

Engineering System Integrity
Engineering Instruction
Electrical Engineering

EE 17-04 V3.0

OHW Structure to Rail Bonding – Rail Spark Gaps

This Engineering Instruction includes urgent engineering information. Adherence to the information in this Instruction is **MANDATORY**.

Date in Force: 27 October 2025

Date of Review: 27 October 2028

Approved by:

Jack Siu
Professional Head
Electrical Engineering

Authorised by:

Jonathon McKinnon
Engineering Technical
Publications Manager

Audience:

- Electrical Asset Engineers
- Electrical Construction Staff
- Electrical Maintenance Staff
- Earthing and Bonding Maintenance Staff
- Electrical Design Engineers
- Authorised Engineering Organisations
- Transport for NSW – I&S Electrical Staff
- ICON Electrical
- PAM Director Energy Networks and Systems

Main Points:

- Mark 3 Rail Spark Gap (DEHN) to be used as the preferred spark gap arrangement for 1500 Volt OHW Structures.
- Work on Rail Spark Gaps to be in accordance with *PR D 78303* Electrical Engineering Document.
- Mark 3 Rail Spark Gap installation Megger Test required.
- Unit to be sprayed with “Cold Gal” to deter theft.

Primary Affected Document: **PR D 78303 Work on 1500 Volt Negative Equipment Outside Substations**
PR D 78306 1500 Volt DC Overhead Wiring Structure to Rail Voltage Test
SWMS D2013/80641 Structure Bond Testing and Maintenance

OFFICIAL

Disclaimer

This document was prepared for use by Sydney Trains and its intended recipient. The information in this document is protected by copyright and no part of this document may be reproduced, altered, stored or transmitted by any person without the prior consent of Sydney Trains. Errors or omissions in this document should be reported to sydneytrainsstandards@transport.nsw.gov.au. Sydney Trains makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems or work or operation.

Document Control

Version	Date	Summary of change
3.0	27/10/2025	ASA updated to PAM (Prioritisation and Asset Management)

Scope

This Engineering Instruction (EI) introduces into use and provides installation and maintenance requirements for the new DEHN Rail Spark Gap and renaming of the existing Rail Spark Gaps used for Bonding 1500 Volt OHW Structures to rail.

This Engineering Instruction supersedes *Engineering Instruction EI E 17/01, Electrical Technical Notes ETN 04/05* and for Rail Spark Gaps only *ETN 09/19*.

It is noted that this EI has been superseded by the Standard Operating Instruction (SOI) *NMD-ME-INS-538* and is to be withdrawn upon the expiry of the current review period.

Background

Structures supporting 1500 Volt equipment are connected to the traction rail at prescribed locations in accordance with Electrical Standard *TS 03743 Bonding for 1500 V DC Traction Systems*.

There are currently two Rail Spark Gap arrangements in service, namely:

- The most common by far is the brass capsule on drawing *EL 0585360* now called the “Mark 1 Rail Spark Gap”.
- For some selected locations – Ferraz Unit on drawing *EL 0590277* now called the “Mark 2 Rail Spark Gap”.

The new DEHN (MA SDS Mast Adaptor Part Number 723199 and SDS1 spark gap capsule Part number 923110) Rail Spark Gap now called “Mark 3 Rail Spark Gap” was PAM Type Approved under approval number E00032. It is capable of discharging surges without forming a permanent short circuit and returning back to its original state. A permanent short circuit or failure of this unit will only occur if the surge exceeds its maximum limits.

Some of these Mark 3 Rail Spark Gaps were predominately trialled in the Blue Mountains and some other selected locations to drawing EL0191530 using a different housing and mast attachment. However, the Type Approved Mark 3 Rail Spark Gap to drawing EL0573512 looks different but operates the same way using the same capsule (item 1) DEHN SDS1. Some Transport Projects may have already installed the Mark 3 Rail Spark Gap for their work.

The manufacturer of the Mark 1 Rail Spark Gap capsule has stopped manufacturing this unit. Therefore, the Mark 1 Rail Spark Gap will not be used for future construction, modifications or capsule maintenance corrective actions. Old stock can be used up where available.

