Government of South Australia
Department for Infrastructure and Transport

Earthing and Bonding for Rail Standard

Asset Management

TP4-DOC-003507

DOCUMENT AMENDMENT RECORD

REV	CHANGE DESCRIPTION	DATE	COMMENTS
1	Initial Issue	28/02/11	
2	Changes in section 2 and 4 and section 7 deleted	24/07/12	
3	Document number change	12/07/13	
4	Updated to include trams. New SAPTA formatting and document number. MOCs 2694476 and 061.	19/06/24	Was document AR-PW-PM-SPE-00129002 (D061)
Document Review Schedule:		Every 3 years	

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1. Introduction

This standard specifies the requirements for the design of electrical Earthing and Bonding Infrastructure for use on the Adelaide Metropolitan Passenger Rail Network (AMPRN) and the Adelaide Tram Network (ATN).

SAPTA on behalf of the Department manages the Adelaide Metropolitan Public Transport Network. As part of the execution of responsibilities of this role it must have a governance structure which includes the adoption of standards, policies and procedures.

2. Purpose

The purpose of this Technical Standard is to outline the requirements for the design of Earthing and Bonding for train and tram traction.

3. Scope

This technical standard applies to all DIT projects and to contractor organisations designing or constructing train or tram infrastructure or maintaining train stations or tram stops on the AMPRN and ATN.

4. Standards and Drawings

STANDARD	TITLE
AS 3000	Electrical Installations (Wiring Rules)
EN 50122	Railway applications – Fixed installations – Electrical safety, earthing and the return circuit

DRAWING	TITLE
301-A2-86-2239	STA Allowable Infringements Minimum Structures – 1600mm Gauge
CS2-DRG-365078	Standard Drawing – Tram System – Minimum Structure Outline – General Layout
TP4-DRG-006984	Standard Drawing – Train & Tram Earthing & Bonding – Primary Earth Terminal (Earth Collector Cabinet) – Typical Arrangement

5. Definitions and Reference Documents

TERM	MEANING
Bonding	The effective connection between an earth electrode and any exposed electrically continuous metalwork of any equipment that may operate in an earth situation
Earthing	The effective connection to the general mass of the earth by means of a suitable earth electrode
E&B	Earthing and Bonding
Electrification	The provision of an overhead wiring system above the track that is energized with 25kV AC (train system) or 600V DC (tram system) current providing traction power for electric motor driven units through a roof mounted pantograph
Final Design Documents	The Design Documents to be issued for construction of the Works that have been subject to all necessary approvals, verification, certification and release of applicable Hold Points required under the Contract.
Final Design Reviews	The design review meeting conducted at the completion of the final design and hosted by the Contractor for the purpose of presenting the final design to the Department
Station	Includes railway stations, tram stops and other Electrification infrastructure (unless noted).

REFERENCE	OWNER	DETAILS
AR-EL-STD-0102	SAPTA	Guidelines for the Protective Provisions Relating to Electrical Earthing and Bonding for the Adelaide Metro Electrified Rail Network (commonly referred to as *The E&B Guidelines*)
TP2-DOC-002020	SAPTA	Guidelines for Low Voltage Electrical Earthing and Bonding for the Adelaide Metro Tram Network
TP5-DOC-003511	SAPTA	Public Transport Standard: Electrical Infrastructure Engineering

6. Design Requirements

All E&B work along the line and within a Station precinct must be designed to safely permit the electrification of the APMRN's rail network or ATN's tram network by means of an overhead traction power wiring system energised with 25kV AC or 600V DC. The electrification may occur concurrently with the currently contracted Works or at a future time. Regardless of the expected timing of electrification, the design must meet these requirements.

