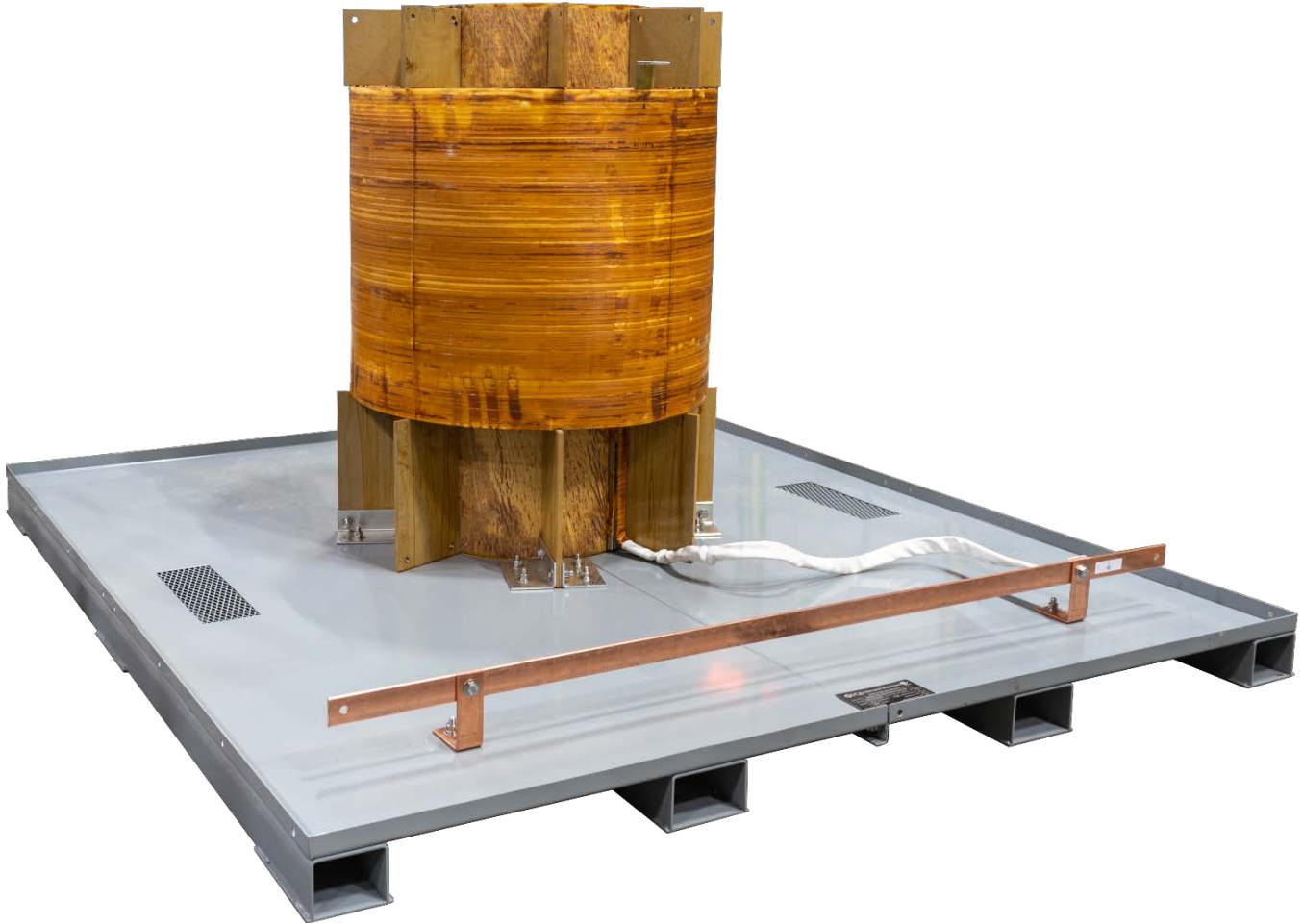


DRY TYPE AIR CORE REACTORS

INSTALLATION, OPERATION AND MAINTENANCE MANUAL



REX POWER MAGNETICS

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1.0 SAFETY

The safety recommendations and guidelines below are to assist the operator in reaching the highest possible level of safety. If further information is required, or particular problems arise which are not covered in this document, please contact Rex Power Magnetics.