Traditionally track failures (track circuit failures) are sometimes attributed to failed Mark 1 Rail Spark Gaps capsules. Now with Mark 3 Rail Spark Gaps these track failures may only be seen momentarily and automatically reset unless it permanently short circuits due to failure of the unit.

The related drawings are:

- Mark 1 Rail Spark Gap (Old Spark Gap) – EL0585360
- Mark 2 Rail Spark Gap (Ferraz) - EL0590277
- Mark 3 Rail Spark Gap (DEHN) – EL0573512
- Bonding to rail for Mark 1 and Mark 3 – EL0583866.

OFFICIAL

Action Required

1. Maintenance, Construction and Design are to use the “Mark 3 Rail Spark Gap” shown on drawings EL0573512 and EL0583866 for all new and existing installations as per Electrical Standard TS 03743. This will be the preferred Rail Spark Gap and is to be installed as per the attached installation instructions for the MA SDS M12 Mast Adaptor. It is to be noted that connection to the appropriate rail to be determined by the Signalling Engineer and in accordance with TS 05168.
2. When installing a new Mark 3 Rail Spark Gap, or replacing the SDS 1 Voltage Limiter (Red Capsule Part Number 923110) within it, or suspect unauthorised tampering with the unit, the following Insulation Resistance (Megger) test is required across the cable connection side and the dome enclosure cover (across the spark gap). This is to test for the presence and correct operation of the SDS1 voltage limiter capsule and is to be conducted with the rail bond cable disconnected:
 - a. Apply 250 V d.c. – Acceptable equals an open circuit indication or high insulation resistance (Minimum 1MΩ)
 - b. Apply 1000 V d.c. – Acceptable equals a short circuit (the unit conducts at 600 V d.c. +/- 20%). The unit will need a brief time to reset before the next step. It is noted that from 2023, the manufacturer has updated the DC sparkover voltage limit for the Mark 3 spark gap from 600 V ±20% to 700 V -14% / +28%, while retaining the same part number. Therefore, these new limits should be used when testing new devices accordingly.
 - c. Apply 250 V d.c. again – Acceptable equals an open circuit indication or high insulation resistance (Minimum 1 MΩ)
 - d. If any of the above tests a, b or c are unacceptable then replace the capsule and carry out the above tests again.
3. The Mark 3 Rail Spark Gap is a shiny brass coloured unit, therefore upon installation the unit is to be sprayed with “Cold Gal” to deter theft of the unit. If repair work removes some of the original Cold Gal paint, simply touch it up with Cold Gal. Ensure that the external insulating sleeves are not compromised during this process.
4. Staff carrying out maintenance or modifications to existing “Mark 1 Rail Spark Gaps” is to replace them with the Mark 3 Rail Spark Gap only:
 - a. When the bond is being modified due to a project or
 - b. When a capsule fails and no existing stock available or
 - c. In locations where there are frequent spark gap failures.
5. Staff engaged in work or testing of Rail Spark Gaps need to be conducted in compliance with Sydney Trains Engineering Procedure *PR D 78303 Work on 1500 Volt Negative Equipment Outside Substations* in particular Sections 7 and 9.
6. When a Mark 2 Rail Spark Gap – Ferraz unit is encountered, please contact Electrical Engineering for advice or follow the approved earthing and bonding design provided for your project.
7. Logistic Stores are to release for general issue the “Mark 3 Rail Spark Gap” units under stock codes 2095487 and 2095495 and set up stock levels for these stock codes.

