TS 03773:1.0

T HR EL 10005 ST

Standard

Requirements for Electric Aerials Crossing Transport for NSW Heavy Rail Infrastructure

Issue date: 27 November 2024

Effective date: 27 November 2024

Disclaimer

This document has been prepared by Transport for NSW (TfNSW) specifically for its own use and is also available for use by NSW public transport agencies for transport assets.

Any third parties considering use of this document should obtain their own independent professional advice about the appropriateness of using this document and the accuracy of its contents. TfNSW disclaims all responsibility and liability arising whether directly or indirectly out of or in connection with the contents or use of this document.

TfNSW makes no warranty or representation in relation to the accuracy, currency or adequacy of this document or that the document is fit for purpose.

The inclusion of any third-party material in this document, does not represent an endorsement by TfNSW of any third-party product or service.

For queries regarding this document, please email Transport for NSW Asset Management Branch at standards@transport.nsw.gov.au or visit www.transport.nsw.gov.au

Document information

Owner: Director Energy Networks and Systems
Asset Management
Planning, Integration and Passenger

Mode: Heavy rail

Discipline: Electrical

Document history

Revision	Effective date	Summary of changes
1.0	11 May 2016	First issue as T HR EL 10005 ST
1.0	27 November 2024	First issue as TS 03773, superseding T HR EL 10005 ST, version numbering recommenced in line with new designation. Second issue update onto new template, technical contents are not changed.

Preface

This standard is a first issue as TS 03773, superseding T HR EL 10005 ST *Requirements for Electric Aerials Crossing RailCorp Infrastructure* version 1.0.

This document outlines the minimum technical requirements for the design and construction of electric aerials crossing over Sydney Trains distribution system infrastructure. The electric aerials are associated with the transmission, distribution and supply of electricity by Sydney Trains and other external third-party organisations.

Changes from the previous version include clarifications throughout various sections with no significant changes to technical content.

Table of contents

1 Scope 6

2 Application 6

3 Referenced documents 6

4 Terms, definitions and abbreviations 8

5 External third-party organisations 9

6 General requirements for electric aerials crossing Transport for NSW heavy rail infrastructure 9

7 Additional requirements for electric aerials crossing Transport for NSW heavy rail tracks or sidings 10

7.1 Structures 10

7.2 Conductors 10

7.3 Guy arrangements 12

7.4 Crossarms 12

7.5 Accessories and hardware 13

7.6 Insulation coordination of crossing span 13

7.7 Prohibited configurations for crossings 13

8 Additional requirements for electric aerials crossing over or under other Transport for NSW heavy rail infrastructure 14

9 External third-party design documentation 14

10 As-built design documentation 15

11 Geographic information system 15

12 Data set associated with electric aerial crossings 15

1 Scope

This standard specifies the minimum technical requirements for the design and construction of all new electric aerials and the alteration of existing electric aerials crossing over TfNSW heavy rail infrastructure.

Crossings of TfNSW heavy rail infrastructure include any aerial service that may conduct electricity.

Where electric aerials cross railway tracks additional requirements are imposed.

This document does not cover the technical requirements for the following:

- buildings and structures under overhead lines – refer to TS 03740
- earthing and bonding requirements for overbridges and footbridges under HV overhead lines – refer to TS 03743
- cable crossings above 1500 V dc overhead wiring – refer to TS 03799
- under track crossings and underground service installations within the rail corridor – refer to TS 03750 and TS 02390.

2 Application

This document is intended to be used by competent personnel engaged in the provision of services relating to rail infrastructure. This document should be read in conjunction with TS 01505.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Australian standards

AS 1154.1 *Insulator and conductor fittings for overhead power lines – Part 1: Performance, material, general requirements and dimensions*

AS 1214 *Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) (ISO 10684:2004, MOD)*

AS 3608 *Insulators – Porcelain and glass, pin and shackle type – Voltages not exceeding 1000 V a.c.*

AS 4899 *Pin insulators – Porcelain and glass for overhead power lines – Voltages greater than 1000 V a.c.*

AS 60305 *Insulators for overhead lines with a nominal voltage above 1000 V – Ceramic or glass insulator units for a.c. systems – Characteristics of insulator units of the cap and pin type*

AS 61109 *Insulators for overhead lines – Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria (IEC 61109:2008, MOD)*

AS 61952 *Insulators for overhead lines – Composite line post insulators for A.C. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria (IEC 61952:2008 (ED.2.0) MOD)*

AS IEC 60433 *Insulators for overhead lines with a nominal voltage above 1000 V – Ceramic insulators for a.c. systems – Characteristics of insulator units of the long rod type*

AS IEC 60720 *Characteristics of line post insulators (IEC 60720, Ed. 1.0 (1981) MOD)*

AS/NZS 2947.1 *Insulators – Porcelain and glass for overhead power lines – Voltages greater than 1000 V a.c. – Part 1: Test methods – Insulator units*

AS/NZS 2947.4 *Insulators – Porcelain and glass for overhead power lines – Voltages greater than 1000 V a.c. – Part 4: Test methods – Insulator strings and insulator sets*

AS/NZS 4680 *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

AS/NZS 7000 *Overhead line design*

Transport for NSW standards

TS 01505 (T MU AM 01001 ST) *Life Cycle Costing*

TS 01656 (TMC 331) *Design of Overhead Wiring Structures and Signal Gantries* (Withdrawn and transferred to heavy rail operator and maintainer that can be contacted for information regarding this document.)

