Division / Business Unit: Engineering & Systems
Function: Electrical
Document Type: Standard

Requirements for Electric Aerials Crossing ARTC Infrastructure

EEG-00-01

Applicability

ARTC Network Wide	SMS

Publication Requirement

Internal / External

Primary Source

PYS 02 (v1.2)

Document Status

Version #	Date Reviewed	Prepared by	Reviewed by	Endorsed	Approved
1.0	23 Dec 21	Standards	Stakeholders (internal & external)	A/Manager Standards	A/General Manager Technical Standards 25/01/2022

Amendment Record

Amendment Version #	Date Reviewed	Clause	Description of Amendment
1.0	23 Dec 21		First issue of Standard with network wide applicability to supersede NSW Standard PYS 02 (v1.2). The changes provide for increased clearance for double stacked container trains on the Inland Route. It has also been aligned to AS/NZS 7000:2016 Overhead Line Design, with respect to issues such as electrical clearance above double stacked trains, pole design for wind load in accordance with the AS for electricity transmission and distribution, and pole distance from the track. Clearance requirements have also been updated to meet current aerials standards where there is currently no double stack container traffic. Other minor interface issues have also been addressed.

Table of Contents

1 Introduction

This publication sets out the design and construction Specification specific to electric aerials crossing over the Australian Rail Track Corporation's (ARTC) infrastructure with emphasis on electric aerials that cross ARTC's railway tracks.

Electric aerials crossing over railway tracks or sidings shall not be installed, altered, or renewed without ARTC approval.

The Specification is applicable to all electrical structures and equipment including conductors, crossarms, insulators, line equipment, stay wires and attachments associated with the transmission, distribution, and supply of electricity.

This publication supersedes Requirements for Electric Aerials Crossing ARTC Infrastructure - PYS 02 (RIC Standard: EP 10 01 00 05 SP).

The requirements for undertrack crossings are contained in AS 4799:2000 Installation of underground utility services and pipelines within railway boundaries; and ARTC Standard ETG-17-01 Installation of Utility Services and Pipelines within railway boundaries.

1.1 References

All references are updated, and the latest edition of the publication referred to applies.

AS/NZS 7000:2016	Overhead Line Design
AS 4799:2000	Installation of underground utility services and pipelines within railway boundaries
ETG-17-01	Installation of Utility Services and Pipelines within Railway Boundaries
EGP-04-01	ARTC Engineering Drawings and Documentation
Section 7	ARTC Track & Civil Code of Practice – Clearances
INF-SP-101	Technical Specification for Asset Field Data Collection

1.2 Australian standards

Standards that also apply include, but are not limited to the latest publication of the following:

AS 1154.1:2009 Insulator and conductor fittings for overhead power lines – Part 1: Performance, material, general requirements and dimensions

AS/NZS 1214:2016 Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)

AS 3608:2005 Insulators – Porcelain and glass, pin and shackle type – Voltages not exceeding

1000 V ac

AS 4435.1:1996 Insulators – Composite for overhead lines – Voltages greater than 1000 V ac

AS/NZS 2947:1999 Insulators – Porcelain and glass for overhead power lines – Voltages greater than 1000 Vac

AS/NZS 4680:2006 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

2 Definitions

Term or acronym	Description
ACSR	Aluminium Conductor Steel Reinforced
ARTC	Australian Rail Track Corporation Ltd.
Conductor	Any electric current carrying medium
Crossing	All components used for the construction and support of electric aerials that cross ARTC railway tracks, including conductors and structures.
Crossing span	The bay of an electric aerial that crosses ARTC railway tracks or sidings.
Electric Aerial	Any bare conductor which is placed above ground, in the open and is suspended between two or more supports.
Install	Includes construct, erect and carry.
Mainline Track	Track used for the running of rail traffic through and between locations
Overhead Line equipment	The structures and overhead equipment necessary for the traction power supply for electric rolling stock. (OLE)
Owner	The owner of the electric aerial
RIM	Rail Infrastructure Manager
Structure	Includes poles, towers, stay wires, crossarms, insulators, equipment and all attachments.

