



Cutler-Hammer

INSTRUCTIONS

Ventilated Dry Type Transformers

SAFETY INFORMATION IMPORTANT - READ CAREFULLY

WARNING - READ ALL INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO HANDLE, INSTALL, USE OR SERVICE THIS EQUIPMENT. FAILURE TO FOLLOW INSTRUCTIONS COULD RESULT IN SEVERE INJURY, DEATH, OR PROPERTY DAMAGE.

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

THESE INSTRUCTIONS DO NOT PURPORT TO COVER ALL DETAILS OR VARIATIONS IN EQUIPMENT NOR TO PROVIDE FOR EVERY POSSIBLE CONTINGENCY TO BE MET IN CONNECTION WITH INSTALLATION, OPERATION OR MAINTENANCE. SHOULD FURTHER INFORMATION BE DESIRED OR SHOULD PARTICULAR PROBLEMS ARISE WHICH ARE NOT COVERED SUFFICIENTLY FOR THE PURCHASER'S PURPOSES, THE MATTER SHOULD BE REFERRED TO THE NEAREST SALES OFFICE OF **EATON**.

ALL APPLICABLE SAFETY PRACTICES INCLUDING, BUT NOT LIMITED TO, OSHA, NFPA, ANSI, REGIONAL AND LOCAL SAFETY CODES, SAFE WORKING PRACTICES AND GOOD JUDGMENT, AS THEY MAY BE APPLIED TO THIS TYPE OF EQUIPMENT MUST BE USED AND OBSERVED BY ALL PERSONNEL WHEN INSTALLING, OPERATING AND MAINTAINING THIS EQUIPMENT.

DANGER - HAZARD OF ELECTRICAL SHOCK OR BURN. DE-ENERGIZE, LOCK OUT AND PROPERLY GROUND ALL CIRCUITS SUPPLYING POWER TO THE TRANSFORMER AND IT'S ACCESSORIES BEFORE REMOVING ANY CASE PANELS OR COVERS AND WORKING INSIDE. FAILURE TO DE-ENERGIZE THE TRANSFORMER AND IT'S ACCESSORIES BEFORE REMOVING THE CASE PANELS OR COVERS COULD RESULT IN SEVERE INJURY, DEATH, OR PROPERTY DAMAGE.

DO NOT MAKE ANY CONNECTIONS THAT ARE NOT AUTHORIZED BY THE NAMEPLATE OR CONNECTION DIAGRAMS.

TRANSFORMER MUST BE PROPERLY GROUNDED BEFORE ENERGIZING.

RECEIVING, HANDLING AND STORING

RECEIVING

Upon receipt of the transformer, make an examination for any damage which may have occurred during shipment. Also inspect for any evidence that water or other contaminants have entered the transformer during transit. If contamination, injury or rough handling is evident, file a damage claim with the transportation company and notify the nearest Sales Office of EATON. Tighten any parts which may have worked loose during shipment and check all materials against the shipping list for possible shortages. Accumulated dirt or dust should be wiped off accessible inside and outside surfaces and any visible dirt or dust on the windings or in the air ducts should be removed as explained under "Maintenance".

HANDLING

The transformer case and base are designed so that the unit may be moved by lifting, skidding, or jacking.

1. Lifting can be accomplished by the following means.

a. The preferable method for moving the complete transformer assembly is by forklift truck under the base assembly.

b. To lift the entire transformer from overhead, remove the top cover and use the lifting eyes or lugs provided on the top of the core and coil structure. Lift vertically using four cables. Each cable angle with respect to the vertical must not exceed 30°. If this limit cannot be met or if there is danger of damaging the transformer during lifting, suitable spreader bars should be used.

c. To remove the core and coil assembly from the case remove the bolts holding the core and coil assembly to the base assembly. Remove any other case panels or parts that will prevent the core and coil assembly from being removed from the case. All high voltage and low voltage line connections must be removed and any accessory wiring disconnected. If a winding temperature indicator or electronic temperature monitor is present, the temperature sensing bulbs must be removed from the tubular wells on the transformer coils. Raise the core and coil assembly about 12 inches from the base. Use a forklift under the core and coil assembly to move it out through the front or rear opening of the case.

