Ensure paragraph marks are showing to read instructions and see placeholder text. Delete this text.

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RISSB Contact details:

Head office:

Phone:	Email:	Web:
(07) 3724 0000 +61 7 3724 0000	info@rissb.com.au	www.rissb.com.au

Standard Development Manager:

Name:	Phone:	Email:
Carly Wilson	0419 916 693	cwilson@rissb.com.au

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Data entry – draft starts next page

Standard number	AS 7630
Version year	2024
Standard name	Track Classification
Standing Committee	Infrastructure
Development group member organisations	Calibre Group QUBE ARTC ONRSR Yarra Trams PTA WA TfNSW Roy Hill Iron Ore DTP Vic Queensland Rail Monash Institute of Railway Technology Mott MacDonald
Review type	This Standard was issued for public consultation and was independently validated before being approved.
First published	AS 7630:2010
ISBN	978-1-76035-690-3
SDM name	Carly Wilson
SDM phone	0419 916 693
SDM email	cwilson@rissb.com.au

Development draft history

Draft version	Draft date	Notes
v0.3	6/09/2023	Draft for DG meeting #1.1
v0.4	10/10/2023	Draft for DG meeting #2
v0.5	26/10/2023	Draft for DG meeting #3
v0.6	17/11/2023	Draft for DG review

Preface

This standard was prepared by the Track Classification AS 7630 Development Group, overseen by the RISSB Infrastructure Standing Committee consisting of representatives from the following organisations:

ARTC	Calibre Group	DTP Vic
Monash Institute of Railway Technology	Mott MacDonald	ONRSR
PTA WA	QUBE	Queensland Rail
Roy Hill Iron Ore	TfNSW	Yarra Trams

Objective

The objective of this Standard is to:

- Provide a nationally consistent performance-based method for track classification that is applicable to all new, upgraded, and existing heavy railways in Australia.
- Enable RIMs to allocate a track classification to all heavy railway track sections for which they are responsible.
- Provide guidance for owners and operators of rolling stock to more readily determine if their rolling stock can physically access a track corridor(s) for which any RIM is responsible by adopting the concept of route availability in addition to the track classification.
- Encourage RTOs to consider, when acquiring new assets, or replacing or upgrading existing assets, how those assets could be configured to lead to increased interoperability within their own railway network, and between other railway networks.
- Through improved interoperability, increase the railway industry's competitiveness and range of commercial opportunities.

This standard is a revision of the previously published 2017 version which includes updates to provide additional guidance on functional and performance requirements for track classification, the consideration of route availability for rolling stock access, and the corresponding infrastructure considerations for track structure, earthworks, civil structures, and wayside systems contained within the heavy railway corridor.

Principles of Track Classification

The concept of route availability encourages interoperability, a key precept of the National Rail Action Plan. This approach allows the description of the track section classification to be used by the owners and operators of rolling stock to readily assess whether their rolling stock can physically access a given track section or series of track sections forming an overall journey.

Compliance

There are four types of provisions contained within Australian Standards developed by RISSB:

(a) Requirements.

(b) Recommendations.

(c) Permissions.

(d) Constraints.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term ‘shall’.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred. Recommendations are identified within the text by the term ‘should’.

Recommendations recognize that there could be limitations to the universal application of the control, i.e. the identified control is not able to be applied or other controls are more appropriate or better.

Permissions – conveys consent by providing an allowable option. Permissions are identified within the text by the term ‘may’.

Constraints – provided by an external source such as legislation. Constraints are identified within the text by the term ‘must’.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities or interfacing organisations where the risk may be shared.

RISSB Standards address known hazards within the railway industry. Hazards, and clauses within this Standard that address those hazards, are listed in Appendix A.

Appendices in RISSB Standards may be designated either “normative” or “informative”. A "normative" appendix is an integral part of a Standard and compliance with it is a requirement, whereas an "informative" appendix is only for information and guidance.

Contents

Figures

Tables

Section 1 Scope and General

1.1 Scope

The purpose of this standard is to set-out the guiding principles and parameters that shall be used by a RIM to classify heavy railway networks whilst also considering the concept of route availability for rolling stock.

The intent is to provide a consistent track classification method that can be readily used by RTOs to assess whether rolling stock can access a given track section or series of track sections that forms an overall journey. Inclusion of route availability in the track classification method enables the consideration of physical parameters that govern the accessibility of rolling stock on a railway track section.

