

Instructions for the Safe Handling, Installation, Operation and Maintenance of Ventilated Dry-Type Transformers

IMPORTANT: The information contained herein is general in nature and is not intended for specific application purposes nor is it intended as a training manual for unqualified personnel. It does not relieve the user of responsibility to use sound practices in application, installation, operation and maintenance of the equipment purchased or in personnel safety precautions. The purchased equipment should be installed in accordance with local, provincial (state) and national Electrical Standards. Should a conflict arise between the general information contained in this publication and

1. Local, provincial (state) or national electrical code requirements.
2. The contents of drawings and/or supplementary material pertaining to the project/location the equipment is purchased for.

Items 1 and 2 shall take precedence.

WARNING: There is a hazard of electric shock or burn whenever working in or around electrical equipment. Power to the transformer must be turned off before working inside a transformer.

1. General

The safe operation of dry-type transformers is dependent upon proper handling, installation, and maintenance practices. Neglecting certain fundamental installation and maintenance requirements may lead to personal injury plus the failure and loss of the transformer as well as damage to other property.

Each transformer is assembled and tested at the factory, after which it is inspected and packed for shipment.

Units designed as NEMA Type 2 construction are converted to NEMA Type 3R with a weather shield conversion kit.

2. Inspection Upon Receipt

Immediately upon receipt of the shipment, identify all units and check them against the shipping list. Make a visual examination to detect any damage which may have been incurred during transit. If any damage is discovered, file a claim immediately with the carrier and send notice of the extent of damage to the local sales office, giving complete

identification, carrier's name and details. The information will enable the company to supply necessary data in support of claim.

3. Handling

All transformers are bolted to a wooden skid for shipment. All units can be handled with a forklift truck. Transformers are provided with lifting eyes at the top of the core and coil assembly. The can be accessed by dismantling the enclosure. Units are not designed for laying on their ends or sides. If it is necessary to handle ventilated Dry-Type Transformers outdoors during inclement weather, they should be thoroughly protected against the entrance of moisture. CAUTION: Never attempt to lift a transformer from points other than the lifting eyes provided.

4. Storage

Any transformer which is not installed and energized immediately should be stored in a clean dry space having a uniform temperature to prevent condensation. Preferably, it should be stored in a heated building having adequate air circulation and protected from cement, plaster, paint, dirt and water. The protective plastic wrapping should be left in place during storage.

5. Application

Insulation systems are classified by industry standards in accordance with the following rating system

Ambient	+Winding Rise	+Hot Spot	Temp. = Class
40° C	55° C	10° C	105° C
40° C	80° C	30° C	150° C
40° C	115° C	30° C	185° C
40° C	150° C	30° C	220° C

These transformers are designed using a 220° C insulation system, regardless of the requested temperature rise of the transformer.

6. Installation

Dry-Type Transformers are for indoor use unless the enclosure is specifically designed for outdoor weatherproof service. They are cooled by means of free circulation of air, the maximum ambient temperature of which should not exceed 40° C (104° F). Damage may result if the air flow is restricted, or if the transformer is loaded beyond its rated capacity. Due to various building and room constructions, it is recommended that applicable codes be followed. Factors which should be kept in mind when locating Dry-Type Transformers are:

personnel safety, accessibility, ventilation, locations affecting sound level, and environmental conditions. Installations should be made in an area reasonably free from dust, moisture, chemical and corrosive vapors or fumes. Dry-Type Transformers must be installed in an upright position.

CAUTION: Installation and maintenance should be performed only by experienced and qualified personnel. No attempt should ever be made to change the taps, or make cable connections while the transformer is energized. To maintain safe operating conditions, do not remove the panels or cover while the transformer is in operation

6.1 Accessibility

Dry-Type Transformers should be located in an area where the transformer can be inspected at any time. The wiring compartment should be easily accessible at all times. It is a requirement of the National Electrical Code and CSA that sufficient access and working space shall be provided and maintained about all electrical equipment to permit the ready and safe operation and maintenance of such equipment. Refer to the requirements of the NEC/CSA code for the particular installation involved. The working space required by this standard should not be used as a passageway or for storage.

6.2 Ventilation

Adequate ventilation is essential for the proper cooling of Dry-Type Transformers. Clean air is desirable. Filtered air may reduce maintenance if a location presents a particular problem. The ventilating screens and openings in the transformers are designed to provide adequate ventilation for the transformer and should not be restricted in any way. Transformers rated through 51 KVA should be located at least 4 inches away (or as many inches as required by NEC/CSA code) from walls or other obstructions to allow free circulation of air through the ventilation openings. For units above 51 KVA, spacing should be a minimum of 6 inches (or as many inches as required by NEC/CSA code). If the transformer is located in a small room, ventilation should be provided to maintain an average of 30° C (86° F) ambient not to exceed 40° C (104° F) in any 24-hour period.