All other relevant definitions are contained in AS/NZS 7000:2016.

3 Scope and application

This standard applies primarily to the design and installation of new electric aerials over ARTC tracks.

The application, design, installation and quality of materials used for all new and proposed electrical aerial crossings over the ARTC track by an Owner and all other proponents shall comply with:

- the requirements of any state legislation and regulations
- the requirements of AS/NZS 7000:2016
- the requirements specified in this document
- the Standards and Procedures of the Owner
-

Maintenance and like for like renewals by the Owner of existing electrical assets shall be undertaken in accordance with:

- the Standards of the Owner
- AS/NZS 7000:2016 and all other relevant Australian Standards
- Sections 3.3, 3.5 and 3.6 and 4 of this document.

Where this is not practicable the Owner or proponent shall submit any non-compliances to ARTC for approval.

In no instances shall a reduction to existing electrical clearances be permitted.

Where ARTC requests a modification to an Owners' existing electric aerial ARTC shall propose to the Owner the sections of this document it would like to apply to the modification.

Clarification should be sought from ARTC where the intent of this standard is unclear.

Except where ARTC is the proponent of the work, applications will only be accepted where they have been certified by the ultimate Owner of the electrical infrastructure. Conductor clearances

3.1.1 Basis of clearance values

In all instances, minimum clearances from top of rail to conductors shall be those under the most unfavourable conditions of temperature and loading with the following criteria applying:

- For mainline track - AS/NZS 7000:2016 Table 3.7 Criteria D*: "In any direction from those parts of any structure not normally accessible to persons"* – plus clearance above Structure Outline F Appendix B10 Section 7 "Clearances" (7100mm).
- For sidings, yards, balloon loops etc where trains could remain stationary - AS/NZS 7000:2016 Table 3.7 Criteria B: "*Vertically above those parts of any structure not normally accessible to persons but on which a person could stand"* – plus clearance above Static Rollingstock Outline F Appendix B1 Section 7 "Clearances" (6500mm).
- Non-current carrying electrical assets shall comply with Outline F Appendix B10 Section 7 "Clearances" (7100mm).

** Upon application and where ARTC determines that it is extremely unlikely that Rollingstock Outline F will be used on a specific section of its Network Rollingstock Outline, values may be amended to accommodate the most likely train consists in that section in accordance with the*

ARTC Track and Civil Code of Practice – Section 7 Clearances and the ARTC Route Access Standard (RAS).

3.1.2 Clearances over non electrified tracks

The height of the conductors 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.

Aerial Crossing Voltage (U)	Minimum Height Above Rail Design Level for mainline track (m)	Minimum Height Above Rail Design Level in yards, sidings, and balloon loops (m)
0V < U ≤ 1000V	7.70	9.45
1000V < U ≤ 33kV	8.60	10.45
33kV < U ≤ 132kV	9.60	11.25
132kV < U ≤ 275kV	10.60	12.75
275kV < U ≤ 330kV	11.10	13.25
330kV < U ≤ 500kV	12.10	14.25

Table 1 – Minimum Electrical Clearances

3.1.3 Clearances over electrified tracks

The height of the conductors above overhead wiring and support structures under the worst sag condition shall not be less than that shown in Table 2.

Aerial crossing voltage	Aerial crossing minimum height above Overhead wire or supporting structure	
	Overhead Line Equipment	Overhead wire supporting structure with walkway
2 000 V ≤ U ≤ 33 000 V	3.7 m	4.5 m
33 000 V < U ≤ 132 000 V	4.5 m	6.0 m
132 000 V < U ≤ 275 000 V	5.5m	7.0 m
275 000 V < U ≤ 330 000 V	6.4 m	7.9 m
330 000 V < U ≤ 500 000 V	By application to ARTC	

Table 2 – Height of conductors above electrified tracks

All clearance requirements of this standard shall only apply to ARTC owned or managed tracks. Clearances within shared corridors, where adjacent tracks are owned by other Rail Infrastructure Managers (RIM), shall be assessed, and managed by the electrical asset owner and that RIM of the adjacent track.

