



Neutral Grounding Resistors (NGRs)





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1.0 COMPLIANCE

1.1 Compliance with Manual Instructions

It is essential that the purchaser / user comply with all instructions and information contained in this manual, and that all personnel associated with the apparatus supplied under this contract are thoroughly familiar with the information contained herein.

1.2 Compliance with Installation Procedures

It is the purchaser / user's responsibility to ensure that the apparatus supplied under this contract is correctly installed in a suitable location by technically qualified and competent persons.

Apparatus supplied as loose components, devices, or sub-assemblies may, when energized, constitute a safety hazard. The purchaser / user must ensure that such apparatus is installed in a secure location, and that all necessary safety information about the installation is provided to all personnel associated with it.

1.3 Relevant Design Standards

Resistors: IEEE32-1972

Enclosure: IEEE32-1972, N.E.M.A.

Enclosure Finish: A.N.S.I.

2.0 SHIPPING AND RECEIVING

2.1 Shipping

The unit is shipped in ready-to-use state except for the cable entrance bushing (if applicable), which is packed inside the enclosure to prevent breakage during shipment.

2.2 Receiving

Once received, the unit should be unloaded and moved by forklift or crane. Top-mounted lifting eye tabs are provided for easy handling by crane.



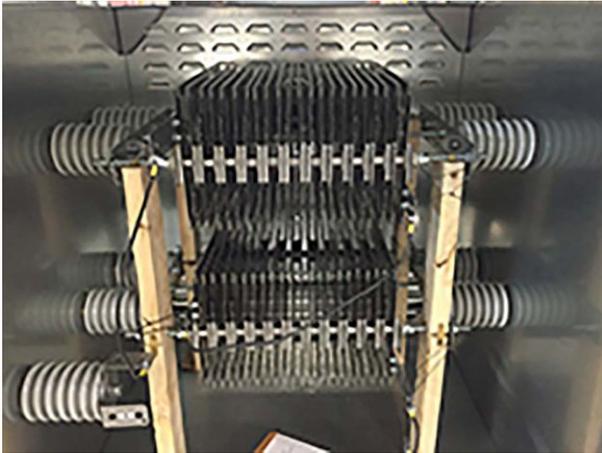
Example of top-mounted lifting eyes



Example of pass through entrance bushing (if applicable)



Example of lifting from top via fork lift



Example wooden shipping braces inside enclosure

Notes

- The unit must not be lifted by placing forks under the unit! Lifting the unit from underneath with a fork lift will damage or destroy it, and will void the warranty. If the unit is to be moved with a forklift, use chains or cables through the lifting eye tabs.
- If the unit comes with temporary wooden shipping braces inside the enclosure, do not remove them prior to setting the unit at the permanent installation location.

At this time a preliminary inspection of the unit should be made to assure it was properly handled during shipment. For more on inspection procedures, see "Site Installation."

2.3 Storage

While the Neutral Grounding Resistor is designed for indoor and outdoor use, if it is to be stored for any length of time prior to installation, it should be covered to protect it against moisture and the accumulation of dust and dirt. The unit should be stored in a dry, enclosed area, or covered with a waterproof cover. ALWAYS BE SURE THE UNIT IS DRY AND CLEAN BEFORE USE.

3.0 GENERAL DESCRIPTION

3.1 Enclosure

Standard enclosures will have a vented bottom and center pitched top with 2 to 4 eye bolts. The sides are solid and not removable. Front and back covers are removable for installation.

3.2 Grid Type Resistor Banks

Each resistor bank is built up from a number of individual resistor plates. Individual plates are not replaceable; only complete bank sections are replaceable if necessary. Resistor grid banks are manufactured from stainless steel alloy plate stamped into suitable resistor grids and fitted with reinforcing capsules / stiffeners where needed. The grids are mounted over insulative mica tubing and spaced with SS spacers and insulative mica washers. The assembly is supported by stainless steel center rods. Each grid bank has stainless steel terminals at each end. The grid design and mounting arrangement allows for free expansion and contraction of the resistor elements without imposing strain on the grids or terminals. The grids are assembled into banks suitable for high-temperature service.