OFFICIAL

8. Asset Management to update relevant databases and establish funding to allow for changing Rail Spark Gap units from Mark 1 to 3.
9. Rail Spark Gap defects are to be recorded in Teams3 or from July in Transport Equip.
10. Engineering and System Integrity's Electrical Engineering to arrange update of relevant documents to include the Mark 3 Rail Spark Gap, namely:
 - a. Electrical TMP's including updating the name for the Mark 1 and 2 Rail Spark Gaps
 - b. *PR D 78303 Work on 1500 Volt Negative Equipment Outside Substations*
 - c. *PR D 78306 1500 Volt DC Overhead Wiring Structure to Rail Voltage Test and*
 - d. *SWMS D2013/80641 Structure Bond Testing and Maintenance.*
11. Engineering and System Integrity's Electrical Engineering to arrange update of drawing EL0583866 to clearly show how to connect other OHW Structures in a daisy chain configuration onto one Rail Spark Gap, where required by design.

List of Reference Drawings

1. Mark 1 Rail Spark Gap – EL0585360
2. Mark 2 Rail Spark Gap (Ferraz) - EL0590277
3. Mark 3 Rail Spark Gap (DEHN) – EL0573512
4. Bonding to rail for Mark 1 and Mark 3 – EL0583866

Contact

Technical Specialist Earthing Bonding or Principal Engineer Power Systems

OFFICIAL

EI A 25-07

Disconnecting and Reconnecting OHW Spark Gaps

This Engineering Instruction includes urgent engineering information. Adherence to the information in this Instruction is **MANDATORY**.

Date in Force: 17 September 2025

Date of Review: 17 September 2026

Approved by:

Romi Vespa
Professional Head
Signals and
Control System

Jack Siu
Professional Head
Electrical
Engineering

Authorised by:

Jonathon McKinnon
Engineering Technical
Publications Manager

Sean Budge
Assoc Director
Electrical Distribution Unit

Audience:

- Signal Engineers
- Signal Electricians
- Project Managers
- Signal Project Engineers
- Maintenance Operation Managers
- Electrical Maintenance personnel
- Electrical Construction personnel
- Electrical Asset Engineers
- Electrical Team Managers
- Overhead Line Workers
- ICON

Main Points:

- Highlight the potential risk of electrical injury when disconnecting and reconnecting spark gap cables.
- No rail connections or spark gaps for 1500 V switches shall be removed by signalling personnel. Arrange with an Authorised Electrical Representative to disconnect and reconnect.
- Enhanced signalling procedures for disconnecting and reconnecting spark gap cables.
- Temporary spark gap bonding arrangements for planned works.

Primary Affected Document: **PR S 40042 Safety Issues for Signalling Personnel**
PR D 78303 Work on 1500 Volt Negative Equipment
Outside Substations

OFFICIAL

Disclaimer

This document was prepared for use by Sydney Trains and its intended recipient. The information in this document is protected by copyright and no part of this document may be reproduced, altered, stored or transmitted by any person without the prior consent of Sydney Trains. Errors or omissions in this document should be reported to sydneytrainsstandards@transport.nsw.gov.au. Sydney Trains makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems or work or operation.

Document Control

Version	Date	Summary of change
1.0	17/09/2025	First issue as a Sydney Trains document

Scope

This Engineering Instruction outlines enhanced Signalling procedures for the disconnection and reconnection of overhead wiring (OHW) spark gap cables and the arrangements for temporary spark gap bonding.

Signalling personnel maybe required to disconnect spark gap cables where the spark gap is affecting track circuit operation (unplanned) or disconnect and reconnect spark gap cables for planned works.

There are no changes to the Electrical procedures as described in *PR D 78303 Work on 1500 Volt Negative Equipment Outside Substations*.

Background

Spark gaps and spark gap cables perform a safety function and are used to control the risk of an OHW structure becoming electrically live.

A spark gap is normally open circuit and is designed to short circuit (failed state) in the event of failure of the 1500-volt insulation on the structure. This will then connect the structure to the return rail and initiate a trip of the traction supply circuit breaker in the substation.

Defective (i.e., failed) spark gaps may affect the operation of track circuits, contribute to electrolysis corrosion, and may even lead to a loss of rail vehicle detection. To overcome such issues, signalling personal are sometimes required to disconnect spark gap cables, which under certain circumstances can pose an electrical hazard.