DANGER	
	<p>There is a hazard of electric shock or burn whenever working in or around electrical equipment. Power must be locked off before working inside a transformer enclosure. This equipment is to be installed and maintained by qualified personnel only.</p>
<ul style="list-style-type: none"> <input type="checkbox"/> Only qualified technicians should attempt to work on electrical equipment. <input type="checkbox"/> A risk assessment should be conducted to determine what hazards are present that need to be addressed in the project plan. <input type="checkbox"/> Always wear protective clothing and footwear when working on or around the transformer. 	

- The use of electrical safety, arc flash safety grounding, and lockout/tagout procedures should always be followed to ensure personal safety when installing, servicing and uninstalling electrical equipment.
- Never energize an air core reactor if it appears to be damaged.
- When working at heights, fall protection should be worn.
- Never lift anything over head or over top of other persons.
- When moving material, ensure that there are no other interferences that might come into contact with the unit such as overhead power lines.
- To avoid lacerations, be aware of the possibility of sharp edges on metal objects.
- In the event of a fire, do not use water to extinguish the flames. Use a suitable quenching agent such as CO₂.
- Terminals are for electrical loading only. Wherever possible, use flexible connectors to avoid mechanical strain on terminal pads.
- Do not lift or move an air core reactor without appropriate equipment and precautions.
- Use the proper “rigging” when handling the units and always connect to the designated lifting points.
- Ensure the lifting accessories are rated to handle the weight of the product and that the correct lifting calculations are used according to the angles of the cables or chains.
- Make sure all power supplies are disconnected and properly grounded before attempting to work on the transformer or inside of the control box.
- Do not make any connections that are not indicated by the nameplate or the connection diagram.
- Ensure that all electrical connections are tight.
- The proper PPE and insulated tools should always be used when working around potentially energized equipment.
- Do not energize the air core reactor without properly grounding the unit per the applicable national electrical code.
- Do not enter the cabinet or stick objects into the unit when energized. This could result in injury or death.
- After de-energization, the air core reactor will still be hot. Allow for the reactor to cool down before starting any work on it.

2.0 GENERAL & SCOPE

The successful and safe operation of a dry type air core reactor is dependent upon proper handling, installation, and maintenance. Neglecting certain fundamental installation and maintenance requirements may lead to personnel injury, the premature failure of the unit as well as damage to other property.

This manual covers general recommendations & requirements for the installation, operation and maintenance of dry type air core reactors of the following types:

- Single phase neutral grounding reactors (shunt reactors)
- Single or three phase current limiting reactors (series reactors).

These recommended practices are for general applications. There may be additional site specific, or reactor specific considerations for your air core reactor, and any special requirements should be referenced back to Rex Power Magnetics and/ or their representative.

IMPORTANT



All persons working on the equipment should be qualified personnel who have experience and the necessary knowledge in working with high voltage equipment. Qualified personnel consist of customer service engineers, qualified professionals, and other authorized operating personnel. This document does NOT serve as a replacement for proper training. Certifications are required to transport, operate, store, install or move the product safely. Complying with these instructions will help to reduce hazards and accidents, while preserving the reliability and service life of the transformer.

3.0 RECEIVING & HANDLING

CAUTION



Never attempt to lift an air core reactor from points other than the lifting points provided. Damage beyond repair may occur if the air core reactor is tilted or turned on its side or end.

Single phase dry type neutral grounding air core reactors are generally shipped completely assembled in a metallic enclosure (See figure 2). Units are oriented flat, and wrapped in a clear plastic sheet to prevent ingress or moisture and dust. The base of these enclosures are designed for fork lift handling.

Three phase stacked dry type current limiting air core reactors (see figure #1) are generally shipped partially assembled with or without an enclosure. For reactors which are not installed in an enclosure, refer to the layout drawings for additional information for safe lifting and handling instructions.



Figure 1: 3 phase outdoor current limiting reactor



Figure 2: Single phase enclosed neutral grounding reactor

It is imperative that a thorough inspection of each unit be done immediately upon receipt, prior to its acceptance, and removal from the carrier's vehicle. Confirm that the identifying part number on the air core reactor nameplate matches the packing list and bill of lading. In some cases, parts may be shipped loose. Ensure all components have been received.

