



Instructions

Installation, Operation and Maintenance of Open-Wound
Ventilated Medium-Voltage Dry-Type Transformers



Howard Industries
Distribution Transformer Division



READ THIS IMPORTANT SAFETY INFORMATION

Read these instructions carefully and become familiar with the equipment before proceeding with installation, operation, or maintenance activities. This equipment contains extremely hazardous voltages. To prevent death, serious personal injury, or equipment damage, all information in these instructions should be read and observed. Safe use of this equipment is dependent on proper installation, operation, and maintenance procedures.

Certain information in this manual is marked with the words DANGER, WARNING, or CAUTION, which indicate hazards.

- DANGER indicates an imminently hazardous situation which, if not avoided, will result in death, serious personal injury, and equipment damage.
- WARNING indicates a potentially hazardous situation which, if not avoided, could result in death, serious personal injury, and equipment damage.
- CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate personal injury, and equipment damage.

Personnel should not attempt to service this equipment until it has been effectively de-energized, and all high-voltage and low-voltage bushing terminals have been properly grounded. Only qualified personnel should install, maintain, and operate this equipment. Qualified personnel are those who are trained in the installation, maintenance, and operation of high-voltage equipment, trained in the proper use of personal protective equipment (such as rubber gloves, safety glasses, protective clothing, hard hats, etc.) and trained in appropriate first aid procedures.

The instructions contained herein are intended to be a general guide for the installation, operation and maintenance of this equipment, when operated in "Usual Service Conditions" as defined in IEEE Standard C57.12.01. Although efforts have been made to ensure accuracy and completeness, these instructions do not address every conceivable application or circumstance that might be encountered.

Features presented herein may not be present in all equipment designs. Standard and optional features are subject to change without notice. Howard Industries makes no representation or warranty with respect to and assumes no responsibility for the completeness, accuracy, sufficiency, or usefulness of these instructions.

These instructions do not cover the installation, operation or maintenance of any accessory equipment installed by the user. Users should refer to instructions provided by the manufacturer of such equipment.

Questions regarding installation, operation, and maintenance, particularly when encountering unusual or special circumstances not sufficiently covered by these instructions, should be directed to the Howard Industries Transformer Division.

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SECTION 1: INTRODUCTION

This document is intended as a general guide for the installation, operation and maintenance of Howard Industries open-wound ventilated medium-voltage dry-type transformers. Although every effort has been made to ensure accuracy and completeness, these instructions do not address every conceivable application or circumstance that might be encountered. Refer to IEEE Standard C57.94—IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers for additional information and recommendations.

The instructions contained herein are applicable to transformers operated in normal conditions as specified in the “Usual Service Conditions” section of IEEE Standard C57.12.01, unless the transformer is designed and equipped to operate in unusual service conditions. Questions regarding installation, operation, and maintenance (particularly when encountering unusual or special circumstances not sufficiently covered by these instructions) should be directed to the Howard Industries Transformer Division.

Features presented herein may not be present in all transformer designs. Standard and optional features are subject to change without notice.

IT IS IMPORTANT TO READ AND COMPLY WITH ALL SAFETY INFORMATION, INSTRUCTIONS AND WARNINGS DISPLAYED THROUGHOUT THESE INSTRUCTIONS BEFORE ATTEMPTING ANY INSTALLATION, OPERATION, OR MAINTENANCE ACTIVITIES.

SECTION 2: HANDLING, INSPECTION AND STORAGE

Ventilated dry-type transformers are shipped either completely assembled in a metal enclosure or as a crated core-and-coil assembly. In either case they are covered with plastic sheeting or other suitable material to protect the equipment from dust and moisture.

Drawings and Documents

Locate all shipping papers, packing lists, outline drawings, and other pertinent information for use when handling and inspecting the transformer. The transformer outline drawing indicates the location of nameplates and provides physical dimensions and weights. The nameplate provides electrical characteristics, winding connections, and weights. The wiring diagram (when provided) describes any control and alarm wiring that may be supplied.

Initial Inspection

Although all transformers, components, and accessories are carefully inspected and tested prior to shipment from the factory, a thorough receiving inspection should be conducted to detect any damage or loss that might have occurred after shipment. The receiving inspection should be completed upon receipt and before unloading from the truck. Note any damage or discrepancies on the bill of lading, file a claim with the carrier, and notify the Howard Industries Transformer Division prior to unloading the transformer and before attempting any repair.