Action required

Note:

At 1500 V switches, No rail connections or spark gap cable shall be removed by signalling personnel. Arrange for the spark gap to be disconnected and reconnected by an Electrical Representative.

1 Precaution checks and tests prior to disconnection of a spark gap

For planned and unplanned works before disconnection of any spark gap cable, signalling personnel are to avoid touching the OHW structure until the following checks and tests are performed to determine if it is safe to disconnect (ensuring appropriate SWMS and SWIs are implemented):

1. Undertake a visual inspection for broken insulators attached to the structure or other signs of electrical faults.
2. Check visual signs of overheating of terminals and cables or insulation melted, blistering or damaged. This may indicate high current flow or high resistance connections.
3. Measure the structure to rail voltage. If greater than 50 Volts D.C. (using a 100K shunt), this may indicate poor OHW insulation.
4. Measure D.C. current in the spark gap cable using a tong meter.
 - a. If current flow is from structure to rail, this may indicate a damaged OHW insulator.
 - b. If the current flow is from rail to structure, and is greater than 0.1 Amps D.C., may pose an electrical hazard upon disconnection.

OFFICIAL

Signalling personnel shall **not** disconnect spark gap cables if any of the above checks and tests indicate it is unsafe. In such cases, they shall notify ICON Electrical to arrange for an Authorised Electrical Representative to carry out the disconnection, replacement or reconnection of the spark gap cable or spark gap.

2 Unplanned work

2.1 Defective spark gaps affecting track circuit operation

Where a spark gap is missing, defective or affects the operation of the track circuit, ICON Electrical shall be notified immediately and spark gap to be arranged to be replaced as a priority.

Following checks and tests as per section 1, if it is determined that it is safe to disconnect the spark gap cable, signalling personnel may disconnect for operational reasons by following the process below:

- a. Disconnect the spark gap cable at the spark gap unit end.
- b. Apply insulation to the spark gap cable removed (at the spark gap unit end) to prevent stray traction current entering the earth and causing electrolysis corrosion and to prevent others being exposed to any potential hazard.
- c. Notify ICON Electrical and ICON Infrastructure that the spark gap cable has been removed from the spark gap unit and is isolated.

3 Planned Works

3.1 Precaution checks and tests prior to disconnection and connection of spark gap cable

Before disconnection of any spark gap cable for planned works, signalling support personnel are to perform the checks and tests as per section 1 to determine if it is safe to disconnect.

If any of the above checks and tests indicate it is unsafe, they shall notify ICON Electrical to arrange for an Authorised Electrical Representative to carry out the disconnection and installation of the spark gap bonding, including any temporary arrangement as per the temporary spark gap bonding plan or design in the Signalling Support Work Package.

3.2 Where temporary spark gap bonding is not required

If the existing spark gap cable is required to be disconnected from the rail and the installation of a temporary spark gap cable is not required, perform the checks and tests as per section 1 to determine if it is safe to disconnect.

If it is determined that it is safe to disconnect, the spark gap cable at the rail end is to be disconnected. Ensure the disconnected end is insulated appropriately to prevent stray traction current entering the earth and causing electrolysis corrosion and to prevent others being exposed to any potential hazard. The disconnected spark gap shall be recorded on a signalling disconnection list.

Before reconnecting the spark gap cable to rail, signalling support personnel should **not** touch the OHW structure until checks and tests 1 to 3 in section 1 above have been completed to determine if it is safe to reconnect.

OFFICIAL

3.3 Where temporary spark gap bonding is required

3.3.1 Temporary spark gap bonding – Planning

For planned work (e.g., re-railing, ballast cleaning, track recon, etc.) where the overhead wiring will remain energised and requires disconnection of a spark gap cable, a temporary spark gap cable shall be provided and connected to the nearest continuous rail in the negative return circuit. This includes all 1500 V D.C. structures including portal, gantries or bridges that may span single or multiple roads and have a spark gap installed.

A temporary spark gap bonding plan is required and signalling support personnel shall identify a suitable nearby traction rail as an alternate temporary rail connection point for the installation of the temporary spark gap bonding.