TS 02390 (T HR CI 12190 ST) *Service Installations within the Rail Corridor*

TS 03499 (ESC 210) *Track Geometry and Stability*

TS 03500 (ESC 215) *Transit Space*

TS 03676 (T HR EL 12002 GU) *Electrolysis from Stray DC Current*

TS 03740 *Buildings and Structures under Overhead Lines*

TS 03743 (T HR EL 12005 ST) *Bonding for 1500 V DC Traction Systems*

TS 03750 (T HR EL 20003 ST) *Underground Installation Configurations for High Voltage and 1500 V DC Cables*

TS 03770 (T HR EL 10001 ST) *HV Aerial Line Standards for Design and Construction*

TS 03795 (T HR EL 08002 ST) *Relative Positions of Signals and Open Overlaps*

TS 03799 (T HR EL 08006 ST) *Services Erected Above Overhead Wiring*

TS 06197.1 *TAO Authorisation Requirements*

Other referenced documents

ENA NENS 04 *National guidelines for safe approach distances to electrical and mechanical apparatus*

Industry Safety Steering Committee of New South Wales, 2012, ISSC 20 *Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure*

TfNSW, Sydney Trains, *Building near the railway* web page

TS 00251 (EL 0017757) drawing *Transmission Lines; Conductor Spacing; Arrangement* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

TS 00252 (EL 0020837) drawing *Transmission Lines; Pole Equipment; Conductor Anchor Steel Crossarm* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document.

ACSR aluminium conductor, steel reinforced

AMB Asset Management Branch

EIM external interface management of Sydney Trains that assists third-party organisations working near railway infrastructure

electric aerials are associated with the transmission, distribution and supply of electricity by Sydney Trains and other external third-party organisations

HV high voltage; a voltage exceeding 1000 V ac or 1500 V dc

JOS judgement of significance

OHEW overhead earth wire

OHW overhead wiring

OPGW optical ground wire

rail infrastructure as defined in *Rail Safety National Law (NSW) 2012*

RL reduced level

TAO Technically Assured Organisation

TfNSW Transport for New South Wales

5 External third-party organisations

Applications for the installation of external third-party electric aerial crossings shall be made to the EIM. The EIM shall arrange for necessary investigations, including review of the technical aspects of an application by a TAO.

Electric aerial crossings shall not be installed, altered or renewed without written permission by the EIM.

Refer to the *Building near the railway* web page for contact information and procedures.

6 General requirements for electric aerials crossing Transport for NSW heavy rail infrastructure

For electric aerial crossings by Sydney Trains distribution system HV, the design, construction and documentation of the crossing shall comply with TS 03770.

For external third-party electric aerial crossings, the design and construction of the crossing shall comply with AS/NZS 7000.

Any proposed installations within the rail corridor shall comply with TS 02390 and TS 03500.

Configurations resulting from electric aerials crossing over TfNSW heavy rail buildings and structures shall comply with TS 03740.

Overbridges and footbridges under an electric aerial line shall comply with TS 03743.

The design shall take into account the possibility of damage resulting from stray dc currents due to electric trains. Particular attention to prevent damage from stray dc currents shall be paid when installing steel or reinforced concrete structures within or close to the rail corridor. Refer to TS 03676 for further information.

For external third-party electric aerial crossings, a maintenance plan shall be provided by the third-party organisation to the EIM. The maintenance plan shall include the following details as a minimum:

- access requirements
- requirements of resources to be provided by the operator and maintainer of rail assets.

The requirements of this document apply to all new electric aerials crossing over TfNSW heavy rail infrastructure. Where existing electric aerial crossings are to be altered, the design and construction of the alteration shall be such that the resultant configuration shall comply with this document. Where it is not practicable to do so, the designer shall list all non-compliances and the proposed design approach to mitigate the risks associated with the non-compliances.

The mitigation measures shall be accepted by the relevant TAO reviewing the design work prior to the commencement of the detailed design. The mitigation measures shall be in accordance with the TAO's JOS processes for aerial lines. For more information, refer to TS 06197.1.

Where the TAO has not established an accepted JOS process for aerial lines, the proposed design shall be documented and submitted via a standards concession.