Before unloading the transformer, perform the inspection described below. If any problems are found, immediately notify the Howard Industries Transformer Division. Claims for shortages or shipping damage must be noted on the shipping documents and reported immediately to the Howard Industries Transformer Division. Failure to make a timely claim will constitute unqualified acceptance and a waiver of all such claims by the purchaser.

1. Remove the protective plastic covering.
2. Read the serial number on the transformer nameplate and make sure it matches the serial number listed on the bill of lading. Also,

check the nameplate for kVA rating, primary voltage rating, secondary voltage rating, impedance and other design characteristics, and make sure they comply with the specifications.

3. Check shipping documents to make sure the shipment is complete, including all listed accessories and hardware. Be aware that additional items may arrive on separate pallets.
4. Check the transformer for indications of external damage. Dents and scratches can often be repaired on site using simple touch-up procedures. If touch-up painting is performed, do not remove or obscure any warning labels, instructional labels or nameplates.
5. An internal inspection of the transformer is usually not necessary, unless obvious indications of external damage have been found. If internal inspection is necessary, carefully check core and coils, primary and secondary leads, bolted connections, and accessory equipment that might be supplied, such as controls, control power transformers, fans, heater strips, current transformers, surge arresters, and RC snubbers.
6. Replace the protective plastic covering if the transformer is to be stored prior to installation.

Lifting and Handling

After successfully completing the initial inspection described above, the transformer can be unloaded, moved and installed as recommended below. The transformer should not be handled during inclement weather, unless precautions are taken to protect the transformer from rain, snow or dust. If exposed to moisture the transformer must be inspected and tested before placing into service to determine if drying is needed.

 **WARNING****FAILURE TO FOLLOW THE INSTRUCTIONS BELOW MAY CAUSE DEATH, SERIOUS PERSONAL INJURY, AND/OR DAMAGE TO THE EQUIPMENT.**

- Be careful when handling, as the transformer has a high center of gravity and could become unbalanced.
- Verify that the capacity of the handling equipment is adequate for the transformer weight.
- Use a crane and adequate lifting cables and spreader bars to handle the transformer.
- Keep all unnecessary personnel clear while handling and moving the transformer.

Check the weight listed on the transformer nameplate and make sure that lifting equipment is adequately rated for a safe lift.

The transformer may be lifted with an overhead crane, using lifting eyes located on the top clamps of the core and coil assembly. The lifting eyes can be accessed by removing the center roof panels. The angle of lifting straps, cables or chains should be less than 30° from vertical. Spreader bars should be used to provide for a vertical lift and to avoid damage to the enclosure.

It is possible to lift the transformer using a forklift, using the designated openings in the base of the transformer. Be aware that the transformer has a high center of gravity and could tip over while being handled. Use safety restraints to make sure the transformer remains stable. Keep all personnel clear while lifting and moving the transformer.

Transformer Storage

Transformers can be temporarily stored if properly prepared. It is recommended that transformers be stored completely assembled. The protective plastic wrap should be left in place during

storage. Prior to storage transformers should be thoroughly inspected as described above in the “Initial Inspection” section. Transformers and any separately packaged accessories should be stored indoors in a clean, dry, noncorrosive location, preferably on a level concrete surface. Avoid storing on an earthen surface, as this could promote corrosion. Maintain adequate building ventilation to allow air circulation around the transformer.

While the transformer is in extended storage, space heaters should be installed and operated inside the enclosure to prevent condensation and moisture absorption. Cut vent openings in the plastic covering to provide adequate air flow. Refer to the “Drying the Core and Coil” section for more information.

For transformers in extended storage, periodic inspections should be made to check for corrosion or damage that might have occurred. The transformer should be thoroughly re-inspected immediately before placing into service.

SECTION 3: INSTALLATION

Location and Mounting Requirements

Consult local and national codes to ensure that the installation meets all applicable requirements. Location of the transformer must permit it to operate in conditions that meet the requirements specified in the “Usual Service Conditions” section of IEEE Standard C57.12.01 (unless the transformer has been specially designed to operate in unusual service conditions). Locations not meeting service condition requirements will compromise transformer capacity and reliability, and will void the warranty. Contact the Howard Industries Transformer Division, if additional information is needed about location and mounting issues not covered by these instructions.