2. The unit can be moved in either direction by using rollers under the base.

3. For use when skidding as well as when using rollers on horizontal surfaces, pulling eyes are incorporated in the bolted-on jacking pads.

4. The unit can be jacked under the jacking pads located on the front and back of the unit.

5. The transformer, complete with its enclosure, may be moved without disturbing high voltage and low voltage equipment. To do this open the high voltage and low voltage bolted line connections, remove all the bolts that attach the high voltage and low voltage equipment enclosures to the transformer enclosure, remove external ground connections to the transformer ground pads, and remove any conduit connections. With all these connections open it will be possible to move the transformer in a direction at 90° with respect to the long axis of the substation.

STORING

If storage becomes necessary, the transformer should be placed in a clean, dry room in which a uniform temperature is maintained. Air circulation through the transformer enclosure should be permitted. The relative humidity to which the insulating materials are exposed should be kept as low as practical. The floor on which the transformer is stored should be impervious to the upward migration of water vapor. Precautions should be taken to guard against entrance of water from any source such as roof leaks, broken water or steam lines, windows, etc.

In cases where the relative humidity during storage is either high or unknown, electric resistance heaters should be used inside the enclosure. These heaters should be located under the windings on both sides of the core. If heaters are used, air circulation through the enclosure must be permitted. Fiberglass furnace filters may be mounted temporarily over the inlet and ventilation openings to minimize dust accumulation within the enclosure. These filters must be removed before the transformer is put in service. Before placing the unit in service, check for dryness as outlined under "Operation".

INSTALLATION

This transformer is to be installed in such a manner and location as to minimize the hazards to all those who have access to it.

LOCATION

Ventilated dry-type transformers are designed for installation in dry locations, reasonably free of dust and chemical fumes. If the unit is to be installed in an atmosphere which includes corrosive agents, additional protective measures may be required. The transformers will operate successfully in a humid atmosphere, but precautions may have to be taken to keep them dry during shut down periods as explained under "Storing". The bolt-on jacking pads can be removed and stored. Replace the bolts and other hardware in the original holes to prevent them from becoming an entrance point for small rodents.

At higher altitudes, decreased air density reduces transformer cooling efficiency and lowers arc-over voltages. If the transformer is to be installed at an elevation above 3300 feet (1000 meters) and the nameplate does not indicate special high altitude design, consult the nearest Sales Office of EATON relative to its suitability for operation at the higher altitude.

VENTILATION

For adequate cooling the unit should be installed at least six inches (152 mm) and preferably a foot (305 mm) or more away from walls and other obstructions which might prevent free circulation of air through and around the unit. Mechanical clearances should be taken into consideration in installing the transformer. Sufficient room should be allowed for removal of panels for cleaning and, with reverse arrangement of units, for changing of taps.

If the transformer is to be installed in a vault, provide ventilation which is adequate to keep the room temperature from exceeding that of the incoming air by more than 5°C. The number and size of air outlets required will depend on their distance above the transformer, and on the efficiency and load cycle of the apparatus. See ANSI Guide C57.94, "Guide for Installation and Maintenance of Dry-Type Transformers".

Arrange air inlets and outlets so that they are permanently open. Do not use as ventilators, windows or doors which may be opened and closed by attendants because of the danger of excessive heating in case they are inadvertently left closed during periods of heavy load or high temperature. If forced ventilation is used, supply about 5000 cubic feet of air per minute (141 cubic meters per minute) for each 1000 kVA of transformer capacity, and deliver the incoming air uniformly around the transformer at floor level and low velocity.

VIBRATION ISOLATION PADS

Rubber vibration isolation pads are an integral part of the transformer and are placed between the core and coil assembly and the transformer base to minimize vibration and noise.

CONNECTIONS

When making connections between plated aluminum transformer terminals and copper or aluminum conductors of associated equipment, the following procedure is recommended.

Assemble a Belleville spring washer and a flat washer under the head of each bolt. Place the Belleville spring washer so that the concave surface is away from the bolt head and the periphery is on the flat washer. The flat washer prevents the outer edges of the Belleville spring washer from cutting through the plating and distributes the bolting forces.