The units should be visually examined to detect any damage or indication of rough handling which may have been incurred during transit. Covers should be removed to check internal components as well. Inspections should be done to identify missing or damaged parts, loose or broken connections, dirt and standing water. If damage is detected or there are any critical observations from the inspection, write a brief description on the bill of lading, file a claim immediately with the carrier and send notice of the extent of damage to the local sales office.

4.0 STORAGE

Air core reactors which are not installed and energized immediately should be stored in a dry, clean space having a uniform temperature to prevent condensation on the winding. Preferably, it should be stored in a heated building having adequate air circulation and protected from cement, plaster, paint, dirt, and water or other gases, powders, and dust. Precautions should be taken to prevent storage in an area that water could be present, such as roof leaks, windows, etc. Condensation or absorption of moisture can be greatly reduced by keeping the air core reactor enclosure 5°C-10°C above ambient temperature. This can be easily achieved by the installation and energization of space heaters. If the reactor is not furnished with internal space heaters, then external, portable heaters can be used. Note: Lamps or heaters should never come in direct contact with the air core reactor coil insulation.

It is not advisable to store an air core reactor outdoors, but in the case that it is unavoidable, protective measures should be taken to prevent moisture and foreign debris from entering the enclosure. The plastic wrapping supplied during shipment should be left in place, and a suitable drying agent such as silica gel packs should be used. The unit should also be checked periodically for indications of condensation on the windings.

5.0 INSTALLATION

CAUTION



Installation 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.

5.1 Location & Environment

Air core Reactors are supplied with either a Type 3R, 4 or 4X rated enclosure, and suitable for both indoor and outdoor installation. For outdoor installations, the appropriate applicable codes must be followed, included cable installation, and hardware suitable for outdoor service.

Air core reactors should be located such that they comply with all applicable local safety and electrical codes. NEC standards require that dry type air core reactors be accessible for inspection and located accordingly.

5.2 Ventilation

Dry type air core reactors must be installed in an area where they can be cooled by means of the free circulation of air. Unless otherwise rated, the average ambient temperature should not exceed 30°C (86°F) and the absolute maximum ambient temperature should not exceed 40°C (104°F) at any time.

Adequate ventilation is essential for air core reactors to meet their nameplate current capability. All dry type air core reactors should be located at least 20 cm (8 in) away from wall or any other obstructions and 25 cm (10 in) from ceiling to allow free circulation of air.

5.3 Mounting

Unless special provisions have been made, air core reactor should only be installed on the floor by securing the base of the enclosure to the floor. Please refer to the layout drawings for the anchor bolt layout.

Mounting Instructions:

- Select an installation location that is on a non-combustible surface.
- The mounting location must allow for air circulation around the transformer for cooling purposes. Please refer to the minimum distances stated in the ventilation section.
- Position the air core reactor in its final location.
- Mark the location of the mounting holes, and drill four holes into the floor.
- Secure / anchor the reactor enclosure to the floor using the appropriate hardware.

5.4 Electrical Connections**CAUTION**

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

All joints suitable for field connection of cable or bus have tin-plated contact surfaces. The lug or bus used for connection should be tin, nickel or silver-plated. When plated parts are joined, no surface preparation other than ensuring clean surfaces is required. Simply bolt the parts together with the hardware supplied, adhering to the recommended torque values in Table 2, Section 5.5. When connecting bus bars, be sure the joints are properly aligned prior to bolting to prevent excessive strain on the insulators. Flexible bus connections are recommended for such connections to eliminate any excess strain.

User installed cables must be kept as far away from the reactor coil as possible. Refer to the Table 1 below for recommended minimum electrical clearance when performing final check. You should only make those connections specified by the nameplate or connection diagram.

