur prior to the final full wave.

Impulse tests shall be made without excitation.

Note: Please refer to IEEE Standard C57.98-2011.

8.2.5 **Audible Sound Level**

Audible sound from transformers originates principally in the transformer core and transmits through the dielectric fluid and/or structural supports, to the outer shell and/or other solid surface, where it radiates as airborne sound.

In some situations, the windings may be a noise source under rated load conditions, but this noise is not included in this standard. The frequency spectra of the audible sound consist primarily of the even harmonics of the power frequency; thus, for a 60 Hz power system, the audible sound spectra consist of tones at 120 Hz, 240 Hz, 360 Hz, 480 Hz, etc.

The audible sound also contains the noise emitted by any dielectric fluid mechanical cooling system. Mechanical cooler sound consists of broadband fan noise, plus discrete tones at the fan blade passage frequency and its harmonics.

9. **Maintenance:**

9.1 **Spare Parts**

VanTran specializes in manufacturing custom transformers and makes only limited quantities of any one design. Replacement parts are best handled on a case-by-case basis. Should additional or replacement parts be necessary for any VanTran transformer, please contact the factory and provide all available nameplate data.

9.2 **Routine Inspection**

Routine inspection of the exterior of the unit should be performed periodically. The inspection interval should take the environmental conditions of the site into consideration. Salty, damp, or otherwise corrosive environments will require shorter inspection intervals than dry/mild conditions.

Periodically check between the radiators (if equipped) for debris and obstructions. Ensure that the unit is getting adequate airflow and that brush, overgrowth, or surrounding equipment is not impeding proper airflow. If the unit is equipped with forced air cooling, manually cycle the fans using the switch in the control panel to ensure proper operation.

Clean any dirt or buildup away from the base and cabinet areas to prevent premature rust and deterioration.

During an external inspection, check the paint for signs of deterioration, including cracked/chipping paint and rust. If paint damage or deterioration has occurred, touch-up or repaint the exterior of the unit as soon as possible to prevent further degradation. VanTran uses several different painting processes depending on the application. An inquiry to the factory, with the serial number of the unit, will determine the type and compatibility of the touch-up paint required.

Gauges should be checked regularly for proper operation. The temperature gauge should fluctuate with load conditions and ambient temperature. However, the gauge should never read over the design value on the nameplate plus the average daily ambient temperature. For example, if it is a 25°C day and it has a 65°C rating on the nameplate it should not read over 90°C on the gauge.

The liquid level gauge will also fluctuate slightly with temperature and loading but a steady drop may indicate a leak and should be addressed. The pressure/vacuum gauge will vary with temperature as well but should never register zero for prolong periods of time (another indication of a leak).

If a transformer cover or inspection plate is removed, care should be taken in putting them back into position.