Electricity Distribution

nationalgrid

Company Directive

STANDARD TECHNIQUE: TP21C

Equal Potential Gratings for Structure Mounted Switchgear at Primary Network Substations

Summary

This standard technique document describes the requirements for equal potential gratings for structure mounted switchgear at primary network substations. Equal potential gratings are employed to control the touch potential.

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	Policy Manager
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All references to Western Power Distribution or WPD must be read as National Grid Electricity Distribution or NGED

Document Revision & Review Table		
Date	**Comments**	**Author**
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1.0 INTRODUCTION

This standard technique document describes the requirements for equal potential gratings for structure mounted switchgear at primary network substations.

An equal potential grating is an electrically conductive mat which a person stands upon when operating structure mounted switchgear. The grating is electrically connected to the switch handle mechanism which ensures that the person operating the switch has their hands and feet at the same potential should a fault occur when switching. Equal potential gratings are also known as stance gratings.

In some WPD licence areas it has been customary practice to install concrete equipotential gratings. This approach is to be discontinued because of the advantages offered by steel lattice gratings, namely:

- Larger surface area so operators are more likely to stand with both feet on it
- Easily formed into larger gratings for switchgear with “walk-around” handles
- Easily cut to size around obstacles
- Much lighter than the concrete ones – a single person lift
- Its condition can be easily assessed
- Cost

2.0 DEFINITIONS

For the purpose of this document the following definitions apply:

Primary Network Substation A 132kV, 66kV, 33kV or 25kV substation

3.0 DESIGN REQUIREMENTS

3.1 General

An equal potential grating shall be installed at every disconnector, earthing switch and fault throwing switch position and shall be electrically connected to the switchgear handle mechanism.

3.2 Gratings

Gratings shall have the following specifications:

- Manufactured from steel which has been hot dipped galvanised in accordance with BS EN ISO 1461 (2009)
- Overall dimensions 1000mm x 1000mm x 30mm
- Pressure welded mesh comprising of 30mm x 3mm load bars at 44mm centres and 10mm x 2mm serrated transverse bars at 44mm centres
- Edged on all four sides with 30mm x 3mm flat bar.
- Each edge bar to have five slotted bolt holes 11mm diameter x 28mm long

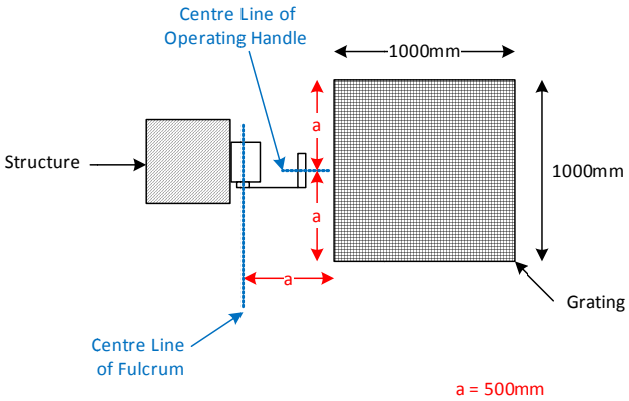
Gratings shall be placed where the operator stands or walks when operating the switchgear and shall be sufficiently large enough that the operator's feet remain on it at all times. The layout required depends on the form of switchgear.

3.2.1 Operating Handle Which Rotates In The Vertical Plane

An example of switchgear with an operating handle which rotates in the vertical plane is shown in the photograph below. The operating handle rotates around the mechanism in an up-down motion.

An operator stands in a fairly stationary position whilst operating the switchgear and consequently a single 1m x 1m grating shall be provided. The grating shall be aligned centrally relative to the sweep of the operating handle, with the closest edge located 500mm horizontally from the fulcrum.