Place a flat washer under the nut on the opposite side of the joint and tighten the nut until the Belleville spring washer is just flattened. (Washers are flattened when there is a noticeable increase in bolting torque.) After the nut has been properly tightened it should be locked with a locking nut or such other locking device as may be furnished with the equipment being connected to the transformer.

When clamp-type terminals are assembled on plated aluminum bars, the same basic procedure given above should be followed except that the Belleville spring washer and flat washer should be placed on the nut on the eye-bolt and the bar.

When connecting bus bars, be sure the joints are properly aligned prior to bolting to prevent excessive strain on the insulators. In a terminal chamber, long sections of unsupported conductor should be avoided and leads should be flexible enough to allow for expansion and contraction.

Suitable devices should be installed to protect the transformer from excessive overloads.

If there is reason to suspect that the transformer will be subjected to transient overvoltages in excess of its BIL rating, surge arresters should be installed. For specific recommendations, consult the nearest Sales Office of EATON.

GROUNDING

A Ground pad with two tapped holes is provided on the base assembly for connecting the transformer case to ground. A substantial and thoroughly reliable connection should be made between the pad and a low resistance ground through a conductor of adequate cross section.

The core and coil structure is connected to ground by means of a flexible connector. This connection must be tight at all times.

When a transformer is designed for use on a system having a solidly grounded neutral, be sure that the neutral lead is permanently and solidly grounded at all times.

CHANGING TAPS

CAUTION: Failure to de-energize the transformer before removing the panels to change taps could result in serious personal injury.

The transformer is shipped connected for operation at the rated voltage shown on the nameplate unless otherwise requested by the user. Access for changing taps is provided by removing the front panels (or back panels on reverse units). De-energize the transformer before removing these panels or attempting to change taps. Make no connections other than those authorized by the nameplate.

Aluminum Tap Terminals

Ventilated dry-type transformers which have aluminum windings are equipped with aluminum tap terminals. Belleville spring washers are included in the tap terminal hardware. When taps are changed, the nuts should be tightened until these Belleville spring washers are flattened. Washers are flattened when there is a noticeable increase in bolting torque.

To prevent oxidation and maintain low contact resistance, aluminum tap terminals are coated with a joint compound which should not be removed. The terminals as received are free of oxides and taps may be changed at installation without any special precautions. If at some future time taps are changed, the following procedure is recommended.

1. Apply a light coat of silicone grease to contact surfaces on terminals and links.
2. Scrub the contact areas with a wire brush, taking care not to gouge the metal surfaces. This abrading will break up any oxides which may have formed.
3. Wipe clean and reapply a thin film of silicone grease.
4. Bolt connecting link in the new position and tighten the nut until the Belleville spring washer is flattened.

OPERATION

Before energizing a dry-type transformer either initially or after any shutdown period in which the unit has cooled to ambient temperature, the transformer should be inspected for evidence of moisture and the insulation resistance should be checked. This should be a one minute test taken with a 500 volt megohmmeter at approximately 25 degrees C measured from winding to ground with the windings not being tested connected to ground. An insulation resistance in megohms equal to 200 times (rated winding volts/1000) is a satisfactory value of resistance to permit energizing the transformer. (Absorption of moisture can be minimized during shutdown periods by using strip heaters to keep the transformer temperature above ambient.)

DRYING

If moisture is found on the windings, leads, or insulation or if the insulation resistance measurements are unsatisfactory, the transformer should be dried. To dry, put a short circuit heat run on the unit by short circuiting the low-voltage leads and impressing impedance voltage on the high-voltage terminals. It may be necessary to impress a voltage higher than the impedance voltage in order to heat the windings sufficiently, but the total temperature of the windings as determined by resistance should not exceed 190 C (or 185 C by non-mercury type thermometer placed in the ducts between windings and in contact with them).