3.1.4 Design

All structures supporting a span of electrical aerials over ARTC railway tracks shall be designed in accordance with AS/NZS 7000:2016 and certified as compliant to this Standard and AS/NZ 7000:2016 by the ultimate Owner.er. All structures and associated conductor attachments each side of the crossing span, supporting voltages below 110kV, shall be full termination structures.

Transmission structures 110kV and above shall have a security Level III with a minimum Wind Return Period of 400 years. Structures, supporting voltages below 110kV shall have a security Level II with a minimum Wind Return Period of 100 years. Structures and crossarms may be of material permitted by AS/NZS 7000:2016.

3.1.5 Location

New structures located at or near level crossings shall be positioned so as not to impact on sighting distances applicable to approaching trains and road users.

All new electrical structures shall be located outside the rail corridor.

For renewal or modification works, where land tenure permits, structures supporting the crossing span shall be located outside the rail corridor.

All structures supporting a span of electric aerials over ARTC railway tracks shall be so located that in the event of failure no part of them will fall within 1.8m of the outside rail of the closest railway track.

Where it is not practicable to locate structures as specified, structures may be erected at a distance nearer the railway tracks provided they are stayed to the satisfaction of ARTC. Any stays and structures shall be so located so as not to create an obstacle to the operation and maintenance of the railway. Stay wires shall be fitted with an approved strain insulator located a minimum of 3m above ground level and shall have a suitably visible stay guard.

Upon application ARTC may permit structures to be self-supporting provided that a design solution poses little probability of the structure falling towards the track and the design is and certified by the owner

3.2 Foundations

Prior to any excavation within the rail corridor an underground services search shall be carried out to identify any ARTC or other underground services.

No excavated spoil is to come in contact with the rail ballast.

Timber poles shall be installed as per the requirements of the relevant electrical infrastructure owner, however a concrete foundation shall not be used.

Any design of reinforced concrete foundation for structures other than timber poles shall be certified by the owner.

3.3 Angle of crossing

For new crossings the angle of crossing between the conductors and the railway tracks shall be between 90° and 45°. ARTC may accept a reduction of this angle if the Owner can demonstrate that there are unreasonable property constraints to achieving this requirement and that the

installation will not result in hazardous induced touch voltages on conductive rail assets (e.g. pipe, fences, cables, rail).

3.4 Conductors

3.4.1 Support

All electric ariels operating at a voltage of less than 110kV shall be fully terminated on the structure either side of the crossing span. The use of pin insulators shall not be permitted.

3.4.2 Cross arms

On pole structures with face fitted crossarms any new or replaced cross arms shall be fitted to the side of the pole which is not facing the rail tracks.

3.4.3 Mid Span Joints

There shall be no joint nor splice in any conductor for any span over the rail corridor unless approved by ARTC.

3.4.4 Steel Conductors

Steel conductors, other than greased ACSR and earth wires, shall not be installed in crossing spans within 25 km of the seashore but special consideration will be given to areas of high altitude less than 25 km from the coast.

In inland areas steel conductors, other than ACSR and earth wires, shall not be installed within 3 km of industrial plants that discharge air pollutants which form acids with airborne moisture.

Any staywires crossing the track shall have a strain insulator installed such that in the event of failure the staywire attached to the structure shall not fall within the rail corridor.

3.4.5 Multiple Circuits

Aerial conductors of different circuits (not including earth wires and stays) shall not cross each other if they are not attached to the same structure.

Where two circuits of different voltage are carried on the same structures and share the same spans, conductors of a higher voltage shall be placed above a lower voltage circuit.

3.5 Accessories and Hardware

3.5.1 Below Ground Earthing

Any below ground earthing shall be positioned so as to ensure that the Earth Potential rise under fault conditions is negligible at the rail corridor boundary (or at 15m from any rail infrastructure if there is no clear boundary line).

3.5.2 Fastenings

All ferrous metal fittings such as insulator pins, shackles, straps, struts, clevises, bolts and the like shall be galvanized, or be stainless steel, to the relevant Australian Standard.

Coach screws shall not be used for termination purposes.