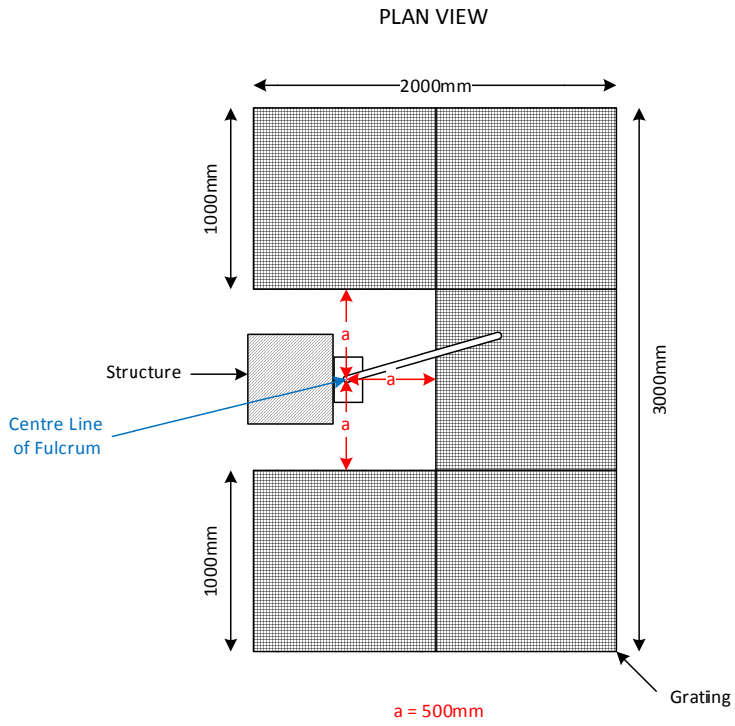
PLAN VIEW



3.2.2 Operating Handle Which Rotates In The Horizontal Plane

An example of switchgear with an operating handle which rotates in the horizontal plane is shown in the photograph below. The operating handle rotates around the mechanism in a side-to-side motion.

An operator "walks around" whilst operating the switchgear and consequently five 1m x 1m gratings connected together to form a "C" shape shall be provided. The gratings shall follow the sweep of the operating handle, with the closest edges located 500mm horizontally from the fulcrum.



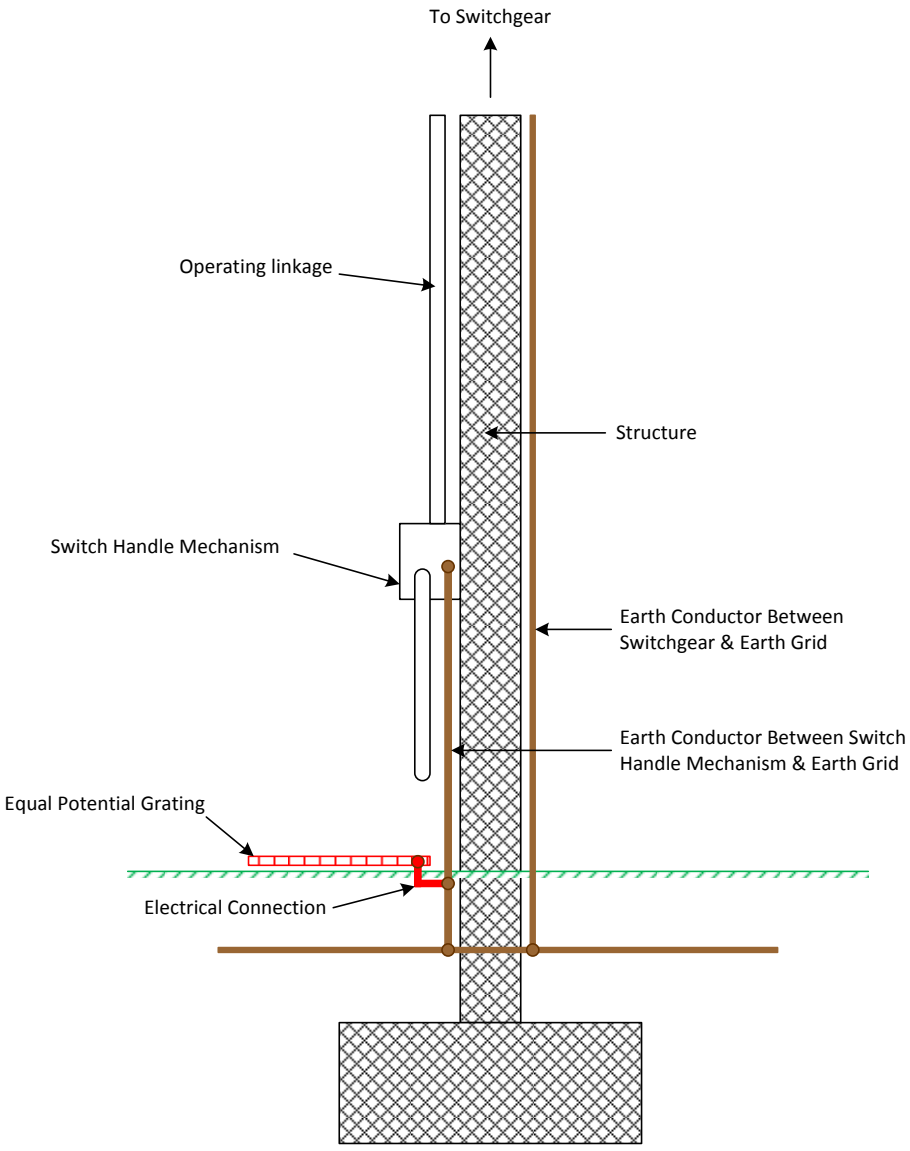
3.3 Electrical Connections

The switchgear and the switch handle mechanism shall be connected to the substation earth grid using separate earth conductors - the sharing of an earth conductor is not acceptable. Modification of the earth conductor connections to comply with this requirement may be necessary where existing gratings are being replaced.