The design must comply with the following:

1. Ensure all Works are undertaken in accordance with:
   - **a) For 'heavy' rail:**
     - SAPTA's Guidelines for the Protective Provisions Related to Electrical Earthing and Bonding for the Adelaide Metro Electrified Rail Network;
     - Drawing 301-A2-86-2239 Minimum Structures – 1600mm Gauge.
   - **b) For trams:**
     - SAPTA's Guidelines for Low Voltage Electrical Earthing and Bonding for the Adelaide Metro Tram Network; and
     - Drawing CS2-DRG-365078 Tram Line – Minimum Structure Outline.
2. Provide a Primary Earthing Terminal (PET) in accordance with drawing TP4-DRG-006984;
3. Locate the Earth Collector Cabinet and PET within the rail or tram corridor, but off platforms;
4. Provide concealed (cad welding is preferred option) earthing and bonding connections which are vandal proof, theft proof and maintenance accessible for all items of electrification infrastructure (for example, furniture, light poles, fences, shelters); the method of concealment must be approved by the Department and must be considered a **HOLD POINT**;
5. Prepare necessary inspection and test plans for all stages of construction and installation, including for any necessary decommissioning, demolition, removal and/or disposal of any existing features rendered unusable by electrification, vide Section 8 below *Inspection and Testing* and Master Specification PC-QA1, clause 6 *Inspection and Testing*; and
6. Ensure that design and verification work is performed by competent persons equivalent to chartered professional engineers practicing in electrical engineering with electrified rail and/or high voltage experience.

7. Verification of Earthing and Bonding Features

The Contractor must arrange for independent verification and certification of the design and provide evidence to the Department that the design of the works satisfies the requirements of:

- **a) For 'heavy' rail:**
  - SAPTA's Guidelines for the Protective Provisions Related to Electrical Earthing and Bonding for the Adelaide Metro Electrified Rail Network; and
  - Drawing 301-A2-86-2239 Minimum Structures – 1600mm Gauge.
- **b) For trams:**
  - SAPTA's Guidelines for Low Voltage Electrical Earthing and Bonding for the Adelaide Metro Tram Network; and
  - Drawing CS2-DRG-365078 Tram Line – Minimum Structure Outline.

prior to submission of Final Design Drawings.

8. Inspection and Testing

The Inspection and Test Plan must be prepared in accordance with Master Specification PC-RW50. It must consider, but not be limited to, the following points:

1. Quantitative inspection criteria for earthing and bonding connections;
2. Statistical validity of sampling where less than 100% of features are inspected;
3. Inspection and test procedures to be used, especially the timing of inspections for conductors that are impossible to check after construction has been completed, such as the welding of steel reinforcement;
4. Collection and retention of the test data, including consolidation of the data to support test certificates;
5. Reporting of the outcome of the inspection and test regime to the Department; and
6. Certification of earthing and bonding compliance for the total Works to the Department.

The Contractor must submit the Inspection and Test Plan, including inspection and test procedures which have been approved by the Independent Verifier, to the Department at the Final Design Review.

9. Records

Earthing and Bonding documentation for detail design must include, but not be limited to, the following:

1. Electrical installation layout plan drawings showing the location of the supply point, all switch boards, isolation transformers, earthing electrodes, conductor routes and the PET Primary Earth Terminal for connection of the Common Bonded Earth Network by the competent specialist skilled persons from the Electrification Constructor;
2. Structure Bonding detail layouts including continuity bonding of reinforcement, provision of tails for connection of reinforcement and foundations steelwork by the Electrification Contractor's competent persons;
3. Section and detail drawings where applicable;
4. A single line schematic earthing and bonding diagram showing connectivity of the Main Earth Neutral links, PET primary earth terminal and earth electrode(s);
5. Specification documents for size of conductors and prospective fault levels throughout the installation;
6. Duct, cable and pit schedules for the earthing and bonding conductors;
7. As built record of the earth electrodes and individual (statistical sample) resistance test results;
8. A design report detailing acknowledgement of departures from AS 3000, Part 2 and other detail as required by AS 3000, clause 1.9.4.3;
9. Construction visual inspection check lists;
10. Verification and Test measurement of the common bonded earth network and installation fault loop impedances.
11. Installation Earthing and Bonding System Test Report; and
12. Endorsed Certificate of Compliance.

Records must be prepared in accordance with Master Specification PC-RW50. The following records in particular must be provided to the Department:

1. Inspection and Test Plan
    - The Inspection and Test Plan in draft and final versions;
    - Formats for inspection and test quantitative data and Contractor's and any subcontractor's certification thereof; and
    - A Certificate of Compliance for the completed earthing and bonding design for the Works. If waivers have been granted, these must be noted.