

Engineering Procedure  
Electrical Distribution Unit

PR D 78205

# Inspection and Care of Portable Earthing Equipment for the High Voltage System

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# Procedure

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## Document control

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	28 July 2015	Chris Leung	First issue as a Sydney Trains document, rebranded from previous RailCorp SMS-06-EN-0564 V1.3
1.1	19 February 2019	Nick Loveday	Updated PR D 78205 "Approved by" to Associate Director Electrical Distribution Unit

## Summary of changes from previous version

Summary of change	Section

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## 1. Purpose and Scope

The purpose of earthing and short-circuiting equipment is to:

- short circuit and conduct to earth any induced voltages,
- cause protection equipment to operate as rapidly as possible and provide maximum protection to electrical workers if the cable, line or equipment is energised unintentionally.

Portable earthing equipment consists of assemblies of insulated flexible cables and clamps and, if necessary, suitable insulated handles or sticks, which are used for earthing and short-circuiting high voltage cables, high voltage aerial lines, or other high voltage (HV) electrical equipment.

This procedure sets out the requirements for the inspection, testing, maintenance, storage and disposal of portable earthing equipment for the HV System.

The portable earthing equipment covers earthing sets commonly known as:

- Substation Earthing Sets,
- Aerial Line Earthing Sets.

This procedure applies to all certified Electrical workers trained and assessed to be competent in the use of portable earthing equipment for the high voltage system.

The purpose is to ensure that such workers are aware of, and comply with, the requirements for the correct treatment of portable earthing equipment.

## 2. Definitions

### 2.1. “Substation Earthing Set”

A set of earthing equipment used to electrically connect isolated high voltage equipment within RailCorp’s substations to earth. Substation Earthing Sets have only three earthing heads and the cables come together at a plate designed for direct connection to an earthing point.

### 2.2. “Aerial Line Earthing Set”

A set of earthing equipment used to electrically connect isolated high voltage aerial conductors together (including overhead earth wire, where installed) to earth. Aerial Line Earthing Sets are suitable for earthing up to 4 conductors and are provided with a single long down lead to reach from the pole top to the ground.

## 3. Configuration of Earthing Equipment

### 3.1. Substation Earthing Sets

The Substation Earthing Set consists of three insulated sticks and three separate cables (1 per phase) joined on a trifurcating plate.

The trifurcating plate has a 14mm hole suitable for connection to a substation earth point. Refer to drawing EL 0002904.



**Figure 1 – Example of Installed Substation Earthing Set**

### **3.2. Aerial Line Earthing Set**

The Aerial Line Earthing Set is suitable for connecting between a driven earth spike and/or permanent earth, several phase conductors, and an aerial earth wire if present.

The configurations of aerial line earthing sets are either:

- Serial connected arrangement, or
- Star connected arrangement.

The serial connected arrangement is where all four sticks and their corresponding cables are connected in series, with one cable being longer to connect onto the earth spike at ground level. Refer to the drawing EL 0004239.

The star connected arrangement is where the down lead is electrically connected to a parking bar, from which 4 cables radiate to the four sticks. Refer to the drawing EL 0027468.



**Figure 2 – Example of Installed Aerial Line Earthing Set**

### 3.3. Identification and Labelling

Each major component of the complete portable earthing set is to be clearly and indelibly labelled with a unique identifier as follows:

- 1) Substation Earthing Sets – as illustrated in EL 0002457.
- 2) Aerial Line Earthing Set – as shown in EL 0027469.

It is important that the identification of each major component of the earthing set remains intact during the life of the equipment, as it shall be referred to and recorded when routine tests are performed to determine the integrity of the earthing set.

The equipment shall be marked to identify its rated current/rated time classification as follows:

- Substation Earthing Sets - 24kA for 0.5 seconds.
- Aerial Line Earthing Sets - 16kA for 0.5 seconds.

The fault ratings indicated above are the minimum permissible ratings. Equipment with ratings lower than the minimum permissible shall not be used. Portable earthing sets with higher ratings shall be correctly marked to reflect their actual ratings.

The complete portable earthing equipment shall be clearly and indelibly labelled with a "Six Month" and "Three Year" label indicating, at a minimum, the Company/person who conducted the inspection and the respective next, six month or three year, inspection date.

## 4. Inspection and Testing of Earthing Sets



*Warning*

*All current carrying components of portable earthing equipment are to be destroyed immediately after it has sustained fault conditions.*

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### 4.1. Care and Storage

All aerial line earthing sets should be stored in their own carry bags. These bags are to be made of a durable material such as canvas or heavy duty woven synthetic material, to protect the earthing sets during storage and transport to work sites.

Substation earthing sets that are stored indoors should be hung on designated racks with sufficient room for safe and easy removal and installation of the earthing sets.

### 4.2. Inspection before each Use

Each time before use, the portable earthing equipment shall be inspected for any visible or obvious outward sign of damage, deterioration, or faulty connections. Cable terminations or connections shall not be taped, as this prevents checking for broken strands. The preferred method for termination support is using clear glue lined (waterproof) heatshrink over terminations as this should allow the visual inspection of the cable condition and terminations to be undertaken. Glue lined heatshrink is required to prevent any moisture entering the termination.

Particular attention should be given to ensure that:

- the inspection label is attached, and that the earthing set is within the indicated due dates for both the six monthly and three yearly inspections. If there is no inspection label attached to the earthing set, it shall pass both the six monthly and three yearly inspections and be labelled accordingly before being used.
- the bolted connections are tight,
- there are no visible signs of corrosion,
- there are no broken strands or stressing of cable at the cable/lug interface, and
- the moving parts are in sound condition – freedom of movement, thread condition and ease of use.
- the sticks are generally in good condition and clean – check for any ingress of moisture.