This Standard applies to all existing, upgraded and new heavy rail networks in Australia over 600 mm track gauge including heritage and tourist railways.

This Standard does not apply to light rail corridors and high-speed rail corridors.

This Standard is the lead standard for track.

By following this standard, the RIM shall undertake its own assessment to classify track sections that are under their responsibility.

1.2 Normative references

The following documents are referred to in the text in such a way that *some* or all of their content constitutes requirements of this document:

- AS 1597: Precast Reinforced Concrete Box Culverts.
- AS 1742.7: Manual of uniform traffic control devices Railway crossings.
- AS 2566.1: Buried flexible pipelines Structural design.
- AS 3725: Design for Installation of Buried Concrete Pipes.
- AS 4678: Earth-retaining structures.
- AS 4799: Installation of underground utility services and pipelines within railway boundaries.
- AS 5100: Bridge design series.
- AS 7508: Track Forces and Stresses.
- AS 7514: Rolling stock – Wheels.
- AS 7636: Railway Structures.
- AS 7637: Railway Infrastructure - Hydrology and Hydraulics.
- AS 7638: Railway Infrastructure - Earthworks.
- AS 7639: Track Structure and Support.
- AS 7658: Railway Infrastructure - Railway Level Crossings

NOTE:

Documents for informative purposes are listed in a Bibliography at the back of the Standard.

1.3 Defined terms and abbreviations

For the purposes of this document, the following terms and definitions apply:

1.1.1
axle load
The weight force exerted on the rails by the two wheels on any axle of a vehicle when stationary.

1.1.2
at grade crossing
A crossing of a track by a roadway or pedestrian crossing at the same elevation. Also known as 'grade crossing'.

1.1.3
kinematic outline
A two-dimensional cross-section of the shape of a rail vehicle that consists of the static outline plus the maximum permitted allowance for vertical bounce upwards, plus lateral and roll movements in response to a steady-state cant deficiency force at maximum permitted cant deficiency (or the maximum permitted installed cant), and the dynamic movements in response to track irregularity.

1.1.4
lateral wheel to rail force
The lateral force between an individual wheel and the rail, including force components at the wheel tread and/or flange, depending on the contact conditions.

1.1.5
heavy railway
Any railway not classified as a light railway, tourist railway or a heritage railway, which has the capacity for a high volume of traffic and characterised by exclusive rights-of-way, multi-car trains, specific signalling system, platform loading, having a track gauge greater than 600mm, and a track speed of 40km/h or greater.

1.1.6
heritage and tourist railway
A railway preserved for its historical value that is not connected to another heavy railway network or operates independently from any other heavy railway network that it is connected to.

1.1.7
high speed railway
A railway that is capable of accommodating rolling stock which can travel at speeds of greater than 160km/h.

1.1.8
light railway
A passenger-carrying railway system operating with trams or other similar shorter length, lower speed and lower axle-load self-propelled rail vehicles. Light railways are typically located in urban areas and often have a shared right-of-way with road traffic.

1.1.9
main line
The line normally used for running trains through and between locations.

1.1.10

National Rail Action Plan (NRAP)
NRAP is run by the National Transport Commission to lead governments and industry to maximise the benefits from investment in Australian rail projects and overcome the legacy of different rail gauges, rolling stock types, and signalling systems.

1.1.11
P/D ratio
The ratio of the maximum static wheel load (P) to the minimum worn wheel diameter (D).

1.1.12
P2 force
Total vertical force (static plus 'low frequency' dynamic forces) per wheel when the rail vehicle operates over a defined angular discontinuity (dip) in the rail vertical profile, representing an idealised dipped rail joint. The dynamic component of P2 Force is directly proportional to speed.

1.1.13
rail infrastructure manager (RIM)
In relation to rail infrastructure of a railway, means the person who has effective control and management of the rail infrastructure, whether or not the person:

(a) Owns the rail infrastructure; or

(b) Has a statutory or contractual right to use the rail infrastructure or to control, or provide, access to it.