7 Additional requirements for electric aerials crossing Transport for NSW heavy rail tracks or sidings

7.1 Structures

All poles supporting a span of electric aerials over TfNSW heavy rail railway tracks or sidings shall be so located that in the event of a failure no part of them will fall within 1.8 m of the outside rail of any railway track, so far as is reasonably practicable. Where it is not reasonably practicable to locate poles as specified, such poles may be erected at a distance nearer to the railway tracks provided that they are stayed in the direction away from the tracks. These requirements apply in all instances regardless of whether the pole is situated in or outside the rail corridor.

As far as is reasonably practicable, support structures for external third-party electric aerial crossings shall be located such that access into the rail corridor is not required for routine maintenance of the structure. When a structure is to be located within the rail corridor, external third-party organisations shall get written agreement from the maintainers of TfNSW heavy rail assets through the EIM.

All structures supporting a span of electric aerials over TfNSW heavy rail railway tracks shall be designed to withstand failure containment conditions, as set out in AS/NZS 7000. Supports shall be designed for the equivalent longitudinal loads resulting from all conductors on the structure in the adjacent span to the crossing being broken. The sag of the remaining conductors in the crossing span shall not infringe the applicable clearances nominated in Section 7.2.4.

7.2 Conductors

The minimum wire diameter of the conductor strands for crossing spans shall be 2.5 mm.

Steel conductors shall not be installed in crossing spans. ACSR may be installed.

7.2.1 Conductor support arrangement

Conductors in crossing spans operating at a voltage of less than or equal to 132 kV shall be terminated on their supporting structures either side of the railway tracks.

Conductors operating at less than or equal to 1 kV shall be terminated with shackle insulators that meet the requirements of AS 3608.

Conductors operating at voltages greater than 1 kV up to 132 kV shall be terminated with a tension insulator set that meet the requirements of the following Standards that is appropriate for the type of insulator selected:

- AS/NZS 2947.1
- AS/NZS 2947.4
- AS 4899
- AS 60305
- AS IEC 60433
- AS IEC 60720
- AS 61109
- AS 61952.

7.2.2 Conductor jumper loop or bridge

Connection between two lengths of electric aerials at a tension structure of a crossing span shall only be made at the conductor jumper loop or bridge where the electric aerial is not in tension. Refer to drawing TS 00251 for illustration.

7.2.3 Joints

Conductors shall have no joints in the crossing spans.

7.2.4 Heights

7.2.4.1 Above non-electrified tracks

The minimum height of electric aerial crossings above the top of the highest rail for non-electrified tracks under the worst sag condition shall not be less than that shown in Table 1.

The clearances have been calculated using a maximum height of 4.27 m for non-electric trains and adding it to the clearances from structures specified in AS/NZS 7000.

Table 1 – Minimum height of conductors above non-electrified tracks

Aerial crossing voltage (U)	Height above rail (m)
U ≤ 1 kV	7.0
1 kV < U ≤ 33 kV	8.0
33 kV < U ≤ 132 kV	8.8

Aerial crossing voltage (U)	Height above rail (m)
132 kV < U ≤ 275 kV	10.3
275 kV < U ≤ 330 kV	10.8
330 kV < U ≤ 500 kV	11.8

7.2.4.2 Above electrified tracks

Aerial crossing voltage of less than 2 kV shall not be used.

For voltages greater than 132 kV, the minimum height of electric aerial crossings above 1500 V dc overhead wiring and support structures shall be determined by the maintainers of TfNSW heavy rail assets. They shall also comply with ENA NENS 04.

The minimum height of electric aerial crossings above 1500 V dc overhead wiring and support structures for voltages between 2 kV and 132 kV shall not be less than that shown in Table 2.

In Table 2 OHW refers to 1500 V dc overhead wiring conductors and associated 1500 V dc equipment. Information on supporting structures of single mast, cantilever mast, portal structure and walkway is contained in the withdrawn standard TS 01656, which has been transferred to the operator and maintainer. Contact the operator and maintainer for information on TS 01656.

Table 2 – Minimum height of conductors above electrified tracks

Aerial crossing voltage (U)	OHW (m)	Single mast (m)	Cantilever mast (m)	Portal structure (m)	Walkway structure (m)
2 kV ≤ U ≤ 33 kV	3.7	3.7 (Note 1)	3.7	3.7	4.5
33 kV < U ≤ 132 kV	4.5	4.5 (Note 2)	4.5	4.5	5.0

Notes:

Note 1: May be reduced to 1.5 m for Sydney Trains distribution system HV aerial lines

Note 2: May be reduced to 2.5 m for Sydney Trains distribution system HV aerial lines

7.3 Guy arrangements

Guy wires shall not be buried in the ground.

Where there is a possibility of a vehicle collision, high-visibility sight guards shall be provided on all ground anchor installations to mitigate the risk of mechanical impact damage.

