NEUTRAL GROUNDING RESISTORS

INSTALLATION, OPERATION & MAINTENANCE MANUAL

Contents

1- SAFETY INSTRUCTIONS

1-1- Compliance with Instructions in this Manual

The Purchaser/User should comply with the instructions and information given in this manual and ensure that all personnel to be associated with the apparatus supplied under this contract are made familiar with the information contained herein.

1-2- Guidance Notes Installation

The Purchaser/User should 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 could, when energized, constitute a safety hazard. The Purchaser/User should ensure that such apparatus is installed in secure location and that adequate safety information about the installation is provided to all personnel to be associated with it.

1-3- Guidance Notes for Users on the safety of personnel

The rules for ensuring the safety of personnel can be summarized as follows:

1-3-1 During Normal Use ensure that the plant operators:

- are fully conversant with all controls , particularly those for emergency shutdown.
- comply with safety warning notices and keep all enclosures shut.
- are trained to recognize signs of mal operation and know what action to take in the event of trouble or difficulty.

1-3-2 During Maintenance, Testing and etc, ensure that only technically competent and authorized persons are permitted to carry out work and that they:

- comply with statutory requirements.
- are fully conversant with the apparatus and the system of which it is a part ,and recognize the safety hazards which could arise, e.g. back feed.
- isolate the apparatus completely (an isolator is not normally provided with a Neutral Earthing Resistor, before carrying out any work it must be isolated elsewhere) before opening enclosures and prove it to be dead.
- Precautions must be taken to ensure that the isolated apparatus cannot become live whilst any work is being carried out.
- comply with safe working procedures for the safety of themselves and of others, including the use of temporary barriers and warning notices.
- are conversant with the information provided particularly on matters relating to safety.
- recognize the hazards which can arise when working on live apparatus and then take all the necessary precautions.
- functionally check the apparatus and the mechanically and/or electrically test it in accordance with the manual and good working practice before putting the apparatus back in service.
- take account of the possibility that the apparatus may have been modified without proper reference to the manufacturer and take extreme caution at

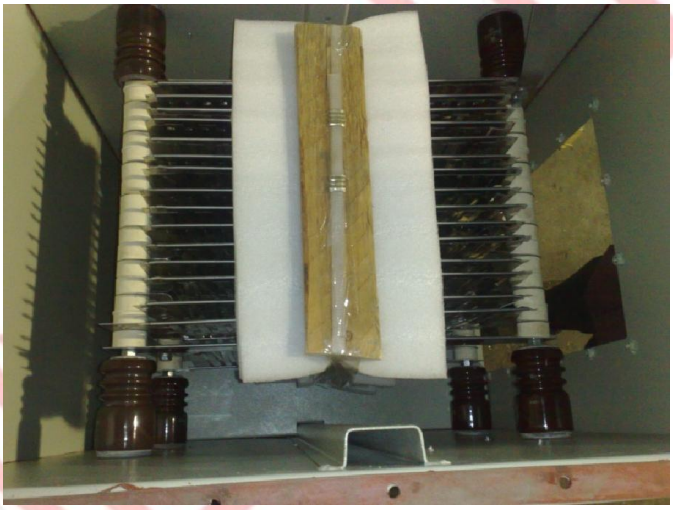
all time before during and after any work is carried out. If there is any doubt as to the correct and safe method of working then further assistance should be sought from the supplier.

1-4- Skills Required for Specific Tasks

To ensure that the apparatus is safe for use under normal healthy plant operation conditions:

- if has been designed and tested in accordance with relative international Standards
- Information is provided in this manual about the conditions necessary for safety and about any hazards which are reasonable foreseeable during normal use together with precautions to be taken to counteract them.

However the Purchaser/User should ensure that the apparatus is maintained in a safe condition, and if technically competent and authorized personnel have to give access to apparatus which is not made completely safe as recommended, everyone under whose authority these persons act should ensure that appropriate safety procedures are generated and are complied with.



2- UNPACKING / LIFTING

2-1- Shipping

PAARSUN NGRs are placed in their normal mounting position onto a wooden skid and securely fastened to the skid with lag bolts. The units are then covered with plastic to protect the finish and to prevent dirt or moisture buildup that can occur during shipping or storage.
Wooden supports are used inside the enclosure to support the resistor banks. Finally, the units are skid-mounted.
All units are loaded by crane or liftruck into the enclosed van of a common carrier. At that point, it is the responsibility of the carrier to provide proper care in shipping and handling.

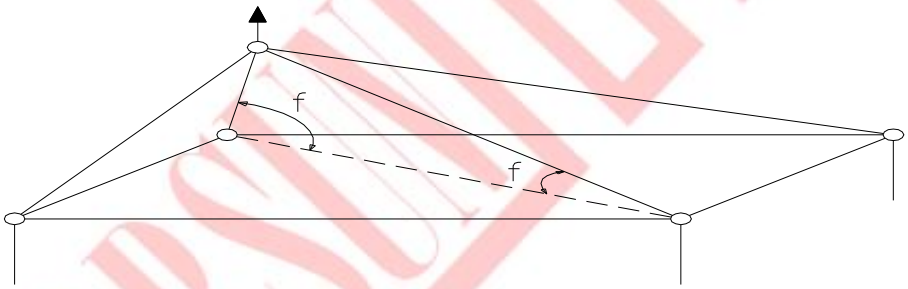
2-2- Receiving and unpacking

Once received the unit should be unloaded and moved by forklift or crane. At this point, a preliminary inspection of the unit should be made to ensure proper handling was practiced during shipment.