1.1.14
rail transport operator (RTO)
An organisation that has an agreement with a Rail Infrastructure Manager (RIM) to enter and use a railway network as follows:

(a) A rail infrastructure manager (RIM); or

(b) A rolling stock operator (RSO); or

(c) A person who is both a rail infrastructure manager (RIM) and a rolling stock operator (RSO).

1.1.15
reference rolling stock outline
The three-dimensional size of a reference vehicle (as per AS 7507), which consists of three specific parts, the reference static outline, reference kinematic envelope and the reference swept outline.

1.1.16
reference vehicle
A rail vehicle whose rolling stock outline (as per AS 7507) has been accepted by the RTO as being acceptable to operate over a defined track section or overall route.

1.1.17
regulator
A government body responsible for ensuring compliance with particular laws, acts, regulations etc., e.g. rail safety regulator.

1.1.18
rolling stock
Any vehicle that operates on, or intends to operate on, or uses a railway track, but excluding a vehicle that is designed for both on and off-track use when not operating on the track. Rolling stock is a collective term for

a large range of rail vehicles of various types, including locomotives, freight wagons, passenger cars, track machines and road-rail vehicles.

1.1.19
rolling stock operator (RSO)
A person or organisation who has effective control and management of the operation or movement of rolling stock on rail infrastructure but does not include persons driving the rolling stock nor persons who control the network and signals.

1.1.20
rolling stock outline
A generic term for the three-dimensional size of a rail vehicle including its swept movements that consists of three specific parts, the static outline, the kinematic outline and swept kinematic outline.

1.1.21
route availability
The assessment process used to determine if a rail vehicle can physically access a track section or series of track sections that form an overall journey. The parameters of Route Availability are Track Gauge, Reference Rolling Stock Outline, Ruling Grade, Lateral Wheel to Rail Force and P/D ratio.

1.1.22
ruling grade
The steepest vertical gradient within a track section or overall route that limits the through load and/or rail vehicle that can traverse that route.

1.1.23
structure gauge
The outline relative to the track cross-section that defines the limiting cross-sectional envelope which no part of any structure or trackside fixture may infringe.

1.1.24
track gauge
The distance between inside running (or gauge) faces of the two rails, measured between points 16mm below the top of the rail heads.

1.1.25
track section
The section of railway track between two locations specified for operating purposes.

1.1.26
track speed
The allowed maximum speed in kilometres per hour (km/h) over a section of track.

1.1.27
train speed
The maximum speed in kilometres per hour (km/h) that a rail vehicle is capable of operating over a track section, either at or below the track speed.

General rail industry terms and definitions are maintained in the RISSB Glossary. Refer to: https://www.rissb.com.au/products/glossary/

Section 2 Application of this Standard

2.1 General considerations

Track classification shall be set based on the following approach;

(a) Minor alterations or additions to existing infrastructure shall consider the impact they may have on the track classification if they do not employ the same standards as existing.

(b) Track infrastructure shall be compatible and capable of operation with the infrastructure in adjoining sections for the purposes of interoperability.

(c) This Standard does not include hazard identification as this will be covered in other individual standards and identified in the associated Hazard Register.

(d) Any variation in maximum allowable track speed on defined track sections under speed restrictions (such as due to axle loads, track defects, altered geometry etc.) shall be determined by conducting a risk assessment and obtaining the approval of the RIM. Alterations to the track classification shall then be re-assessed and communicated to all interested parties.

(e) The capable train speed for both current and foreseeable future rolling stock that do or will use the section of track being classified.

(f) The current and foreseeable future maximum axle loads that do and will use the section of track being classified.

Section 3 Track classification parameters

3.1 General

This standard uses a hierarchy of how heavy railway track sections are classified based on the following:

(a) Route availability based on physical characteristics:
  (i) Track Gauge.
  (ii) Reference Rolling Stock Outline.
  (iii) Ruling grade.

(b) Route availability based on engineering parameters:
  (iv) Maximum Lateral Wheel to Rail Force.
  (v) Maximum P/D ratio.
  (vi) Static Axle Load Limit.
  (vii) P2 Force Limit.

The RIM shall classify all track sections under their responsibility according to the above parameters and the methodology presented in Sections 4 and 5, and the worked example presented in Appendix A of this standard.

An operator and/or owner of rolling stock shall similarly classify each rail vehicle using the same classification method such that the class of track on which it is able to operate is visible by inspection.