3.3 Incoming Cable Connections

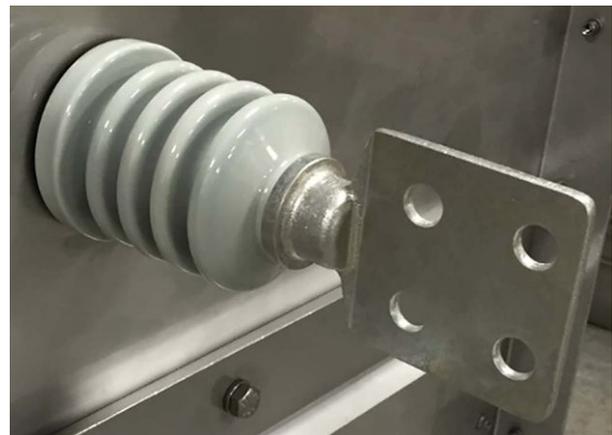
A bottom-mounted bushing inside the enclosure, or side / top mounted ceramic bushing of suitable voltage and current rating, is provided and terminated with a NEMA 2-hole connector.

3.4 Outgoing Cable Connections

A bottom-mounted bushing inside the enclosure, or side / top mounted ceramic bushing of suitable voltage and current rating, is provided and terminated with a NEMA 2-hole connector.



Example of bottom mounted bushing for N/G connection



Example of side/top mounted pass through bushing for N/G connection

4.0 INSTALLATION AND SITE REQUIREMENTS

4.1 Access Clearances

At least 36 inches is required around all removable covers for access. This may be subject to local or site regulations requiring greater clearances.

4.2 Ventilation Clearances

A free-air flow environment is required around the resistor enclosure with a recommended minimum of approximately 10 inches.

4.3 Enclosure Operational Temperatures

During normal service, either due to steady-state current flow (if specified) or a fault condition, both the issuing air temperature and the enclosure surface temperature may exceed 100 °C.

Note

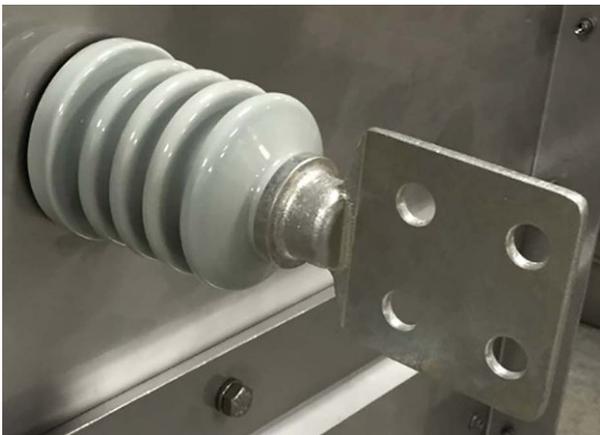
- Equipment or combustible materials must not be placed on the top cover of the enclosure or placed in contact with the sides.

4.4 Mounting Surface

A flat foundation or other suitable square and plumb mounting arrangement is required.

4.5 Assembly

The Neutral Grounding Resistor is supplied assembled except for the porcelain entrance bushing (if applicable), which is shipped inside the enclosure and must be mounted by purchaser / user.



Porcelain side / top entrance bushing (if applicable) is shipped inside the NGR and must be installed on site

4.6 Tools and Equipment

Ordinary hand tools are all that are needed for assembly. A battery powered drill can be handy for removing cover screws but is not required. No special tools are required. Lifting equipment must be capable of keeping the unit in an upright position while in motion.

4.7 Installation Procedure

1. Place the Neutral Grounding Resistor on the prepared base.
2. Remove front and back covers.
3. Remove all internal packaging / bracing material.
4. Examine for signs of damage during transit.
5. Secure the Neutral Grounding Resistor onto its base.
6. Install the cable entrance bushing in the hole provided, and tighten securely (if applicable).
7. Connect the resistor bus bar to the bushing (if applicable).
8. Make sure all connections are tight.
9. Connect incoming cable to the entrance bushing cable clamp or NEMA 2-hole pad labeled "N" for Neutral.

