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Module 10

Use of Voltage Testing Devices, Portable Earthing Equipment and Temporary Continuity Jumpers

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1 Purpose

This module provides a consistent approach to using voltage testing devices, portable earthing equipment and temporary continuity jumpers on 25 kV a.c. electrified lines.

NOTE: Further requirements for working on or about the electrified lines are contained in the Rule Book Module AC (GE/RT8000/AC and Handbook HB16 (GE/RT8000/HB16)).

2 Scope

This module states the requirements when using voltage testing devices, portable earthing equipment and temporary continuity jumpers on 25 kV a.c. electrified lines.

The requirements for assembly, maintenance and care of voltage testing devices, portable earthing equipment and temporary continuity jumpers are stated in Network Rail standard NR/L3/ELP/27237.

It is applicable to Network Rail personnel and to Network Rail's contractors.

To provide a consistent approach to working on or about 25 kV a.c. electrified lines, Train Operating Companies may, as best practice, apply this standard in full on infrastructure they control.

This Standard also includes:

- Work on or about any future sections of electrification on Network Rail controlled infrastructure and areas required to adopt a process for securing points of disconnection to form points of isolation to use the Supplementary Isolation Process (Module X).
- Planning of isolations, testing and earthing of overhead line equipment on Network Rail controlled infrastructure equipped with 750V d.c. overhead line system (Sheffield Tram Train - Module Y).
- Planning of isolations, testing and earthing of overhead line equipment on Network Rail controlled infrastructure equipped with 1500V d.c. overhead line system (Sunderland Metro Systems Operating Area – Module Z).

3 General

When overhead line equipment has been isolated but not earthed it can still be at a dangerously high voltage as a result of:

a) re-energisation at 25 kV due to the inadvertent closure of a circuit breaker or an electric train running into the isolated overhead line section; **or**

b) induction from adjacent live OLE or from nearby overhead transmission power lines.

When the isolated OLE is earthed in accordance with this standard, the voltage cannot rise to a dangerous value.

It is important, therefore, that the method of application and removal of portable earths and temporary continuity jumpers is carried out in accordance with this module.

Voltage testing devices, portable earthing equipment and temporary continuity jumpers shall be product approved, and shall be used only by persons who have been trained and are competent in their use.

Voltage testing devices and insulated earthing poles shall not be used unless they have a current test certificate.

Before use, the user shall visually inspect any voltage testing device, portable earthing equipment and temporary continuity jumper intended to be used, to verify that they are suitable for use. Any defective, suspect or out-of-date item shall not be used. Portable earths or temporary continuity jumpers that have been subjected to short-circuit current shall not be used.

During use prevent earthing poles, portable earths and temporary continuity jumpers from coming into contact with adjacent live equipment.

When using portable earthing equipment, temporary continuity jumpers and voltage testing devices do not compromise the minimum clearance of 540 mm (1 foot 9 inches) between catenary conductors and autotransformer conductors.

When portable earths or temporary continuity jumpers are to remain in the OLE over a long period, they shall be replaced at appropriate intervals so that they remain effective.

4 Voltage Testing Devices

When overhead line equipment is tested, the voltage testing device shall be assembled, maintained and inspected prior to use in accordance with Network Rail standard NR/L3/ELP/27237, be product approved and have a valid test certificate. The operating instructions specific to the voltage testing device shall also be followed.

Testing shall be conducted a minimum of 3m along the conductor from OLE structures and/or in-line insulation to minimise electro-magnetic interference where there is sufficient conductor length. Where 3m is not possible a-resistive voltage testing device shall be used.

NOTE 1: Any self-check test on a voltage testing device is not sufficient on its own to confirm the functionally of the device to correctly indicate the status of the OLE.

NOTE 2: Some manufacturers describe a voltage testing device as a Live Line Indicator (LLI).

5 Portable Earthing Equipment

5.1 Portable Earths

Portable earthing of OLE shall be carried out by the application of short portable earths at designated earthing points or long portable earths in unavoidable circumstances when their use is justified in accordance with Module 10 clause 7.5.

NOTE 1: for instance unavoidable circumstances:

a) when a broken conductor has to be earthed and there are no suitably located designated earthing points; or

b) where a designated earthing point is found to be defective and there is no other suitably located designated earthing point.

Portable earths are classified as either a Circuit Main Earth (CME) or an Additional Earth.

Duplicate product approved portable earths meet the requirements of a CME.

A single product approved portable earth meets the requirements of an Additional Earth.

Where portable earths are required to pass continuous or traction current, the clamps shall be of the screw type.

NOTE 2: Snap-on clamps are unsuitable for these conditions.

5.2 Earthing Poles

Earthing poles shall be approved, assembled, tested and used in accordance with their specific instructions.

6 Temporary Continuity Jumpers

Temporary continuity jumpers shall be capable of carrying the short-circuit current and traction current appropriate to the duty. Where jumpers are required to pass continuous or traction current, the clamps shall be of the screw type.

NOTE: Snap-on clamps are unsuitable for these conditions.

7 Application and Removal of Portable Earths

7.1 Application of Short Portable Earths

The structure-to-rail bond at the designated earthing point shall be visually checked to verify that it is intact. Where the bond is buried, it shall be tested to verify its electrical continuity.

Where an earth wire is installed, a visual check shall be made to verify that the earth wire and its connection(s) to the traction return rail are intact. Where a connection is buried, it shall be tested to verify its electrical continuity.