The following conditions apply for the temporary spark gap bonding:

- a. The temporary spark gap cable shall **not** be installed for longer than 10 days.
- b. The cable type and length of the proposed temporary spark gap cable shall be detailed in the temporary spark gap bonding plan and shall meet the following requirements:
 - i. Make every reasonable effort to replace the existing steel bonding cable with 300 mm² aluminium cable, allowing for up to 20 metres of additional length. If site-specific constraints make replacement impractical, up to 20 meters of 300 mm aluminium are permitted to be attached to the existing spark gap cable, ensure that the mating surfaces of the joint are clean to minimise any resistance.
 - ii. Where temporary spark gap cable longer than 20 metres is required, the solution shall be of the equivalent resistance of the cable being replaced. This requires re-terminating the new cable to the structure (not extending the existing cable).
- c. If the planned works is greater than 10 days or where requirements i and ii cannot be met, signalling support personnel shall request Engineering Systems Integrity (ESI) Electrical Engineering Design Section at least 8 weeks prior to the works to produce a temporary spark gap bonding design. This will require the assistance of the Electrical staff to support the disconnect and reconnect at the structure.
- d. Temporary spark gaps bonds shall be recorded on a signalling disconnection list.
- e. The signal support personnel shall inspect the temporary spark gap bonding cable during the works. The frequency of inspections of the temporary spark gap bonding cable shall be determined by the support signal engineer based on the assessment of works being performed and included on a work instruction.
- f. The support signal engineer shall approve the temporary spark gap bonding plan or endorse the designed temporary spark gap connection as part of the signals support works package.

3.3.2 Temporary spark gap bonding - installation and connection

Before disconnecting any spark gap cable, signalling support personnel are to confirm that it is safe to disconnect by performing the checks and tests as per Section 1. If it is determined that it is safe to disconnect the spark gap cable, signalling personnel shall follow the process below:

- a. Before connecting the temporary spark gap cable to the alternate rail connection, clean the rail of dust, paint, or any other insulating material to ensure good electrical contact.
- b. Remove the original spark gap cable and replace with the temporary spark gap cable. Where the temporary spark gap cable is extended, ensure both the original and new spark gap cable mating surfaces are thoroughly cleaned and prepared to minimise contact resistance of the connection.
- c. Connect the temporary spark gap cable to the alternate rail connection point, in accordance with the temporary spark gap bonding plan or design.

OFFICIAL

3.3.3 Temporary spark gap bonding - disconnection and removal

On completion of the planned works where temporary spark gap bonding is connected, signalling support personnel shall perform the checks and precautions as per Section 1 to ensure that it is safe to remove the temporary spark gap cable and reconnect and certify the original spark gap cable.

If at any time it is determined that it is unsafe to disconnect the temporary spark gap cable or reconnect the original spark gap cable, contact ICON Electrical to arrange for an Authorised Electrical Representative to perform the disconnection, reconnection, and certification of the spark gap cable.

Contact

Romi Vespa, Professional Head Signalling and Control Systems
Jack Siu, Professional Head Electrical Engineering
Sean Budge, Associate Director Electrical Distribution Unit

0400 409 291
0412 532 399
0412 521 544

OFFICIAL

**Engineering System Integrity
Electrical Network Safety Rules**

**Engineering Procedure
Electrical Distribution Unit**

Electrical Distribution Network Management

PR D 78303

**Work on 1500 Volt Negative
Equipment Outside Substations**

Version 1.3

Date in Force: 1 February 2022

Approved by: Associate Director
Electrical Distribution Unit
Engineering System Integrity

Authorised by: Engineering Technical
Publications Manager
System Integrity

Disclaimer

This document was prepared for use by persons in connection with works near or on/within the rail network electricity system operated by Sydney Trains. Sydney Trains makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems or work or operation. It is the document user's sole responsibility to ensure that the copy of the document it is viewing is the current version of the document as in use by Sydney Trains. To the extent permitted by law, Sydney Trains excludes any and all liability for any loss or damage, however caused (including through negligence), which may be directly or indirectly suffered in connection with the use of this document.