6.3 Sound

Audible sound may be a factor, and consideration should be given to the specific location and method of installation of the transformer. Keeping in mind the following suggestions:

- Mount the transformer away from corners of walls or ceilings.
- Provide flexible conduit to make the connection to the transformer.
- Use sound absorbing material on the walls and ceiling.
- Locate the transformer as far as practical from areas where high sound levels are undesirable.

6.4 Environmental Conditions

Ventilated Dry-Type Transformers are normally designed for indoor installation applications only. They may be installed outdoors if they are of outdoor construction. Outdoor construction may consist of specifically designed NEMA Type 3R enclosures or weather shield conversion kits to convert indoor NEMA Type 2 enclosures to NEMA Type 3R. The transformer nameplate specifies the proper weather shield kit to be used on the specific transformer. When this kit is properly installed, the enclosure is listed by CSA/UL for NEMA Type 3R protected outdoor installation. Transformers should be installed in locations where the ambient atmosphere is free from unusual chemical fumes or dust.

6.5 Outdoor Installation

The same care must be taken when selecting a location for outdoor Dry-Type Transformers. Walls may be built around the transformer if proper care is taken to allow sufficient air flow. It is recommended that a suitable concrete pad with adequate drainage be used for the outdoor location. Pad should be approximately 4" above ground level.

CAUTION: Outdoor transformers are not tamper proof. The location of the transformer must be away from children and all unauthorized personnel. Failure to do so may result in serious injury.

7. Connections

All cable entrances should be into the terminal compartment indicated on the drawings. When making cable connections or changing taps, **always use two wrenches when tightening or loosening bolted connections to prevent distortion or damage.** The terminal connections are either bare aluminum, tin plated aluminum or copper. The aluminum surfaces are furnished with a protective coating to prevent oxidation. The unused tap connections are also furnished with a protective coating. This coating should remain intact until these connection points are needed.

CAUTION: Make only those connections shown on the nameplate or connection diagram. Before energizing, check all tap jumpers for proper locations, and all bolted connections for tightness.

If it is necessary to change taps or assemble a lug to a connection point, gently scrape coating from new connection surface using a sharp knife. Apply a light coating of grease from the tap jumper pad to the scraped surface and tighten connection using two wrenches as described above.

NOTE: After installation of connectors and cabling, a minimum of 1" clearance must be maintained from energized parts to all case parts.

7.1 Lighting Tap Applications

Most transformers with 240 volt delta secondaries have a 120 volt single-phase lighting tap. The maximum single-phase 120 volt load should not exceed 10% of the three-phase KVA rating. The load should also be balanced at 5% maximum between terminals X1 to X4 and 5% between terminals X2 to X4. The three-phase KVA must also be reduced by 30% of the nameplate rating.

7.2 Grounding

All core and coil structures have a flexible ground connection to the enclosure which ensures that all dead metal parts have the same potential. The transformer enclosure should be solidly grounded so that no danger will exist for operating or maintenance personnel. A transformer ground stud or ground bus is provided for the customer's ground connections. The grounding conductor for a transformer should have a current-carrying capacity in accordance with the National Electrical Code/CSA Requirements.

8. Before Energizing

Before energizing the transformer, loosen or remove all shipping hardware, and store for future use. If it is desired to change location of the transformer at a future date, reinstall all shipping hardware. If shipping hardware is left in place, excessive enclosure vibration will increase the sound level.

Check all tap jumpers for proper locations, and all bolted connections for tightness. After installation is completed, remove any debris from the bottom of the wiring compartment. Securely tighten all screws which hold the panels and covers in place to eliminate possible vibration of these parts.

9. Operation

To maintain safe operating conditions do not remove panels or covers over openings in the enclosure while the transformer is energized.

CAUTION: Never attempt to change taps or connections unless the transformer is de-energized and all windings are grounded.

For all relatively clean and dry indoor installations, the transformer will operate satisfactorily under normal conditions of energization and load. There is no concern over the transformer's ability to retain its electrical strength during reasonable periods of shut down. Under severe conditions and extended shutdown periods condensation may form and ultimately be absorbed into the insulation. If such a situation occurs, the transformer should be inspected for visible signs of moisture before re-energizing. The transformer should be dried as specified Section 20, "Drying" if moisture is visible.

Transformers should not be overloaded. The resulting temperatures can cause insulation deterioration and transformer failure.