7.4 Crossarms

For Sydney Trains distribution system electric aerial lines, crossarms on crossing spans shall be galvanised steel. Refer to drawing TS 00252 for illustration.

Where single crossarm arrangement is used, the crossarm shall be fitted to the side of the pole remote from the railway tracks.

Where bolts are used through wooden crossarms in external third-party electric aerial lines, measures to prevent splitting of the crossarm shall be applied.

7.5 Accessories and hardware

Insulator and conductor fittings shall comply with AS 1154.1.

Ferrous metal fittings shall be galvanised in accordance with AS/NZS 4680.

Mild steel fasteners shall be galvanised in accordance with AS 1214.

7.6 Insulation coordination of crossing span

Insulation coordination measures shall be taken for all conductors operating between 1 kV and 66 kV that cross railway tracks or sidings. The insulation between the structure and each conductor on both sides of a crossing span support structure shall have a wet power frequency flash over 40 kV greater than that of the adjacent structures.

7.7 Prohibited configurations for crossings

Conductors operating at a voltage of less than 2 kV, including those forming part of a telecommunication system, shall not be installed directly over electrified railway tracks.

Note: OHEW and OPGW as part of an HV circuit may be installed.

Conductors shall not be installed directly over OHW open overlaps and normally opened switched open overlaps – refer to TS 03795 for description of open overlap and switched open overlap.

Angle of crossing between the conductors and the railway tracks shall not be less than 45°.

Conductors of external third-party organisations shall not be supported on Sydney Trains distribution system structures.

Aerial conductors of different circuits shall not cross each other over the railway tracks.

There shall not be more than one electric aerial crossing for each overhead wiring bay.

Crossing shall not be over three or more main line tracks, those being running lines normally used for running rail traffic through and between locations.

Pole height extension brackets shall not be used to carry conductors on crossing spans.

8 Additional requirements for electric aerials crossing over or under other Transport for NSW heavy rail infrastructure

All electric aerials crossing over or under Sydney Trains distribution system HV aerial line or over other TfNSW heavy rail infrastructure shall satisfy the conditions set out in Section 7.2.2, Section 7.2.3, Section 7.3 and Section 7.5.

Steel conductors shall not be installed in crossing spans. ACSR and aerial bundled cable conductors may be installed.

Conductors of external third-party organisations shall not be supported on Sydney Trains distribution system structures.

New or alteration to electric aerial crossings or TfNSW heavy rail infrastructure shall not result in prohibited activities, as specified in ISSC 20. Where controlled activities are to be implemented, the designer shall mitigate any safety risks associated with the activity. These controlled activities shall be approved by a TAO, the maintainer of the electric aerial, and the maintainer of rail assets.

9 External third-party design documentation

External third-party organisations shall submit all of the following design documentations with applications to the EIM:

- layouts of the electric aerials over or under Sydney Trains distribution system infrastructure
- profiles of the electric aerials over or under Sydney Trains distribution system infrastructure
- details of any earthing arrangement and provisions for electrolysis mitigation, where applicable
- underground services search for any proposed installations within the rail corridor.

The layout and profile shall be clearly dimensioned and show the following:

- approval for construction by the third-party organisation
- location of crossing span support structures and their distance from the railway tracks, including track kilometrage – refer to TS 03499
- the distance to adjacent OHW and Sydney Trains distribution system aerial line support structures either side of the crossing span, and their identification numbers
- Integrated Survey Grid or Map Grid of Australia coordinates of the support structures, based upon the coordinated design alignment of the adjacent rail track
- the RL of top of structures

- the RL of the electric aerial heights at the structures
- dimensioned clearances over TfNSW heavy rail tracks and infrastructure under worst-case conditions
- northern compass point
- buildings or structures within 20 m of the crossing span
- support structure material
- dimension of the structure
- specification of conductors, including OHEW and OPGW
- span lengths
- voltage of crossing span
- conductor attachment arrangements
- number of conductors
- minimum and maximum tension of conductors.

10 As-built design documentation

External third-party organisations shall submit as-built design documentations to the EIM within 30 days of commissioning.

The TAO responsible for maintaining Sydney Trains distribution system aerial lines shall update all affected TfNSW heavy rail documents to incorporate external third-party as-built crossings.

11 Geographic information system

The geographic information system (GIS) of the TAO maintaining Sydney Trains distribution system aerial lines shall be based on the updated as-built design documentation.

12 Data set associated with electric aerial crossings

For all electric aerial crossings, the following data shall be maintained, registered and stored by the TAO responsible for maintaining Sydney Trains distribution system aerial lines:

- the as-built plan of the electric aerial over or under TfNSW heavy rail infrastructure
- the as-built profile of the electric aerial over or under TfNSW heavy rail infrastructure.