3.2 Track gauge

A common track gauge is necessary for route availability. The existing track gauges of broad (1600mm), standard (1435mm), narrow (1067mm) and the type of mixed gauge track sections shall be considered.

3.3 Reference rolling stock outline

The operators and owners of rolling stock shall categorise their rail vehicles against the RISSB reference rolling stock outline(s) in accordance with AS 7507.

The RIM is responsible for specifying the appropriate reference rolling stock outline(s) for each track section they are responsible in accordance with AS 7507.

3.4 Ruling grade

The RIM shall nominate the ruling grade for each track section.

Based on the ruling grade within a track section or the steepest ruling gradient within a series of track sections that forms an overall journey, RSO's shall assess if their rolling stock can traverse such gradients based on relevant loading conditions.

3.5 P/D ratio

P/D ratio is a measure of rail contact stress which is calculated by dividing the maximum static wheel load (P) that a rail vehicle imposes on a rail by the minimum allowable worn wheel diameter (D) for that rail vehicle.

The calculation of P/D ratio force shall be in accordance with AS 7508, Equation 4.1.

RTO approved rolling stock wheel profiles shall be in accordance with AS 7514.

3.5.1 P/D limits

The RIM shall specify a maximum P/D ratio that any rail vehicle may impose on the track structure for a section of track.

The limit in maximum P/D ratio for non-conformal contact (as per AS 7508, Equation 4.1) generally applies to conventional rolling stock for conventional rail operations.

Typical P/D values are shown in the table below.

Table 1 – Typical P/D Ratio Limits

Area of operation	P/D ratio limit (kN/m)
Unrestricted Limit	125
Restricted Limit	147

Note:
Rolling stock with a P/D ratio greater than the unrestricted limit shall operate with restrictions in place. RIMs shall define the restrictions that apply to rolling stock that exceeds the unrestricted P/D limit.

Higher P/D limits than the above may be allowed by RIMs due to higher strength materials, annual tonnages, consistency of loading, rail and wheel profile characteristics and maintenance practices, and other factors specific to the track section.

It is recommended that advice is sought from the RIM on their allowed P/D limits.

3.6 Lateral wheel to rail force

The lateral wheel to rail force shall be determined in accordance with AS 7508, Section 7.2.

Each track section shall be allocated by the RIM a maximum allowed lateral wheel to rail force as follows below unless specified otherwise:

(a) 84 kN for the interstate standard gauge network.

(b) 84 kN for track with rail sizes of greater than 41 kg/m and resilient rail fastenings, excluding Queensland 1067mm gauge track.

(c) 50 kN for the Queensland 1067mm gauge and all other track.

3.7 Static axle load (P)

Each track section shall be allocated by the RIM a maximum static axle load (P) that any train may impose on the track and railway structures.

Refer to Section 6.3 for further guidance on the axle loading design of railway structures.

3.8 P2 force

Each track section shall be assessed for the maximum P2 Force that a rail vehicle may impose on the track structure.

The calculation of P2 Force shall be in accordance with AS 7508, Equation 5.1.

3.8.1 Vehicle speed

For route availability and the calculation of P2 Force, the nominated speed of the rail vehicle should be the track speed or train speed.

Confirmation from the RIM shall be sought on the speed value to be adopted, which may differ for the rolling stock type, rolling stock configuration, or for other reasons.

3.8.2 P2 force limit

The P2 Force exerted by a rail vehicle travelling over a dipped weld in one rail shall not exceed the limits specified by the RIM for a section of track.

Section 4 Method of track classification

4.1 Route availability

The RIM shall determine the route availability parameters for all track sections under their responsibility in accordance with Section 3 above. The route availability parameters include;

(a) track gauge
(b) reference rolling stock outline
(c) ruling grade
(d) lateral wheel to rail force; and
(e) P/D ratio.

4.2 Track section classification

The RIM shall classify track sections under their responsibility based on the P2 Force Limit and Axle Load Limit that they will allow within a track section.

Typically, track sections may need to cater for different rolling stock that have varying axle loads and operating speeds. The P2 Force Limit, which considers both the operating speed and static axle load as input parameters, allows for such combinations to assess train interoperability with respect to the track classification.

Refer to Appendix A for a worked example of P2 Force calculation and the resulting track classification which uses the below track classification matrix in Figure 1.