10. VOLTAGE TAPS AND PROCEDURES

The transformer must always be disconnected before proceeding with tap changes. Primary voltage must be connected to the proper adjustment voltage tap. The tap lugs must be tightened and loosened with appropriate tools to avoid bending or damaging the tap terminals. The taps position schematic, corresponding to the nameplate, is located inside the transformer.

11. NOMINAL CURRENTS

Load current on each line must not exceed the nominal current rating of the transformer. The practice of maintaining the load at 80% of the nominal current rating is recommended. This is a preventative measure, should the ambient temperature become too high to allow adequate cooling of the unit.

12. BALANCED LOADS

The loads applied to the transformer must be phase balanced and must never exceed the allowed capacity of each winding.

13. VIBRATIONS AND NOISE ELIMINATION

To reduce Vibrations and to eliminate/lower audible noise emanating from the transformer;

- a) Genuine anti-vibration pads should be installed under the transformer.
- b) Flexible conduits should be installed on both the primary and the secondary of the transformer.
- c) The capacity of the supporting surface must be greater than the transformer's weight.
- d) A floating cement base with proper anti-vibration material will help to eliminate the vibrations transmitted to the building structure.
- e) Horizontal structures, for ceiling mounted transformer(s) supported by vertical rods, must be isolated with rubber washers.

14. SOUND LEVEL

The sound level of a dry type distribution transformer may vary from 40 to 65 decibels depending on the size of the transformers, quality of the installation and the mounting location. Direct installation on wood or wooden structures is particularly noisy, and is not recommended. The high noise level at the time of initial energizing is normal and will attenuate within a few seconds.

It is recommended that the transformers be installed as far away as possible from the public.

15. VENTILATION

The average ambient temperature for any 24 hours period must not exceed 30° C and at no time the temperature is to exceed 40° C.

The wall clearance instructions per CSA/NEC code and local code requirements must be followed to ensure proper cooling of the transformer from the back. Front and back ventilation slots must never be obstructed.

16. OVERLOAD

Overloading of dry type distribution transformer(s) is not recommended.

17. ENVIRONMENT

Dry type distribution transformers must be installed inside a building, in an environment where no excessive dust, corrosive fumes, flammable fibres, water dripping and excessive humidity are present.

18. TRANSPORT AND HANDLING

Dry type distribution transformers are constructed to resist mechanical effects due to short circuits; however they are relatively fragile when handled.

Even when subjected to a small drop of 15 cm, the heavy steel laminations held by the internal structures could be displaced due to the weight of the transformer. This could have negative effects on the electrical circuit of the transformer and cause increased noise levels and even transformer failures.

19. Maintenance

Under normal operating conditions, Dry-Type Transformers are virtually maintenance free. However, they do require occasional external cleaning, repainting, internal cleaning, painting, and periodic care and inspection.

Maintenance must be done with the transformer in a de-energized condition. This would include such things as tap changing, internal inspection and cleaning, locating causes of faulty performance, replacing parts, etc. Corrective maintenance should be performed by a person who is familiar with the construction and operation of the apparatus and the hazards involved. In conducting corrective maintenance, such a person should:

Where periodic inspection of any kind cannot be made, it should be recognized that the life of the transformer may be affected.

The frequency of inspection will depend on the atmospheric and/or environmental conditions at a given transformer installation or location. A transformer may operate satisfactorily for many years without attention but, under unusual service conditions, maintenance may be required in a matter of months.

A continuously energized transformer needs periodic maintenance only to remove accumulations of dust and dirt from cooling ducts and other surfaces. Large accumulations may reduce cooling efficiency and lead to overheating. The frequency of cleaning will depend on the environment in which the transformer is located. Cleaning is recommended at least once a year in relatively clean installations and at more frequent intervals in more heavily contaminated atmospheres. Transformers which are de-energized for periods of time generally require more frequent maintenance to insure removal of contamination.

Accumulation of dirt on insulating surfaces becomes a hazard when a considerable amount of moisture is absorbed. It is always advisable to clean any transformer suspected of having been contaminated with dirt and moisture. Vacuuming is the recommended method for cleaning. Special attention should be given to cooling ducts within the windings. Low pressure, **dry air** can be used if care is taken to avoid driving the contamination deeper into insulations.

- **Be sure that the transformer is disconnected from all electric power sources before servicing.**
- Inspect terminals for alignment, tightness, pressure, burns, or corrosion. Consult factory to replace pitted or badly burned lugs.
- Inspect air ducts for the accumulation of dust and foreign substances; vacuum any accumulation.
- See that bolts, nuts, washers, pins, terminal connectors, including ground connection, are in place and in good condition.

20. Drying

Moisture is detrimental to most insulation systems. It is advisable to dry out any transformer which has been exposed for long periods of high humidity. Whenever moisture is visible on insulation surfaces, the unit must be dried before being energized.