It is recommended that ventilated dry-type transformers be mounted in indoor locations. The transformer must be mounted at least 24 inches (610 mm) from walls or other obstructions to allow for adequate ventilation. There should be free circulation of clean, dry air around the transformer. Provide adequate clearance as required by national or local codes for transformers installed near combustible material. Mount the transformer on a level reinforced concrete pad or other suitable surface that is rated to support the weight of the transformer and is adequately drained. Do not mount the transformer directly on an earthen surface.

To obtain average sound levels similar to factory test results, it is recommended that a 10 foot clearance be maintained on all sides. It is recommended that flexible bus connections and flexible conduit be used to reduce structure-borne noise. Also, for non-seismic rated transformers, it is recommended that the mounting bolts be loosened slightly to allow the vibration pads between the feet and base cross channels to effectively absorb transformer vibration.

Remove all packing material and shipping braces before energizing the transformer.

DANGER

All packing material and shipping braces must be removed before energizing the transformer.

FAILURE TO FOLLOW THIS INSTRUCTION WILL RESULT IN DEATH OR SERIOUS PERSONAL INJURY.

Restricted Access

Ventilated dry-type transformers are not designed to be tamperproof and must be located in secure areas not accessible by unauthorized individuals.

DANGER

The transformer must be mounted in a secure, restricted-access location that is inaccessible to unauthorized personnel.

FAILURE TO FOLLOW THIS INSTRUCTION WILL RESULT IN DEATH OR SERIOUS PERSONAL INJURY.

Grounding

The transformer must be permanently and effectively grounded according to applicable local and national codes. Ground the transformer by using the grounding pads located on the base of the transformer. Do not use hold-down bolts or cleats, or any other fittings for ground connections. A proper low-resistance ground is critical for safe operation.

DANGER

The transformer must be permanently and effectively grounded at all times.

FAILURE TO FOLLOW THIS INSTRUCTION WILL RESULT IN DEATH OR SERIOUS PERSONAL INJURY.

Cable Connections

Connections must be made to the high-voltage and low-voltage terminals as indicated on the transformer nameplate and wiring diagram. The high-voltage winding has multiple tap positions available to allow for adjustment for source voltage. If tap adjustment is necessary, refer to instructions in the “Changing Tap Positions” section.

Before making primary and secondary connections, check to make sure that all mating connector surfaces are clean and smooth. Connections must be tightened appropriately to prevent overheating and possible subsequent failure of the connection. Connections should be adequately supported to avoid placing undue stress on the terminals. Load and source cables should be rated for at least 194 °F (90 °C). Table 1 indicates minimum uninsulated clearances that should be maintained at the terminals. Table 2 indicates recommended torque values for bolted electrical connections using Grade 5 hardware.

Surge Arresters

In some cases surge arresters will be shipped separately from the transformer and must be installed at the job site. Follow the installation instructions provided with the arresters.

Table 1: Minimum Recommended Terminal Clearances

Transformer BIL (kV)	Minimum Clearance (in.)
10	1.00
20	1.00
30	1.50
45	2.50
60	3.75
75	4.75
95	6.25
110	7.50
125	8.75
150	11.25

Table 2: Torque Guidelines for Terminal Connection Using Grade 5 Hardware (Non-lubricated)

Bolt Size	Recommended Torque (Foot-Pounds)
3/8-16	15-30
1/2-13	40-70
5/8-11	110-130

SECTION 4: INSPECTION AND TESTING

After the transformer has been installed, but before it is energized, the following tests and checks should be performed at a minimum to ensure that the transformer is ready to be placed into service. Periodic tests should be made as a preventative maintenance procedure and before re-installing a transformer that has been out of service.



FAILURE TO FOLLOW THE INSTRUCTIONS BELOW WILL RESULT IN DEATH, SERIOUS PERSONAL INJURY, AND/OR DAMAGE TO THE EQUIPMENT.

- Only qualified personnel with appropriate equipment should perform these tests.
- Be aware of dangerous voltages and avoid personal contact with live terminals.
- Disconnect source and load leads from the transformer.
- Wear personal protective equipment to prevent injury from potential arc-flash or contact with dangerous voltages.
- Make sure the transformer is properly grounded at all times.
- Disconnect surge arresters, fans, potential transformers (PT's), temperature control systems, low-voltage control systems, meters, and any other auxiliary equipment.
- Current transformers (CT's), if supplied, must be connected to a metering load or have their secondary terminals shorted together and grounded to prevent dangerous voltage buildups.