If any defect is found with the equipment inspected, it shall be withdrawn from service and not used until satisfactorily repaired.

### 4.3. Six-Monthly Inspection

Every six months and irrespective of any other inspection or test, the portable earthing equipment shall be inspected as follows:

- Inspections as detailed in Section 4.2, and
- Checking that the identification and inspection label detailed in Section 3.3 is clear and legible.
- Results of the inspection shall then be recorded on the Inspection Record Sheet, refer *PR D 78205 FM 01 'Inspection Record Sheet'* and the appropriate inspection label placed on the earthing set, indicating due date for the next inspection.

### 4.4. Three-Yearly Inspection

Every three years and irrespective of any other inspection or test, the portable earthing equipment shall be inspected as detailed in Section 4.2 and *either*:

- all heatshrink tubing or other termination support is removed and the outer strands of the cable inspected at each termination. The removal of this material shall be achieved without damaging the cable. There shall be no broken strands and no visible corrosion or signs of overheating. After successful inspection, the termination support shall be renewed to the same specification as originally fitted. If the inspection was unsuccessful, that is there are broken strands, visible corrosion or signs of overheating then the termination shall be cut off and re-terminated as detailed in Appendix A, *or*
- re-terminated at each clamp as detailed in Appendix A of this document. This method involves the cutting, inspection and re-termination of the cable terminations.

**NOTE:**

*All aluminium conductor earthing sets shall be re-terminated at least every 6 years from either the purchase date or when last re-terminated. All re-terminations shall be carried out in accordance with Appendix A and the manufacturers' instructions and recommendations, and shall use identical or equivalent components. Such re-terminations are to be recorded under the "Comments" column of PR D 78205 FM 01 'Inspection Record Sheet'.*

- Results of the inspection shall then be recorded on the *PR D 78205 FM 01 'Inspection Record Sheet'*, and the appropriate inspection label be placed on the earthing set, indicating the due date for the next inspection.

## **4.5. Records**

Inspection records shall be kept until 12 months after the item is permanently removed from service.

## **5. Inspection of Sticks**

### **5.1. General**

The following requirements for the inspection of earthing sticks refer specifically to dedicated sticks being an integral and permanent component of the earthing set. These dedicated type sticks are not to be used for any purpose other than applying earth sets.

If the dedicated sticks can be detached from the portable earthing clamps they shall be clearly labelled to ensure they are not confused with any non-dedicated sticks. The words "FOR EARTHING ONLY" shall be clearly visible on each of the detachable sticks in the set and be in the same type, size and BOLD font and put under clear heatshrink material in the same fashion as the unique identification number.

### **5.2. Inspection before each Use**

Refer to the relevant elements in Section 4.2

### **5.3. Six-Monthly Inspection**

Refer to the relevant elements in Section 4.3.

### **5.4. Three-Yearly Inspection**

Same requirements as for Section 4.4 above.

### **5.5. Non-dedicated Sticks**

Detachable sticks that do not form an integral part of the earthing equipment may also be utilised for applying the portable earths. Such non-dedicated sticks may also be used as operating sticks or rods.

Since such sticks can make contact with live high voltage conductors, they shall comply with all the requirements, including those for in-service inspections and tests, as stipulated in PR D 78107 Inspection, Testing, Care and Maintenance of Insulated Sticks and Tools for Electrical Equipment.

## **6. Defective Equipment**

If in the course of inspection or use an item is found to be defective, it shall immediately be removed from service. The person removing the item from service shall affix a "DANGER- DO NOT USE" tag to the item. The tag shall describe the defect of concern.

The supervisor shall then decide if the item is to be repaired or destroyed.

Items that cannot be repaired shall be destroyed or disabled so they cannot be used.

The item shall not be used or re-issued for use until it has been repaired and successfully re-tested or re-inspected.





**Warning**

*The "DANGER - DO NOT USE" tag shall not be removed before the defective item has been repaired or destroyed.*

## 7. References

ISSC 14 Guide to electrical workers' safety equipment (October 2010)

EP 95 10 00 06 SP Requirements for Portable Earthing Equipment for the High Voltage System

PR D 78107 Inspection, Testing, Care and Maintenance of Insulated Sticks and Tools for Electrical Equipment

PR D 78205 FM 01 'Inspection Record Sheet', Inspection of Portable Earthing Equipment for the High Voltage System

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## Appendix A Re-termination Procedure of Portable Earthing Equipment

### (1) Scope

This Appendix sets out the re-termination procedures for portable earthing equipment, including the method of making a physical inspection of the flexible cable terminations.

### (2) Principle

Cable terminations are cut off and the cable insulation and strands examined. They are suitable for re-termination if found to be satisfactory.

### (3) Procedure

The procedure is as follows:

- (a) Cut the cables at or beyond the end of any termination support, eg heatshrink tubing or stress control clamp.
- (b) Inspect the cable insulation.
- (c) Strip off enough cable insulation to allow careful inspection of the conductors by unwinding the individual strands.

If more than 1% of the conductor strands are broken, or the strands are significantly oxidised, or the insulation is cracked or wrinkled, the cable is failed. If this damage is localised, the cable may be cut further back and the assessment repeated.

- (d) If the cable is satisfactory, then the cable may be re-terminated so that the new terminations are exactly the same as the originals.

### (4) Report to Supervisor

Report the condition of the insulation and the proportion of broken conductor strands, via the use of *PR D 78205 FM 01 'Inspection Record Sheet'*. The cable is rejected if cracks or wrinkles are visible in the insulation, or if more than 1% of the conductor strands are broken.

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