10. Connect outgoing cable to the exit / ground bushing cable clamp or NEMA 2-hole pad labeled "G" for Ground.
11. Reinstall the enclosure front and rear covers.
12. Connect enclosure ground cable to the ground lug hole provided on any of the four corners on the exterior of the enclosure.
13. Be sure all enclosure hardware is correctly installed and tightened.

5.0 COMMISSIONING

5.1 Resistance Test

Check the resistance value, using a Kelvin double bridge or a digital low-resistance ohmmeter. It must be the value stamped on the nametag $\pm 10\%$ unless specified otherwise.

5.2 Insulation Test

Disconnect the resistor ground cable. Check the insulation resistance between the resistor elements and the enclosure, using a 1000 V_{DC} megger. It should be greater than 100 M Ω .

Alternatively: perform an AC high-potential test. Maximum applied voltage = (2.25 x phase voltage) + 2000 V at 60 Hz. Reconnect the ground cable after completing test.

6.0 OPERATION PROCEDURES

6.1 Personnel Safety

The rules in the section must be followed to ensure the safety of personnel associated with this apparatus.

1. During normal use, ensure that the plant operators:
 - a. Are fully familiar with all controls, particularly those for emergency shutdown.
 - b. Comply with all safety warning notices and keep all enclosure covers on during operation.
 - c. Are trained to recognize signs of faulty operation, and know what action to take in the event of trouble.
2. During maintenance and testing, ensure the following:
 - a. Only technically competent and authorized persons are permitted to carry out work.
 - b. Personnel comply with all statutory requirements.
 - c. Personnel are thoroughly familiar with the unit and the system of which it is a part, and can recognize any potential safety hazards.
 - d. Unit is isolated completely before opening enclosures. Personnel must make absolutely certain it is dead before starting work. All possible precautions, e.g., lockouts, must be taken to ensure that the isolated apparatus cannot become live at any time while it is being worked on.
 - e. All service personnel comply with all safety procedures for the protection of themselves and of others, including the use of temporary barriers and warning notices.
 - f. Personnel are completely familiar with all pertinent information provided, particularly on safety matters.



- g. Personnel understand the hazards inherent in working on a live electrical apparatus and take all necessary precautions.
- h. Personnel consider that the unit may have been modified without proper reference to the manufacturer and take extreme caution at all times before, during and after any work is carried out.
- i. Always thoroughly check and test the unit in accordance with this manual and good working practice before putting the unit back in service.

6.2 Skills Required for Specific Tasks

To ensure that the unit is safe for use in normal plant operation it has been designed and tested in accordance with relevant U.S. and international standards. Information is provided in this manual regarding the conditions necessary for safety against hazards reasonably foreseeable during normal use and the precautions taken to counteract them.

It is the purchaser / user's responsibility to ensure that the unit is maintained in a safe condition by technically competent and authorized personnel only who act in compliance with all appropriate safety procedures.

7.0 MAINTENANCE

7.1 Equipment Isolation

The equipment must be completely isolated from all power before performing any maintenance.

7.2 Routine Maintenance

Very little maintenance is required on this equipment, but routine inspections should be carried out at regular periods to ensure that the equipment is kept in a good and reliable condition. The frequency of the inspection depends upon site conditions i.e. atmospheric pollution, safe access to the equipment, etc. but initially could be done every 6 months.

7.3 Standard Procedure

1. Access the resistor units by removing either the front or back cover and lifting the cover away.
2. Remove all dirt from cable terminals and insulators.
3. See that all connections are sound and all mounting hardware is tight.
4. Inspect the enclosure for damage or excessive corrosion and repair as needed.
5. After inspection, be sure all covers are securely fastened.

8.0 REPLACEMENT PARTS

8.1 Should it be necessary to replace any part of this equipment, the customer should contact the manufacturer. Refer to the drawing number of the equipment (on the nameplate) and give the part number and a description of the part required. See attached drawing.