The grating shall be electrically connected to the earth conductor connecting the switch handle mechanism to the earth grid. There shall be no supplementary connections to other parts of the substation earth grid.

There shall be no inadvertent contact between the grating and any other earthed metalwork, for example, where gratings are installed around pipework.

The aforementioned requirements are to ensure that any fault current flowing down from the switchgear to the earth grid does not flow via the connection to the switch handle mechanism, or through the grating itself.



Two connections shall be provided at the grating end of the electrical connection when five gratings are connected together to form a composite grating, one at each end of the “C”.

The connection shall be made using copper earth tape with a cross section of not less than 25mm x 3mm and must be visible for its entire length in order than an operator can check its presence / integrity prior to carrying out a switching operation. In order to avoid creating a tripping hazard it acceptable for the connection to be buried beneath a light covering of stone chippings which can be readily moved by an operator.

Suitable precautions shall be taken to ensure there are enduring, low resistance connections between the copper earth tape and the grating, and also between individual gratings where several are connected together to form a composite mat.

The overall resistance, measured between the grating and the switchgear operating handle, shall be no greater than 0.020 ohms (i.e. 20 milli-ohms or 20,000 micro-ohms).

4.0 INSTALLATION REQUIREMENTS

4.1 Materials Required

4.1.1 General Requirements

Shops Code	Description
50547	Steel lattice grating - 1m x 1m
51155	Copper tape 40mm x 4mm
Direct purchase	Copper flow brazing rod

4.1.2 Additional Requirements For “C” Shape Mats

Shops Code	Description
51911	Stainless steel bolt M10 x 25mm (pack of 100)
51912	Stainless steel nut M10
51913	Stainless steel washer M10
51914	Stainless steel spring washer M10
50891	Switch contact grease (1kg tin)

4.1.3 Additional Requirements For Gratings Cut Around Pipework And Other Protuberances

Shops Code	Description
33578	Cold galvanising spray paint

4.1.4 Additional Requirements For Mats Installed Above Concrete Constructions

Shops Code	Description
50548	Fixing spike for grating
Direct purchase	Hook –bolt
Direct purchase	Epoxy resin concrete fixing system
Direct purchase	Post hole concrete mix

4.2 Installation Instructions

4.2.1 Preparation

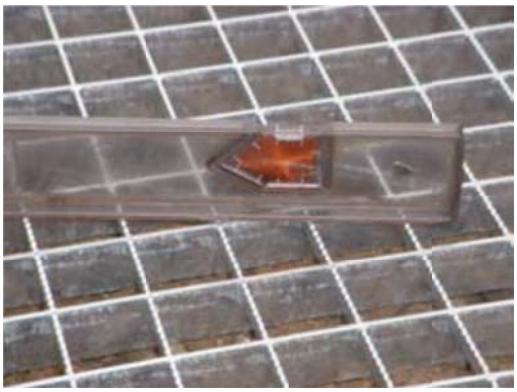
- Identify the form of the switchgear (walk-around or up-down operation).
- Determine the size and shape of grating required (single or “C” shaped grating).
- Establish the position of the grating by measuring 500mm (±50mm) horizontally from the handle fulcrum position. In practice it is probably easier to first measure the horizontal distance “X” between the fulcrum and the structure, and then measure 500mm + X from the structure.

- Check for obstacles such as trench covers, footings, pipework etc.

4.2.2 Grating Installation – General

- Remove the chippings from an area a little larger than the grating footprint.

- Create a level base 30mm below the finished level of the chippings either by reinstating some of the removed chippings or by excavating some of the subsoil (as appropriate, depending upon the depth of the chipping layer). Place the grating in position, checking that it is 500mm (±50mm) horizontally from the handle fulcrum position and that it is level in all directions. Check that there is no inadvertent contact between the grating and any other earthed metalwork.