Minimum Electrical Clearances	
BIL [kV]	Minimum Clearance [in (mm)]
10	1.0 (25)
20	1.0 (25)
30	1.5 (38)
45	2.5 (64)
60	3.5 (89)
95	4.75 (121)
110	7.50 (191)
125	8.75 (222)
150	11.25 (286)
200	16.00 (406)

Table 1: Minimum Electrical Clearances Chart

5.5 Recommended Torque Values

Table 2 below summarizes the recommended torque values for the different types of bolted electrical connections found on air core reactors. All electrical connections should be checked prior to the energization of a unit.

Recommended Torque Ranges for Bolted Electrical Connections			
Bolt Size [Dia – Pitch]	Carbon Steel Grade 2 or 5 [ft-lb]	Brass Alloy CU270 [ft-lb]	Stainless Steel B8 or B8M [ft-lb]
1/4" – 20	10 – 12	n/a	5 – 10
3/8" – 16	15 – 30	12 – 15	15 – 20
1/2" – 13	40 – 70	20 – 30	30 – 40

Table 2: Recommended Torque Ranges for Bolted Electrical Connections

Note: When a lock washer is used in a connection, it should be tightened until the lock washer is completely compressed, but not distorted.

5.6 Grounding

All non-current carrying metal parts in an air core reactor must be grounded in order to remove static charge that accumulates in the unit. A 1/4" x 2" ground bus is provided for the customer's ground connections. The ground terminal of neutral grounding air core reactors, and the winding shield (if supplied) are connected to the ground bus at the factory. The enclosure and ground bus must be grounded in accordance with the National Electrical Code.

5.7 Accessories

If the air core reactor is supplied with any additional accessories such as current transformers, ground fault relay, etc. please refer to the manual for that specific piece of equipment for more information on the application, installation, operation and maintenance of the accessory.

6.0 OPERATION

Air core reactors are designed to operate continuously at their rated nameplate current rating. The surface of the enclosure, may be warm to the touch. Under normal operation / loading, the enclosure temperature may rise 65°C over ambient.

CAUTION



Never operate a dry type air core reactor without protective covers/panels installed. Never remove protective panels while the unit is energized. Injury or death may result, as well as damage to the equipment.

6.1 Inspection Before Energization

For the safe and proper operation of dry type air core reactors, we recommend that the following items be checked for completeness:

- Check all electrical connections to make sure they are correct (refer to the nameplate schematic), and that they have all been torqued per the recommended values in table #2.
- Check to make sure all the grounding connections have been made, including for the enclosure, and that all connections have been torqued per the recommended values in table #2.
- Check to make sure that there are not foreign objects in the coil(s) that may be blocking the ventilation.
- Check that the reactor has been securely anchored, and that there are no loose mechanical connections.
- Check the clearances between live parts and cables / grounded parts are per the distances specified in table #1.
- Check the reactor enclosure for any visual damage.

6.2 Commissioning Test

Commissioning electrical tests are not applicable to air-core reactors. However, if power sources and measuring equipment are available at field, it is recommended to perform the following tests:

- Measurement of dc resistance
- Measurement of inductance / impedance at power frequency

The measured figures at field shall be compared with those values presented in the routine test reports. Depending on the power source type and accuracy of the measuring equipment, the results may deviate slightly from the factory values.

7.0 MAINTENANCE

CAUTION



Failure to de-energize and ground the air core reactor enclosure and terminals before performing maintenance could result in serious personal injury or death.

Under normal operating conditions and environments, air core reactors do not require maintenance. However, periodic care and inspection is a good practice, particularly if the unit is exposed to extreme environmental conditions.

Corrective measures taken when necessary to assure the most satisfactory service from this equipment. Evidence of rusting, corrosion, and deterioration of the insulation, varnish or paint should be checked, and corrective measures taken when necessary.

For clean, dry locations, an annual inspection may be sufficient, but for other locations, such as those with excessive dust or chemical fumes, more frequent inspections may be required. Usually after the first few inspection periods, a definite schedule can be set up based on the existing conditions.

Inspections should look out for the following:

- Dirt or dust accumulation on insulators and support structures
- Objects which are obstructing the cooling ducts, and which may prevent the cooling of the equipment.
- Loose or corroded electrical connections.
- Signs of overheating and of voltage creepage over insulating surfaces as evidenced by tracking or carbonisation.
- Evidence of rusting, or corrosion of the paint.



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