The heat run should be continued for a minimum of eight hours. Insulation resistance is a function of insulation temperature as well as moisture content, thus for comparison, readings must be taken at the same temperature. During the course of a drying heat run, the insulation resistance may

initially decline as the insulation heats up. After the insulation temperature stabilizes, the insulation resistance will begin to increase. When the insulation resistance stabilizes, the drying procedure should be terminated. The transformer should then be allowed to cool to ambient temperature after which the insulation resistance should again be measured and compared with minimum requirements.

An alternate to the short circuit drying heat run is to use a procedure in which hot air is directed into the bottom of all windings. The temperature of this air should not exceed 150° C but should be as close to this temperature as possible to minimize the drying time. If the transformer is equipped with fans, they should be removed to prevent damage to the fan motors by exposure to this hot air.

Oven drying is not recommended because an oven temperature that would be effective in a reasonable length of time could damage the tin plating on the current carrying terminal surfaces. For further information on drying, refer to ANSI Guide C57.94, "Guide for Installation and Maintenance of Dry-Type Transformers".

FAN COOLING

When fans are provided they are intended for use only when the transformer is required to carry a load in excess of its self-cooled rating. Fans should not be operated when the transformer is carrying a load significantly less than its self-cooled rating. Such operation may keep some parts of the insulation system at a temperature low enough to permit moisture absorption and may result in serious injury to the insulation system.

MAINTENANCE

The transformer should be inspected at periodic intervals and corrective measures taken when necessary. The frequency at which these inspections are made depends on operating conditions and the importance of continuity of service. In clean, dry locations an annual inspection may be adequate. In areas where the air is contaminated with dust or chemical fumes, three-month intervals may be required.

To inspect the transformer, **de-energize, lockout and properly ground all circuits supplying power to the transformer and its accessories** and remove the front and rear panels. **CAUTION: Failure to de-energize the transformer and its accessories before removing the front and rear panels may result in serious personal injury.** Inspection should be made for accumulation of dirt on insulating surfaces and in places which would restrict the flow of air, for loose connections, for the condition of terminal boards and for the general condition of the transformer. Observation should also be made for signs of overheating and of voltage creepage over insulating surfaces as indicated by tracking or carbonizing.

Insulation resistance and power factor values may vary considerably with transformer design, size and voltage. Thus changes in these values versus time for a given transformer are more significant than a specific value. It is suggested that these measurements be made after cleaning the transformer at each maintenance period. Care must be taken that these measurements are made in the same way and with the

transformer at essentially the same temperature each time. The voltage at which these measurements are made should not exceed the line to ground operating voltage or 500 volts whichever is greater. The transformer high voltage and low voltage line connections must be opened for these tests. The trends in these values will permit a more informed judgment as to the condition of the insulation system. Refer to the paragraph under "Operation" for minimum acceptable values. Coil jack screws, if provided, should be checked and tightened if loose.

CLEANING

If dirt is found on the windings, insulators, leads or terminal boards, it should be removed to permit free circulation of air and to guard against the possibility of insulation breakdown. Particular attention should be given to cleaning top and bottom ends of winding assemblies and to ventilating ducts. The use of a vacuum cleaner is recommended as the first step in cleaning followed by the use of compressed air. The compressed air should be clean and dry and should be applied at pressures below 25 PSI (170 kPa). Dry nitrogen can be used instead of air if precautions are taken to avoid the dangers of asphyxiation. Lead supports, terminal boards and other major insulating surfaces should be brushed or wiped with a dry cloth. The use of liquid cleaners is not recommended because of the possible deteriorating effects on the insulating materials.

When you need Service

If you need service on products manufactured for EATON, a world-wide service organization is ready to serve you. Warranty administration, site testing services, installation, system studies, maintenance, trouble-shooting, site repairs and training seminars can be provided. Contact the nearest Sales Office of EATON for more information.

If you need to repair, recondition, or rebuild any electrical apparatus, an EATON Service Shop near you is available day or night, seven days a week, for work in the shop or in your premises. Latest factory methods and genuine EATON renewal parts are used to maintain the original performance of your equipment.

For full information about these services, contact the nearest Sales Office of EATON.

RENEWAL PARTS

Address order for renewal parts to the nearest Sales Office of EATON. Include a complete description of the part wanted, plus the rating and serial number of the transformer.