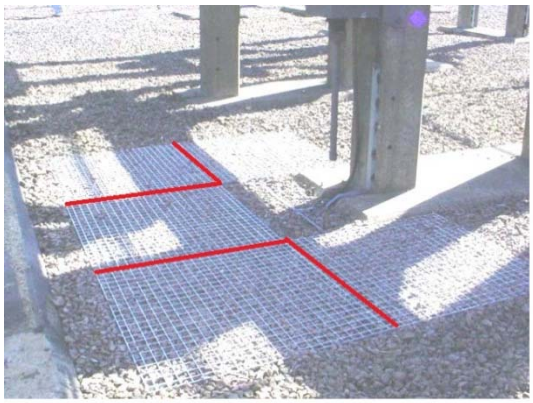


Reinstate the chippings around the side of the grating in order to hold it in position. The grating should, so far as is reasonably practicable, be "flush-fit" with the surface of the chippings so that it does not present a tripping hazard.

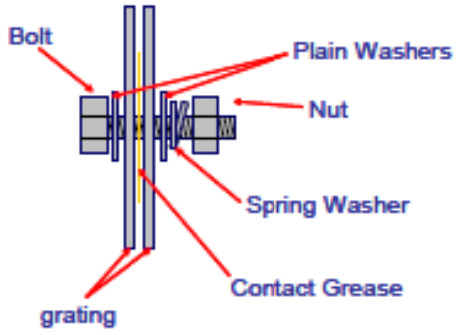
Fill the grating with chippings for further stability.

Grating Installation – “C” Shaped Mats

- Apply contact grease to the mating edges of the gratings (i.e. to the sides marked in red on the following photograph) before bolting together.

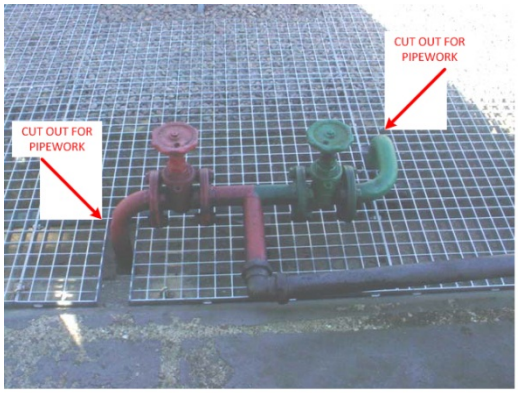


- Bolt the individual gratings together using five stainless steel fixings per side. The fixing arrangement shall be as per the following sketch.



4.2.3 Grating Installation – Pipework and Similar Protuberances

- The grating should be cut around pipework and other similar above-chipping protuberances. When fitting a grating around pipework or other earthed metalwork, sufficient material should be removed in order to ensure there is no inadvertent contact between the two. The pressure-welded construction of the grating means that load and transverse bars which have been cut do not become loose but remain securely affixed.
- Parts of the grating which are damaged by cutting shall be protected by the use of zinc-rich cold galvanising paint. Sufficient paint shall be applied to provide a coating at least equal in thickness to the original layer.



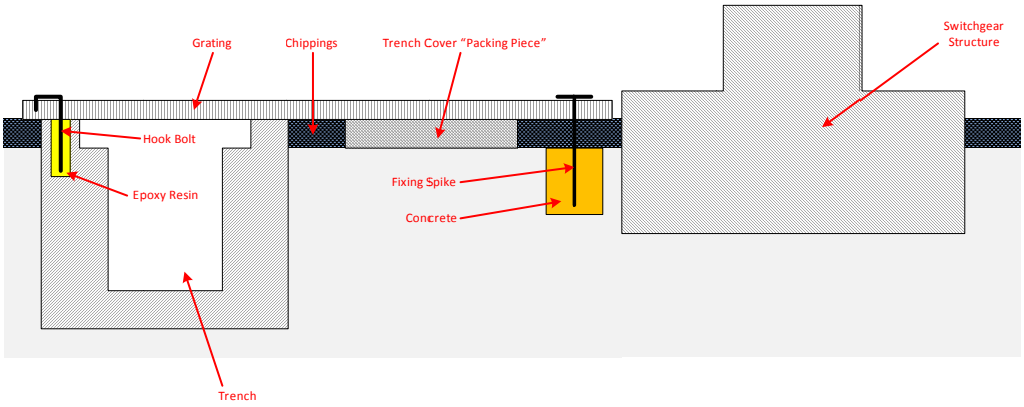
4.2.4 Grating Installation – Cable & Pipe Trenches

The grating should be installed on top of the trench, making sure it covers the full width. The grating will not have chippings packed around its edges or as an infill within its mesh and therefore will have a tendency to slide along the trench. Consequently additional means of fixing it in position are required.