If the structure-to-rail bond or the earth wire connection(s) is damaged, it shall be reported to the ECO. An alternative bond to the traction return rail shall be provided.

Before portable earths are applied, the overhead line equipment or autotransformer feeder shall be tested using an approved valid live line indicator.

The earth end connection of the short earth shall always be made BEFORE the line end is connected to the overhead line equipment.

NOTE: This is essential for personal electrical safety.

Both the earth end and line end clamps shall be applied using an earthing pole.

Where a line guard is fitted to protect an overhead line conductor mechanically, the clamp shall be applied only to the line guard and not directly to the conductor.

Where screw clamps are used, they shall be checked for tightness using an earthing pole.

7.2 Removal of Short Portable Earths

Remove the line end connection of the short earth BEFORE the earth end is broken.

NOTE: This is essential for personal electrical safety.

Both the line end and earth end clamps shall be removed using an earthing pole.

7.3 Application of Long Portable Earths

a) Only interlocking long portable earths of the approved type shall be used.
b) Visually check that the structure to rail Bond is intact. Where the Bond is buried it shall be tested to verify its electrical continuity. Where Earth wire is installed, visually check the Earth wire and related connection(s) to the traction return rail are intact.
c) If application is to be made to a painted surface, sufficient paint shall first be removed to allow good electrical contact between the clamp and the steelwork.

NOTE 1: It is the anvil of the earth end clamp which is the electrical contact, not the point of the screw

d) If application is to be made directly to the OLE, measures shall be taken to mitigate the risk of the Earth becoming disconnected during the works. Earths shall be positioned such that they are not at risk of being struck by On-Track Plant or Machines.

NOTE 2: Long portable earths to be positioned clear of loading gauge.

e) Before use, examine the condition of each Earth (including the condition of the label). If damage is evident, the Earth shall not be used until repaired.
f) Long portable earths should be labelled at the clamp (earth) end with a visible label bearing the following legend: this clamp (earth) end to be applied first and removed last.
g) The Authorised Person who applies the earth end shall also apply the line end.
h) Where two or more Earths are to be applied within 3 metres of each other, the same Authorised Person shall apply all the Earths concerned.
i) If there is a mixture of short and long portable earths at the same location, the long portable earths shall be applied last.
j) The clamp (earth) end shall be applied **before** the line end.

NOTE 3: This is essential for personal electrical safety.

k) The earth end clamp shall be applied to the traction return rail or an overhead line structure by hand and tightened, checking that it is secure.
l) Apply the line end clamp using an earthing Pole. If the clamp is to be applied to stranded conductors, the clamp shall only be applied to the Line Guard provided.
m) When a screw clamp is used at the line end, check that the clamp is securely attached.

n) If the earth end clamp becomes detached whilst the line end clamp is attached, the earth end clamp shall be regarded as Live and shall not be approached or touched until the line end clamp has been removed and lowered to the ground using an earthing Pole.

7.4 Removal of Long Portable Earths

a) The Authorised Person who removes the line end shall also remove the earth end.
b) Where two or more earths are to be removed at the same time within 3 metres of each other, the same Authorised Person shall remove all the earths concerned. All line ends shall be removed before any earth end is touched.
c) If there is a mixture of short and long portable earths at the same location, the long portable earths shall be removed first.
d) The line end connection of the long portable earth shall always be removed **before** the clamp (earth) end is removed.

NOTE: This is essential for personal electrical safety.

e) The line end clamp shall be removed using an earthing Pole.
f) When the line end clamp has been lowered to the ground, the earth end clamp shall then be removed.

7.5 Additional Precautions to be Taken with Long Portable Earths

Long portable earths shall not be used unless authorised by the Electrification and Plant Maintenance Engineer (E&PME) or an electrically competent Designated Project Engineer (DPE) who shall satisfy themselves that the use is unavoidable and is justified. No person shall authorise their own use of long portable earths. With the exception of Return Conductor **only** earthing where the use of long portable earths shall be applied in accordance with clause 9.

NOTE: The Electrification and Plant Maintenance Engineer (E&PME) or Designated Project Engineer (DPE) may consider delegation through existing delegated authority arrangements.

As close as practicable to the time long portable earth is to be used, the Electrification and Plant Maintenance Engineer (E&PME) or an electrically competent Designated Project Engineer (DPE) shall remind the user of the safe method of use.

The person who applies the earth end clamp shall also apply the line end clamp. Similarly, the person who removes the line end clamp shall also remove the earth end clamp.

Where two or more long portable earths are to be applied or removed within the close vicinity of each other at the same time, the same person shall apply or remove all the long portable earths concerned. All line end clamps shall be removed before any earth end is touched.

8 Application and Removal of Temporary Continuity Jumpers

When it is necessary to apply temporary continuity jumpers after the overhead line equipment has been earthed, but before an overhead line permit has been issued, these jumpers shall be applied and subsequently removed using an earthing pole.

9 Earthing of Return Conductors with Long Portable Earths

At each of the designated earthing points at the limits for return conductor earthing only, a single long portable earth shall be applied between the traction return rail and the return conductor in addition to duplicate portable earths. Intermediate single portable earths shall be applied within the safe working limits in accordance with the requirements in Module 7. These long portable earths shall be removed along with the short portable earths during the process of cancelling the earthing.

NOTE 1: Long portable earths to be positioned clear of loading gauge.

Where portable earths are required to pass continuous or traction current, the clamps shall be of the screw type.

NOTE 2: Snap-on clamps are unsuitable for these conditions.