- If the NGRs are inside wooden box should be moved by lift track or crane from bottom
- Open the box carefully
- Open the plastic cover
- Open the Removable plate
- The block of resistors have been packed by strap, foam and wooden. Open all of them
- Check inside of enclosures and be sure that ceramics and bushings are safe

2-3- Lifting

Top mounted eye-bolts are provided for easy handling by crane (minimum angle 45° between sling & horizontal). A forklift can be used to place the unit providing that extra precaution is taken to ensure the forks rest against the steel angles of the enclosure and not the bottom screening.



Maximum Lift for 4 eye nuts =700*Sine f * 4KG

Table 2. LIFING SLING ANGLE DATA M16 EYE NUTS

ANGLE (F°)	MAX LIFT (KG)
90	2800
85	2790
80	2760
75	2700
70	2630
65	2540
60	2420
55	2290
50	2140
45	1980

3- INSTALLATION

3-1- Location on site

The equipment should be located taking heed of the following points:

a) Access

At least 1000mm is required for access in front of all removable cover, but subject to local/site regulations which may dictate greater clearances. Removable access to leave metal must be located in a secure environment.

b) Ventilation

Neutral Earthing Resistors may become very hot during operation. A free-air flow environment is required around the resistor enclosure with a recommended minimum of approximately 250mm.

c) Safe Working

High Temperature–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.
Equipment or combustible materials must not lie on the top cover of the enclosure or be in contact with the sides.

3-2- Installation Stages

- A flat foundation is required.
- The Neutral Grounding Resistor is supplied assembled.
- No special tools are required.
- Lifting equipment must be capable of lifting the NGR weight is given on the rating plate.
- Place the Neutral Grounding Resistor on the prepared base.
- Remove front and back covers.
- Drill gland plate as required.
- Check fixing integrity of resistors.
- Examine for signs of damage during transit (i.e., check that the both enclosure and support structure are undamaged). It means that there are no broken insulators and the resistor elements are secured on their mountings.
- Secure the Neutral Grounding Resistor on to its base. For a concrete base, use expanding bolts or rag bolts which penetrate at least 100mm in to solid ground.
- Ensure that all connections are tight.
- Refit back cover.
- Connect incoming cable.
- Carry out commissioning checks as detailed below.
- Connect outgoing cable (Resistor Earth).
- Refit front cover.
- Connect enclosure earth bonding cables as required.
- Check all enclosure bolts are tight.

Table 3. Tightening Torque

	Torque N-m	
Size	**Stainless Steel bolts& Screws**	**Bushing connections**
M6	**7.2**	**-**
M8	**17.6**	**-**
M10	**35**	**14**
M12	**61.2**	**20**
M16	**152**	**25**
M20	**296.4**	**35**
M24	**512.8**	**45**

4-COMMISSIONING

4-1- Measuring the cold resistance value

Check resistance value, this must be the value stamped on the rating plate ±10%. If the ambient temperature exceeds 20°c, the following temperature correction formula must be used:

$R_T =$ $R_{20°C}(1 + \alpha \times (T - 20))$
T: Actual ambient temperature
$R_{20°c}$: Resistor value at 20 °C
R_T: Resistor value at T °C
α: Temperature coefficient

4-2- Measuring Insulation under DC Voltage

With earth connection disconnected check insulation resistance, this should be greater than 100MΩ (dependent on site levels of humidity).

Note: If the Earth Bushing is on the outside of the enclosure, the maximum applied potential shall be 10kV.

4-3- Current Transformer(s)

When connecting the Resistor's Terminals, Connect the terminals S1 & S2 of the Current Transformer secondary side to the Appropriate Control Panel's Terminals.

- Do not forget to ground one of the two (2) terminals (usually S2)
- Do not energize Current Transformers with the secondary winding open circuit.

4-4- Earth Cable

Reconnect earth cable

NOTE:

- When removing covers and gland plates etc. ensure all screws, nut, washers etc. are refitted on re-assembly.
- Note that during the first energizing, some safe smoke may exhaust from the resistor. This will not affect the resistor.

5- DE-COMMISSIONING

- Ensure the equipment is isolated and that the reminder of any electrical system it formed part of can function safely without the Neutral Grounding Resistor in circuit.
- Remove cable box cover, disconnect and remove incoming cable.
- Remove outgoing earth and bonding earth cables.
- Remove foundation bolts.

6- MAINTENANCE

The equipment must be completely isolated from the power supply before any maintenance is carried out.

6-1 Routine Maintenance

A little maintenance is required on this equipment, but maintenance inspection should be carried out at regular periods to ensure that the equipment is kept in a good and reliable condition i.e. atmospheric pollution, safe access to the equipment etc. but initially could be on a 6 monthly basis.

- Access to the resistor units is obtained by removing the front or back cover and lifting the cover away.
- Remove cable box cover.
- Remove all dirt from cable termination and porcelain insulators. They must be wiped off, using a duster and a rapidly evaporating thinner (not water!) Any contamination must be immediately removed.
- Check that all connections are sound and that fixing nuts and screws are tight.
- Inspection Enclosure for damage to paint finish, if applicable, and make good any damaged areas.
- Check that the support insulators and bushings are not broken. Identify and replace the cracked or broken insulators and bushings.
- After inspection, ensure that the covers of the enclosure are securely fastened in position.

6-2 Maintenance after a System Fault

It is necessary to wait for 30 minutes after power cut off to allow the resistor active parts and the frame to cool. Remove end covers and check:

- That the support insulators are not broken.
- That the Resistor Elements are undamaged. Whilst they will show signs of having been very hot, they should not be distorted and the ceramic supports should not be cracked or disintegrating.
- That the incoming cable connection is sound. Also check the earth connections from the resistor and the frame.
- Check that all fastenings are tight and refit covers.