Copyright

The information in this document is protected by copyright and no part of this document may be reproduced, altered, stored or transmitted by any person without the prior consent of Sydney Trains.

Document control

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	28 July 2015	Christopher Leung	First release for Sydney Trains, rebranded from previous RailCorp SMS-06-EN-0568 V1.3
1.1	12 July 2018	Christopher Leung	3 Yearly Review
1.2	19 February 2019	Nick Loveday	Updated PR D 78303 "Approved by" to Associate Director Electrical Distribution Unit
1.3	1 February 2022	ENSR Project Team	Reviewed as part of the ENSR Project.

Summary of changes from previous version

Summary of change	Section
Minor grammatical updates	All
Updated document references	All

Table of Contents

1	Purpose	4
2	Definitions.....	4
3	Safety Principles	4
4	Work Which Requires the Substation Negative to be Disconnected from Rail.....	4
5	Negative Bus Rail Termination (Track Side Negative Bus)	5
6	OHW Permanent Rail Connections	6
7	Work Which Requires the Substation Negative to be Disconnected from the Track Side Negative Bus.....	7
7.1	Breaking, making or working on a SINGULAR substation negative connection, i.e. not all the connections, to the Track Side Negative Bus	7
7.2	Breaking making or working on ALL substation negative connections to the Track Side Negative Bus	7
8	Rail Spark Gaps.....	8
8.1	General.....	8
8.2	Testing.....	8
8.3	Working on Rail Spark Gap and Bond	8
9	Electrolysis Bond	9
10	Structure Bond Testing and Maintenance.....	9
11	Reference documents.....	9

1 Purpose

To describe the procedures required in carrying out work on 1500 Volt negative equipment outside Substations.

NOTE

A Sectioning Hut is defined as a substation. Refer to **Electrical Safety Definitions** page available on the **RailSafe** site.

NOTE

Refer to *PR S 40027 Traction Return (1500V DC)* for precautions necessary when work is performed that may affect any part of the traction return in 1500V DC electrified areas.

2 Definitions

Refer to the **Electrical Safety Definitions** page available on the **RailSafe** site.

3 Safety Principles

When work is to be carried out on 1500 Volt negatives outside substations, precautions must be taken to ensure that:

- The return path for current from trains and other equipment is not broken.
- Workers do not bridge across a broken negative connection.
- Workers are not exposed to dangerous voltages between negative (rail) and earth.

4 Work Which Requires the Substation Negative to be Disconnected from Rail

Refer to *PR D 78304 Work on 1500 Volt Negative Equipment Inside Substations* Section 3.1 Work requiring the substation negative to be disconnected from rail, for details.

5 Negative Bus Rail Termination (Track Side Negative Bus)

The Negative Bus Rail Termination, commonly referred to, and hereafter referred to as the Track Side Negative Bus, is the interface between the substation negative(s) and the traction rail.

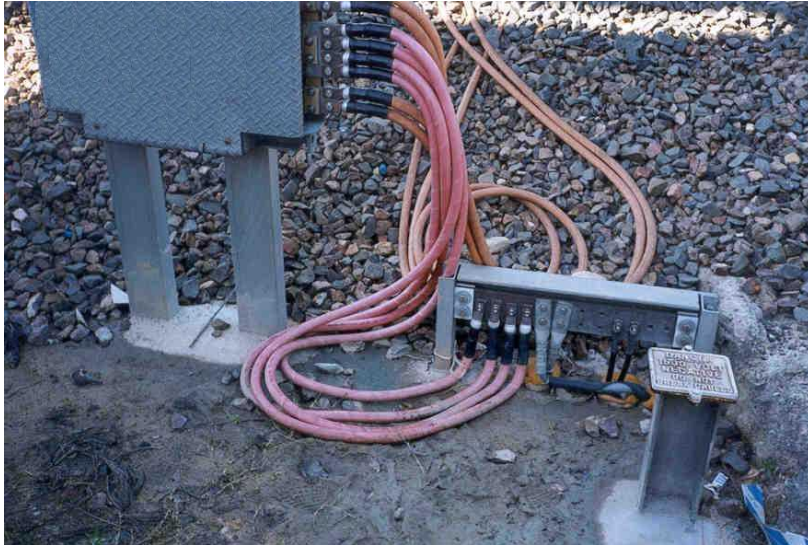


Figure 1: Example of a Track Side Negative Bus

The Electrical discipline is responsible for:

- The installation and maintenance of cables from the Substation to the Track Side Negative Bus.
- The **running** of cables from the Substation to the Traction Rail, when a Track Side Negative Bus does not exist.

The Signalling and Control Systems discipline is responsible for:

- The installation and maintenance of Cables from the Track Side Negative Bus to the Traction Rail.
- The **connection** of the cables to the Traction Rail, when a Track Side Negative Bus does not exist.

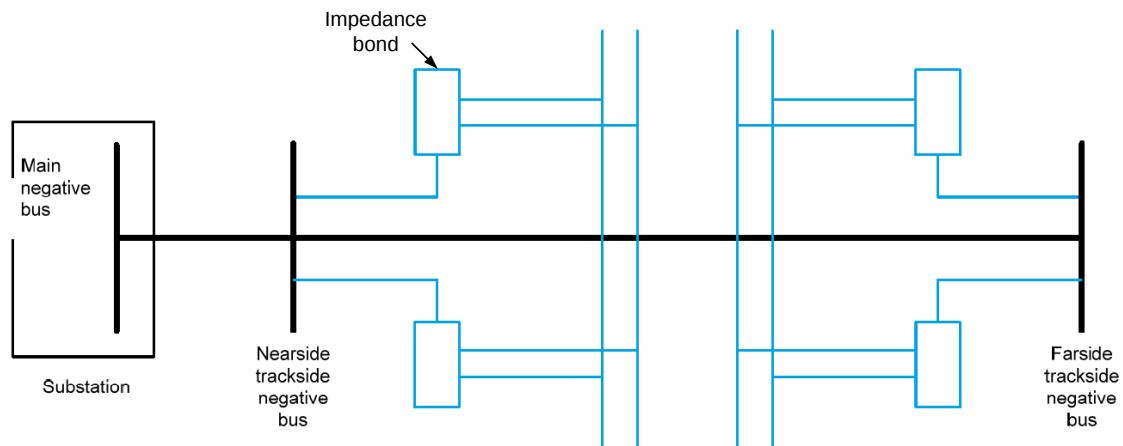


Figure 2: Typical negative track connections

6 OHW Permanent Rail Connections

All permanent OHW rail connections shall be done in accordance with an Approved and Accepted Signal Design. Rail bond welding shall be done by workers appropriately qualified in accordance with TfNSW Engineering Specification *SPG 0709 Traction Return, Track Circuits and Bonding*. Connection of the permanent rail connections to rail shall be done by the Signal Engineer in accordance with SPG 0709.

These requirements are applicable to:

- Rail connections from trackside negative bus.
- Rail connections from OHW structure spark gaps.
- Rail connections from OHW switches.
- Provisions for permanent connection points for portable rail connections.

7 Work Which Requires the Substation Negative to be Disconnected from the Track Side Negative Bus

7.1 Breaking, making or working on a SINGULAR substation negative connection, i.e. not all the connections, to the Track Side Negative Bus

With the substation live, a singular substation negative connection may be disconnected, connected or worked upon for a short time only. This time period shall be a maximum of one shift only.

Any replacement of a cable or connection shall be a 'like for like' or as dictated via an Engineering Advice.

When breaking, making or working on a SINGULAR substation negative connection, i.e. not all the connections, to the Track Side Negative Bus:

NOTE

The number of cables and preferred cable size for the equipotential bond shall be identical to the negative cable being disconnected or as that specified in Transport for NSW (TfNSW) standard *T HR EL 20002 ST 1500 V DC Cables and Cable Ratings*.