Pre-Service Tests

The following pre-service tests should be conducted in the order listed below before placing the transformer in service to ensure that it is in satisfactory operating condition and to obtain data for future comparison. Refer to IEEE Standards

C57.12.91 and C57.94 for recommended test procedures and carefully follow the instructions and safety warnings provided by the test equipment manufacturer. If the transformer is wet or has been subjected to unusually damp conditions, it should be dried before testing. A low measured value during the insulation resistance test indicates the possibility of moisture. Refer below to "Insulation Resistance Test." Refer to the "Drying the Transformer" section for instructions.

Prior to testing, disconnect the transformer from all source and load leads. Also disconnect surge arresters, fans, potential transformers (PTs), temperature control systems, low-voltage control systems, meters, and any other auxiliary equipment. Current transformers (CT's), if supplied, must be connected to a metering load or shorted together and grounded to prevent dangerous voltages at the CT terminals.

1. **Ratio Test** — Use a Transformer Turns Ratio tester (TTR) to perform a turns ratio test to verify the proper primary-to-secondary winding ratios. Measure the ratio at each tap position to verify that each of the ratios is correct. Measured values should be within 0.5% of the values indicated on the transformer nameplate.
2. **Insulation Resistance Test (500-Volt Megger® test)** — Use the insulation test to measure the resistance of the insulation between windings and from each winding to ground. This test should be performed in a humidity-controlled area. Before performing the test, thoroughly clean the core-and coil assembly and terminals. The minimum recommended test value is 2 MΩ per kV. For instance, a minimum resistance value of 27.6 MΩ would be recommended for a winding rated at 13.8 kV. Contact the factory if the measured value is low.
3. **Winding Resistance Measurements (Optional)**
4. **Applied Potential Test (Optional)** — Conduct an applied voltage test performed at 75% of factory test level as described in IEEE Standard C57.12.91 and IEEE Standard C57.12.01.

Pre-Service Inspection

The following pre-service inspection should be performed at a minimum before placing the transformer in service.

1. **Grounding** — Be sure that the transformer is permanently and effectively grounded using the ground pads at the base of the transformer. Do not use hold-down bolts or any other component for grounding.
2. **Bolted Connections** — Check all electrical and mechanical bolted connections for tightness.
3. **Tap Connections** — Check the primary supply voltages with appropriate measurement equipment, while observing proper safety precautions and personal protective equipment requirements. If the measured voltages are lower or higher than the nameplate primary voltage rating, the primary tap connections must be changed to compensate for the difference. Tap positions must agree with the primary voltage supplying the transformer. Inspect the tap jumpers to verify that tap connections are correct. Tap connections must be the same for each phase. If tap connections must be changed, refer to the instructions in the “Changing Tap Connections” section.
4. **CTs and PTs** — If current transformers (CTs) and/or potential transformers (PT’s) are supplied, make sure they are properly installed. CT leads must be connected to a metering load or have their secondary terminals shorted together and grounded before the transformer is energized.
5. **R/C Snubbers** — If R/C snubbers are supplied, check to ensure they are properly installed.
6. **Accessory Wiring** — Check the wiring of fan, control and alarm circuits (if supplied) to make sure there are no loose connections and no damage to wire insulation.
7. **Enclosure Finish** — Check all painted surfaces for signs of damage or corrosion.
8. **Packing Material** — All plastic wrapping material, temporary shipping braces and other packing material should be removed.
9. **Tools** — Check to make sure that all tools and equipment have been removed from the enclosure.
10. **Enclosure** — Make sure that all enclosure panels are securely installed.

Drying the Transformer Coils

Ventilated dry-type transformers that have been stored or de-energized for a substantial period of time may have absorbed moisture from the environment. If it is determined that the transformer has absorbed excessive moisture, then it should be dried prior to testing or placing into service. Prior to drying primary and secondary leads must first be disconnected from the source and load. Then drying can be accomplished by applying external heat or by the current circulation method. The time required for drying will depend on the size and voltage rating of the transformer, its moisture condition and the drying method used. Adequate dryness may be determined by measuring insulation resistance as described below in the “Determination of Coil Dryness” section.

CAUTION

Monitor the drying process carefully to avoid a fire hazard and have a suitable fire extinguisher available.

FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT PERSONAL INJURY AND DAMAGE TO THE EQUIPMENT.

To dry the transformer, temporarily install space heaters inside the enclosure at the core clamp base on both sides of the core/coil assembly. Coils can also be dried by placing the core/coil assembly in a suitable drying oven. Contact the factory for instructions before proceeding. Use of a drying oven is the preferred method when using external heat and the method that should be used for transformers without an enclosure.

During the drying process, the temperature should not be allowed to exceed the temperature limit of lowest rated component/wiring (90° C or 105° C).

Determination of Coil Dryness

Coil dryness may be determined by measuring insulation resistance (Megger® test). Measure the initial resistance values before beginning the drying process to obtain a base for comparison. Then begin heating the transformer core and coils. The presence of moisture will be evident by the initial rapid decrease in measured resistance values. Eventually the resistance will gradually increase until near the end of the drying process, when it will increase more rapidly. Continue to dry the coils until resistance values stabilize and remain constant for several hours. Refer to “Insulation Resistance Test” on page 10. Contact the factory if problems occur.

Changing Tap Connections

If tap connections must be changed, refer to the following instructions and safety precautions.



FAILURE TO FOLLOW THE INSTRUCTIONS BELOW WILL RESULT IN DEATH, SERIOUS PERSONAL INJURY, AND/OR DAMAGE TO THE EQUIPMENT.

- Only qualified personnel with appropriate equipment should perform this operation.
- Be aware of dangerous voltages and avoid personal contact with live terminals.
- Wear personal protective equipment to prevent injury from potential arc-flash or contact with dangerous voltages.
- Make sure the transformer is de-energized. Use a suitable voltage meter to verify zero voltage.
- Use a suitable grounding device to ground the coils and remove any static charge that might be present.

1. De-energize the transformer while observing safety warnings above.
2. Remove the metal access panel to gain access to the primary winding tap connections.
3. Ground the coils to ensure zero voltage and removal of any static charge using an appropriate grounding probe.
4. Refer to the transformer nameplate and reconnect the tap jumpers on each phase to the proper position. Tap position on each phase must be the same.
5. Tighten each tap connection according to the torque recommendation contained in Table 2.

6. Be sure to remove all tools, test equipment and other materials from the enclosure.
7. Reinstall all metal enclosure panels.

Inspection and Tests after Placing into Service

After the transformer is energized, the following tests and inspections should be performed before supplying power to the load.



FAILURE TO FOLLOW THE INSTRUCTIONS BELOW WILL RESULT IN DEATH, SERIOUS PERSONAL INJURY, AND/OR DAMAGE TO THE EQUIPMENT.

- Do not energize the transformer using single-phase switches or fuses. Use only gang-operated three-phase switches to energize a three-phase transformer
- Do not operate the transformer with any of the primary phases open.
- Only qualified personnel with appropriate equipment should measure transformer voltages.
- Be aware of dangerous voltages and avoid personal contact with live terminals.
- Wear personal protective equipment to prevent injury from potential arc-flash or contact with dangerous voltages.
- Make sure the transformer is securely and effectively grounded at all times.
- CT leads must be connected to the metering load or shorted together and grounded to prevent dangerous voltages at the CT terminals.

Verifying Correct Secondary Voltage — Before supplying voltage from the transformer to the load, verify that the secondary voltage is correct. Using a suitable AC voltmeter, measure the voltage of the secondary windings and make sure they agree with the secondary voltages listed on the transformer nameplate.

Observing Operation — After the transformer is initially energized, visually inspect it occasionally for a few hours, to make sure that no abnormal conditions are observed.

Audible Sound — It is normal for transformers to emit an audible humming sound, which is primarily caused by alternating magnetic flux in the transformer core. Amplitude and harmonic content of the sound is influenced by transformer size, the energizing voltage level and sinusoidal purity, load conditions and acoustic conditions at the installation site. Refer to IEEE C57.12.01 for more information about expected sound levels. Unusual sounds should be investigated, as this might indicate a potential problem.

SECTION 5: OPTIONAL EQUIPMENT

Optional equipment described below may or may not be present in any particular transformer design. The inclusion of particular accessory device in any transformer design is governed by industry standards and by individual user specifications.

Current Transformers

Current transformers (CT's) are supplied when specified for connection to customer-supplied equipment to allow remote measurement of line and/or phase currents. CT's can be provided on primary or secondary circuits, and are mounted inside the transformer enclosure.