- Remove the trench covers and chippings where they are situated below the prospective position of the grating.
- In the area where the chippings have been removed, create a level base the thickness of a trench cover below the finished level of the trench, either by reinstating some of the removed chippings or by excavating some of the subsoil (as appropriate, depending upon the depth of the chipping layer).
- Place the redundant trench covers on the levelled area, where they will act as a packing piece to level the grating.
- Dig small “post” holes along the side of the trench cover “packing pieces” which is remote from the trench. The holes shall have a size which is suitable for the grating fixing spike.
- Drill holes in the side of the trench of a diameter suitable for the hook-bolt fixings.
- Place the grating in position, checking that it is 500mm (±50mm) horizontally from the handle fulcrum position and that it is level in all directions.

- Secure the grating in position using the hook-bolts and fixing spikes. Epoxy resin should be used to fasten the hook-bolts into the drilled holes, and concrete should be used to secure the fixing spike into the post holes.
- Reinstate the chippings around the sides of the trench cover packing pieces and the grating (except where it passes over the trench), making the grating as “flush-fit” as far as is reasonably practicable. Fill the grating (except where it passes over the trench) with chippings.

Note: It will not be possible to prevent a slight tripping hazard where the grating passes over the trench. The trip hazard will be no worse than the multitude of others that are present in a substation compound, which equally, are not reasonably practicable to eliminate.



4.2.5 Installation of the Electrical Connection

- Drill a fixing hole at one end of the earth tape and tin

- Apply contact grease to the end of the earth tape and bolt to the grating

- Two connections are required on “C” shaped gratings, one at each end

- Braze to the earth tape going direct to the switch handle mechanism. The brazing should be in accordance with the requirements of Standard Technique ST: TP21L Fixed Earthing Systems - Construction Techniques – Jointing.

- The electrical connection should be readily visible for inspection. If the connection is likely to present a tripping hazard then it should be lightly covered with chippings in order to reduce the risk. The chippings should be able to be easily removed by hand so that an operative can verify the presence of the connection prior to carrying out a switching operation. If the electrical connection is not covered by chippings, then it should be painted grey to deter theft.

5.0 TESTING REQUIREMENTS

This section should be read in conjunction with Standard Technique ST: TP21O Measurements Associated with Earthing Systems.

The following tests shall be carried out on completion of the installation works:

5.1 Joint Resistance Test

The resistance shall be measured across each earth conductor joint to check its electrical integrity.

This measurement shall be performed on every joint created, including:

- Bolted joints between individual gratings

- Bolted joints between a grating and an earth conductor
- Bolted, brazed or welded joints between discrete earth conductors
- Bolted joints between switchgear and an earth conductor
- Bolted joints between a switch handle mechanism and an earth conductor

5.2 Bonding Test

The resistance shall be measured between an individual item of earthed equipment and the substation earth electrode in order to verify that it is effectively connected to the earth electrode system.

This measurement shall be performed on the following items irrespective of whether or not their earth connection has been newly created, modified, or disconnected and reconnected:

- The earth connection between the switchgear and the earth grid
- The earth connection between the switch handle and the earth grid
- The earth connection between the equal potential grating and the switch handle

Note: The last two bullet points state "the switch handle", not "the switch handle mechanism"

APPENDIX A

SUPERSEDED DOCUMENTATION

None

APPENDIX B

ANCILLARY DOCUMENTATION

POL: TP21	Fixed Earthing Systems
ST: TP21B	Design and Installation of Fixed Earthing Systems - Major Substations
ST: TP21L	Fixed Earthing Systems - Construction Techniques - Jointing
ST: TP21O	Measurements Associated with Earthing Systems
ST: OS2G	Response following Loss of Substation Earthing Equipment
EE SPEC: 89	Fixed Earthing Systems for Major Substations

APPENDIX C

IMPLEMENTATION

The requirements of this Standard Technique shall be implemented whenever:

- New structure mounted switchgear is installed
- Existing structure mounted switchgear equipped with an alternative form of equal potential grating is relocated
- It is necessary or prudent to replace an existing equal potential grating

Where any difficulty is encountered in the application of this policy, the company's Technical Policy Manager should be notified, who will consider whether an application specific concession or an amendment to this document is appropriate.

APPENDIX D

IMPACT

This standard technique is relevant to staff responsible for the design, construction and maintenance of earthing systems at primary network substations.

APPENDIX E

KEYWORDS

Earthing, touch potential, switchgear, stance grating, equal potential gratings