- a. A temporary equipotential bond shall be installed across the break.
- b. When disconnecting a "singular" negative connection to the Track Side Negative Bus, it is necessary to ensure that no current is flowing in the connection to be disconnected. Accordingly, prior to disconnecting a negative connection:
 - The negative cable(s) to be disconnected shall be positively identified.
 - A tong tester (DC) shall be used to prove that no current is flowing in the circuit.
- c. Persons shall not bridge themselves between the disconnected substation negative cable and the Track Side Negative Bus and should perform any work on an insulated platform.
- d. Providing the above instructions 6.1 (a) to (c) are complied with *PR D 78502 Substation Access Permit* would not be required.

NOTE

A Substation Access Permit would only be required for work on the traction return circuit if all connections between the substation negative and the Track Side Negative Bus will be broken. No permit is required if an electrical path from the substation negative to the traction rail remains and its continuity has been checked.

7.2 Breaking making or working on ALL substation negative connections to the Track Side Negative Bus

Refer to PR D 78304 Section 3.1 Work requiring the substation negative to be disconnected from rail, for details.

8 Rail Spark Gaps

8.1 General

Steel structures supporting 1500 Volt equipment are connected to the traction rail at prescribed locations in accordance with TfNSW standard *T HR EL 12005 ST Bonding for 1500 V DC Traction Systems* through a rail spark gap and rail bond.

The rail spark gap device, normally bolted to the structure, is fitted with a spark gap capsule. These capsules are normally open circuit and are designed to short circuit in the event of failure of the 1500 Volt insulation on the structure.

WARNING

The OHW structure is considered safe to touch if the measured structure to rail voltage does not exceed 50Vdc. Workers must not touch the structure and the rail bond at the same time unless the bond and the structure are bridged together with a jumper lead. Refer to SMS SWMS D2013/80641 Structure Bond Testing and Maintenance for further information.

8.2 Testing

The voltage across a spark gap must only be measured with an approved test equipment, refer to *SP D 79039 Electrical Tools and Test Equipment*.

If voltage measured across a spark gap is $> 2V$, the spark gap is considered to be satisfactory. If the voltage measured is in the range of 0 to $\leq 2V$, the spark gap could be short circuited or the rail bond could be open circuited.

For details refer to *PR D 78306 1500 Volt DC Overhead Wiring Structure to Rail Voltage Test* and D2013/80641.

8.3 Working on Rail Spark Gap and Bond

Before personally bridging between rail and structures, the rail to structure jumper lead must be used as follows:

- a. Install the rail clamp to the foot of the traction rail. Ensure that the clamp bites into metal if rust or other debris is present on the rail foot.
- b. Install the insulated clamp onto the overhead wiring structure in a firm and unhesitating manner.

NOTE

The jumper lead must be connected to the same rail as the spark gap rail bond, i.e. the traction rail.

WARNING

The time for which the structure is connected directly to traction rail must be minimised to reduce the risk of electrolysis damage occurring.

When work is completed, remove the jumper lead as follows:

- a. Disconnect the insulated clamp from the structure in a quick and unhesitating manner. Do not touch the overhead wiring structure at the same time as touching an exposed clamp or bond.
- b. Disconnect the rail clamp from the foot of the traction rail.

9 Electrolysis Bond

Workers must not:

- Bridge between underground services and rail.
- Bridge themselves across a broken electrolysis bond connection.

10 Structure Bond Testing and Maintenance

For work regarding structure bond testing and maintenance refer to D2013/80641.

11 Reference documents

D2013/80641 Structure Bond Testing and Maintenance

PR D 78304 Work on 1500 Volt Negative Equipment Inside Substations

PR D 78306 1500 Volt DC Overhead Wiring Structure to Rail Voltage Test

PR D 78502 Substation Access Permit

PR S 40027 Traction Return (1500V DC)

SPG 0709 Traction Return, Track Circuits and Bonding

T HR EL 12005 ST Bonding for 1500 V DC Traction Systems

T HR EL 20002 ST 1500 V DC Cables and Cable Ratings