Figure 1 – Track classification matrix

STATIC AXLE LOAD LIMIT (t)	P2 FORCE LIMIT (kN)				
	300-250	249-220	219-190	189-160	159-130
	A	B	C	D	E
	TRACK CLASS				
40	A40	B40	C40	D40	E40
30	A30	B30	C30	D30	E30
25	A25	B25	C25	D25	E25
23	A23	B23	C23	D23	E23
21	A21	B21	C21	D21	E21
20	A20	B20	C20	D20	E20
19	A19	B19	C19	D19	E19
17	A17	B17	C17	D17	E17

Note:
Common railway industry axle load limits can be classified by applying this value as a suffix to the alphabetical category of the P2 Force limit. For example, a 23-tonne axle load limit and a P2 Force limit of 200kN would give a track classification of C23 track.

Section 5 Documentation of track classification

5.1 Record keeping

The RTO shall appropriately document an electronic record of Heavy Railway track sections for which they are responsible that are classified according to the methodology provided in Sections 3 and 4.

To define the track section, place names such as stations or junctions can be used, which is recommended to also be supplemented by kilometrage expressed to the nearest lineal metre.

5.2 Accessibility of records

The register of track section classifications by the RTO shall be made available in an electronic location accessible by any person requesting the information that is given authorisation by the RTO.

5.3 Updating of records

Track classifications shall be updated whenever the following circumstances apply:

(a) There is a change to any of the dimensions which form part of track classification for any track section; OR

(b) There is a change to the Heavy Railway network's physical configuration such that a new track section(s) result, or existing track section(s) are altered.

The updates above need only include changes to existing classified track sections, or the recording of the classification of newly constructed track sections.

Section 6 Design considerations for railway infrastructure

6.1 Track structure

Track structure typically consists of the rails, fastenings, sleepers, ballast and formation.

Ballasted and non-ballasted track structure shall be designed in accordance with AS 7639 and any other applicable RTO standards.

The selection of rail size and type, sleeper type, fastening system and ballast depth for a track section shall include assessment for both the track classification and the other parameters in Section 3 that would influence the track structure design.

6.2 Earthworks and drainage

Railway earthworks including but not limited to embankments and cuttings shall be designed in accordance with AS 7638 and any other applicable RTO standards.

Railway drainage systems including but not limited to longitudinal drainage and cross drainage shall be designed in accordance with AS 7637 and any other applicable RTO standards.

The design of railway earthworks and drainage shall consider the track classification for that section of track and the parameters in Section 3 that influence their design.

6.3 Railway structures

Railway structures including bridges and retaining walls shall be designed in accordance with AS 7636, AS 5100, AS 4678 and any other applicable RTO standards.

Culvert structures shall be designed and load rated in accordance with AS 1597.

The design of railway structures shall consider the track classification for that section of track and the parameters in Section 3 that influence the structural design.

6.4 Tunnel Structures

Tunnel structures shall be designed in accordance with AS 7636, AS 5100, and any other applicable RTO standards.

The design of tunnel structures should consider the track classification for that section of track and the parameters in Section 3 that influence the tunnel structural design.

For track sections with tunnels, that RIMs shall typically adopt track structure that is associated with higher track classifications. This is due to the potential heightened risk profile for tunnel structures with respect to collision loading, rolling stock kinematic envelope and structure gauge clearances.

6.5 Below Ground Utilities

Below ground utilities that are located within the railway corridor shall be designed and installed in accordance with AS 4799, and any other applicable RTO or utility owner standards.

Rigid concrete buried pipes shall be designed in accordance with AS 3725, and flexible buried pipes shall be designed in accordance with AS 2566.1.

The design of all underground utilities and pipes shall consider the track classification for that section of track and the parameters in Section 3 that influence their design.

6.6 Wayside Assets

Wayside assets within the rail corridor shall be designed in accordance with applicable Australian Standards and RTO standards.

The design of wayside assets shall consider the track classification and the parameters in Section 3 that influence the selection of asset types and their design. Such parameters to be considered for the design of wayside assets may include track speed, traffic type and structure gauge.

6.7 Level Crossings

The introduction of new level crossings and pedestrian crossings should be avoided where possible across all Australian railway corridors (new and existing) notwithstanding the track classification type.