Transformers are shipped from the factory with CT leads shorted together and grounded. If the CT's are not connected to a metering load by the user, they must remain shorted and grounded to avoid hazardous voltage at the CT secondary terminations.



WARNING

CT leads must be connected to a load or short-circuited and grounded before the transformer is energized to avoid hazardous voltage at the CT terminals.

FAILURE TO FOLLOW THIS INSTRUCTION MAY RESULT IN DEATH, SERIOUS INJURY AND/OR DAMAGE TO THE EQUIPMENT.

Potential Transformers

Potential transformers (PT's) are provided when specified for connection to customer-supplied equipment to allow measurement of line-to-line and/or line-to-neutral voltages. PT's can be provided on primary and secondary circuits, and are mounted inside the transformer enclosure.

Snubbers

RC snubbers are supplied when specified to reduce the incidence of transformer failure by mitigating switching transients that can be induced by transformers, switching device (particularly vacuum breakers) and system interaction (Refer to IEEE

Standard C57.142 for more information on this subject.). Failure to properly protect the transformer from such transient events may void the transformer warranty. Snubber circuits can be factory supplied and mounted inside the transformer enclosure. Alternatively, snubber circuits can be customer supplied and mounted in an enclosure near the transformer. An optional monitoring system is available to provide the end user with the operational status of the snubber circuits. A snubber monitoring system may also be supplied if specified to monitor the condition of the snubber system.

Fans

Fans are supplied when specified or when required by design to provide forced-air cooling of the coils.

Temperature Monitoring System

When specified, an electronic temperature monitoring system is provided to monitor coil temperatures. The electronic temperature monitor (ETM) controls fan operation (if applicable) and provides an external alarm signal, when an over-temperature condition occurs. Refer to the instruction manual provided with the ETM for more information.

Space Heaters

When specified, space heaters are supplied by the factory and mounted inside the enclosure directly below the coils. Space heaters are thermostatically controlled and are provided with a terminal block for connection to an external power source.

Space heaters should be used when the transformer will be stored prior to installation or subjected to periods of de-energization to prevent the accumulation of moisture on the core/coil assembly.

Neutral Grounding Resistors

Neutral grounding resistors are supplied if specified. Refer to the instructions provided by the resistor manufacturer.

Other Optional Equipment

Dry-type transformers may be supplied with other optional equipment not discussed in these instructions. In such cases, contact the Howard Industries Transformer Division for information.

SECTION 6: MAINTENANCE

Periodic Inspection

Transformers should be inspected periodically while in service, with the frequency of inspection determined by service conditions. Transformers operating in unusual service conditions should be inspected more frequently. Refer to IEEE Standard C57.12.01 for a discussion of usual and unusual service conditions.



FAILURE TO FOLLOW THE INSTRUCTIONS BELOW WILL RESULT IN DEATH, SERIOUS PERSONAL INJURY, AND/OR DAMAGE TO THE EQUIPMENT.

- Review the safety precautions on page 2.
- De-energize the transformer before beginning any inspection or maintenance activities using lock-out/tag-out procedures
- Remove any static charge by grounding with a suitable grounding device.

Inspection and Maintenance Checklist

While observing the safety instructions above, perform the following checks.

1. Inspect for damage to metal enclosure surfaces and make the necessary repairs.
2. Check all fasteners for tightness and signs of corrosion. Repair as necessary.
3. Make sure the ventilation openings are clear of debris. Maintain a clean and unobstructed area around the transformer, including sufficient clearance to ensure adequate cooling of the transformer.
4. Remove enclosure panels and inspect the interior for dirt, debris or other contaminants. Clean as necessary. Check for loose connections and signs of overheating. Repair as necessary.
5. Replace any damaged or unreadable nameplates, instructional labels, and safety labels.
6. Remove all tools and cleaning materials. Reinstall the enclosure panels prior to putting the transformer back into service.

Repair Parts

Repair parts can be ordered from the Howard Industries Transformer Division. A description of the part and the transformer serial number will be required to ensure that the correct part has been ordered.

Warranty Claims

The Howard Industries Transformer Division should be notified immediately when problems are discovered during the warranty period. All warranty repairs must be made or approved by the Howard Industries Transformer Division.

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**Installation, Operation, and Maintenance of
Open-Wound, Ventilated, Medium-Voltage Dry-Type Transformers**

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