4 Data set requirements

A plan and profile in both hard copy and native format shall be provided to ARTC for any works associated with the design, installation and modifications to electric aerial crossing railway tracks or sidings for approval by ARTC. It shall be clearly dimensioned and show:

- A locality plan
- A plan and profile of the crossing span, including initial conditions and design temperature
- The track kilometrage relative to the railway km posts
- The location of any electrical aerial structures and their distance from the railway tracks and from any electric aerials or structures on the rail corridor
- Any buried services identified
- Cadastral boundaries
- The dimensioned minimum clearances over ARTC infrastructure under worst sag conditions.
- The Northern compass point
- The structure material
- The foundation details
- The structure ID
- MGA 2020 coordinates of structure locations
- Height of structure above ground level
- The conductor type, size and number
- The tension of the conductor under worst conditions of temperature and/or wind in both kN and % of UTS
- The crossing span length
- Crossing span voltage
- Method of conductor attachment
- The direction to and the name of the closest station either side of the crossing
- Where applicable, details of any earthing installations and provisions for electrolysis mitigation
- In the electrified area the distance to the adjacent overhead wiring support structures and their identification numbers.

Within 30 days of installation the following ‘as built’ documentation shall be supplied to ARTC:

- The schedule “Australian Rail Track Corporation - Electric Aerial Crossing Data Sheet” duly completed for each electric circuit (the schedule is shown in Appendix 1)
- The “as constructed” profile of the electric aerial crossing
- Data as specified in INF-SP-101 Technical Specification for Asset Field Data Collection.

Applicants for new electric aerial crossings over railway tracks or sidings shall ensure that the “as constructed” plan of the electric aerial crossing conforms with the requirements of EGP-04-01 and that a plan of search results of ARTC underground services as well as other underground services for any proposed foundations on the rail corridor is supplied to ARTC.

This data shall be maintained, registered and stored by the relevant ARTC Maintenance Provider for each electric aerial crossing railway tracks or sidings.

Appendix 1 – Electric Aerial Crossing Data Sheet

Location and voltage details					
Nearest railway: station:		From:		To:	
Aerial Crossing voltage:	V	Track Kilometrage:			km
Owner:		Number of tracks crossed:			
Conductor details					
Number of conductors:		Size of conductors:			mm
Type of conductors:		Angle between crossing span and tracks: (a) Diagram 1			
Initial Conditions	%UTS kN	Maximum tension under worst conditions			%UTS kN

Structure details	Structure No. 1	Structure No. 2
Structure Number:		
Foundation Type		
Structure material (wood, concrete, steel etc)		
Depth in ground:	m	m
For poles, diameter at ground level:	mm	mm

Crossarm details for pole structures		
	Pole No. 1	Pole No. 2
Crossarm material (timber, fibre composite or steel):		
Method of crossarm attachment to pole:		
Crossarm config. (single or double):		

Pole relative levels		
	Pole No. 1	Pole No. 2
Ground RL:		
Lowest attachment RL:		
Next attachment RL:		

Next attachment RL:		
Next attachment RL:		

Horizontal distances – Refer Diagram 1	
Distance (R1) from structure* P1 to ARTC boundary (including negative distance):	m
Distance (R2) from structure* P1 to closest rail:	m
Crossing span length (R3):	m
Distance (R4) from structure* P2 to closest rail:	m
Distance (R5) from structure P2* to ARTC boundary (including negative distance):	m
Distance (R6) from structure* to overhead electrical in rail corridor (where applicable):	m
Distance (D1) from centre line of Owners overhead electrical crossing to structure P3 (where applicable):	m
Distance (D2) from centre line of Owners overhead electrical crossing to structure P4 (where applicable):	m
Angle Θ of crossing to centre line of track:	degrees
Angle Φ of crossing to overhead electrical in rail corridor (where applicable):	degrees

*If the structure is a tower the distance shall be measure from the closest tower leg to the rail. Where the structure has more than one pole, the closest pole to the rail shall be used for measurement.

Diagram 1 – Electric aerial crossing plan. Other aerials that cross above or below the crossing span