Risk assessment shall be undertaken for any newly proposed level crossings or pedestrian crossings.

Railway crossings shall be designed in accordance with AS 7658, AS 1742.7 and applicable RTO standards.

Appendix A Worked Example of P2 Force Calculation

1. P2 Force equation from AS 7508 Clause 5.2 (which factors in the vehicle speed and axle load)

P2 force calculation Equation 5.1

$$P_2 = P_0 + 2\alpha . V \left[\frac{M_u}{M_u + M_t}\right]^{0.5} \times \left[1 - \frac{C_t . \pi}{4.[K_t.(M_u + M_t)]^{0.5}}\right] \times [K_t . M_u]^{0.5}$$

where

P_2 = *force (kN)*
P_0 = *vehicle static wheel load (kN)*
M_u = *vehicle unsprung mass per wheel (kg)*
2α = *included angle of dip, nominally 0.010 or 0.014 radians*
V = *vehicle velocity (m/s)*
K_t = *equivalent track stiffness (MN/m)*
C_t = *equivalent track damping (kNs/m)*
M_t = *equivalent track mass (kg)*

2. Typical track input parameters from AS 7508 Clause 5.2

Table 5.2 - Typical track parameters for equation 5.1

Network	Rail size kg/m	Equivalent track stiffness, K_t MN/m	Equivalent track damping, C_t kNs/m	Equivalent track mass, M_t kg
Interstate Corridor	<53	96	50	232
	≥53	110	52.5	310
Hunter Valley	≥53	117	56	338
Sydney	<53	110	52.5	135
	≥53	100	48	117
Queensland narrow gauge	>41	109	52	133
Typical value for all other routes, (but user should check with Rail Infrastructure Manager)	≥53	109	52	133

Note: User should check with Rail Infrastructure Manager for the actual values for all networks

3. Example P2 Force calculation for three different rolling stock vehicle types traversing the same track section

Vehicle 1		
110km/h speed 19t Axle Load		
V	110	km/h
V	30.56	m/s
M_u	1000	kg
2α	0.014	radians
K_t	109	MN/m
C_t	52	kNs/m
M_t	133	kg
P_0	93	kN
P2	210	kN

Vehicle 2		
80km/h speed 25t Axle Load		
V	80	km/h
V	22.22	m/s
M_u	1200	kg
2α	0.014	radians
K_t	109	MN/m
C_t	52	kNs/m
M_t	133	kg
P_0	123	kN
P2	218	kN

Vehicle 3		
130km/h speed 17t Axle Load		
V	130	km/h
V	36.11	m/s
M_u	1100	kg
2α	0.014	radians
K_t	109	MN/m
C_t	52	kNs/m
M_t	133	kg
P_0	83	kN
P2	230	kN

4. Conclusion of results

Each vehicle exerts a different P2 Force on the track as a result of differing axle load and speed of operation.
Vehicle 3 will require the highest track classification for P2 Force Limit.
Vehicle 2 will require the highest track classification for Axle Load Limit.

As per Section 4.2 of this standard, the minimum track class required is B25 to enable operation of all three rolling stock vehicle types.
The below track classifications which are highlighted green would therefore be adequate.

STATIC AXLE LOAD LIMIT (t)	P2 FORCE LIMIT (kN)				
	300-250	249-220	219-190	189-160	159-130
	A	B	C	D	E
	TRACK CLASS				
40	A40	B40	C40	D40	E40
30	A30	B30	C30	D30	E30
25	A25	B25	C25	D25	E25
23	A23	B23	C23	D23	E23
21	A21	B21	C21	D21	E21
20	A20	B20	C20	D20	E20
19	A19	B19	C19	D19	E19
17	A17	B17	C17	D17	E17

Appendix B Bibliography (Informative)

The following referenced documents are used by this Standard for information only:

- AS 7450: Rail systems interoperability.
- AS 7633 Railway Infrastructure – Track Clearances.
- AS 7640 Railway Infrastructure – Rail management.
- AS 7642: Turnouts and other special trackwork.
- AS 7643: Track stability.
- AS 7644: Rail corridor access.
- AS 7664: Railway signalling cable routes, cable pits and foundations.
- RISSB Reliability, Availability, Maintainability (RAM) Guideline.
- RISSB Wheel and Rail Profile Development Guideline.