AS 7528:2018

Australian STANDARD®

Interior Communications

RISSB RAIL INDUSTRY SAFETY AND STANDARDS BOARD

Rolling Stock Standard

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This Australian Standard® AS 7528 Interior Communications was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organisations:

Bombardier DPTI TfNSW

RTBU

The Standard was approved by the Development Group and the Rolling Stock Standing Committee in Select SC approval date. On Select Board approval date the RISSB Board approved the Standard for release.

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Development of the Standard was undertaken in accordance with RISSB's accredited process. As part of the approval process, the Standing Committee verified that proper process was followed in developing the Standard.

RISSB wishes to acknowledge the positive contribution of subject matter experts in the development of this Standard. Their efforts ranged from membership of the Development Group through to individuals providing comment on a draft of the Standard during the open review.

I commend this Standard to the Australasian rail industry as it represents industry good practice and has been developed through a rigorous process.

Paul Daly
Chief Executive Officer
Rail Industry Safety and Standards Board

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Interior Communications

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Contents

Appendix Contents

1 Introduction

1.1 Purpose

This Standard represents a national approach to defining the minimum functional and performance requirements for rolling stock interior communication systems to support the provision of statutory and key information and assistance to passengers.

1.2 Scope

Included in the scope of this Standard are on-train interior communications system installed on passenger rolling stock that facilitate the following mandatory use cases for audio, visual or audio and visual communications with an individual or group of passengers:

(a) Obtain alighting assistance.

(b) Obtain emergency assistance.

(c) Obtain general service information.

(d) Alert of imminent hazards.

(e) Warn passengers of an emergency situation.

Included in the scope of this Standard are on-train interior communications system installed on passenger rolling stock that facilitate the use case of audio communications with on-train or on-ground personnel for train operations.

The use cases defined in this Standard involve the following actors:

(a) Individual passenger.

(b) Group of passengers.

(c) On-train personnel (crew).

(d) On-ground personnel.

(e) On-train electronic systems.

(f) On-ground electronic systems.

The use cases defined in this Standard support the rail transport operator (RTO) in the provision of statutory and key information and assistance to passengers. RTOs may define additional use cases for the provision of discretionary information or assistance such as commercial advertising and infotainment.

Excluded from the scope of this Standard are use cases that require passengers to provide their own equipment, such as mobile phones, tablets and laptops.

Excluded from the scope of this Standard are on-train electronic systems associated with train management, control and operations, such as train radio, train control, CCTV surveillance and condition monitoring.

Excluded from the scope of this Standard are on-ground electronic systems.

Excluded from the scope of this Standard are train-to-ground radiocommunications systems. Refer to AS 7660 Wireless Communications in the Rail Corridor.

Excluded from the scope of this Standard are rolling stock that does not convey passengers, such as locomotives, freight vehicles, and infrastructure maintenance vehicles.

1.3 Compliance

There are two types of control contained within Australian Standards developed by RISSB:

(a) Requirements.

(b) Recommendations.

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 recognise that there could be limitations to the universal application of the control, i.e. the identified control cannot be applied or other controls can be appropriate / better.

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.

Controls in RISSB standards address known railway hazards as included in an appendix.

1.4 Referenced documents

1.4.1 Normative references

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

The following referenced documents are indispensable for the application of this Standard:

(a) AS 1428.1 Design for access and mobility Part 1: General requirements for access - New building work.

(b) AS 1428.2 Design for access and mobility Part 2: Enhanced and additional requirements - Buildings and facilities.

(c) AS 1428.5 Design for access and mobility Part 5: Communication for people who are deaf or hearing impaired.

(d) AS 60529 Degrees of protection provided by enclosures (IP Code).

(e) AS 60950-1 Information technology equipment – Safety Part 1: General requirements (IEC 60950-1, Ed. 2.2 (2013), MOD).

(f) AS/NZS 1680.2.1 Interior and workplace lighting Part 2.1: Specific applications - Circulation spaces and other general areas.

(g) Disability Discrimination Act 1992.

(h) Disability Standards for Accessible Public Transport 2002.

(i) EN 50125-1 Railway applications - Environmental conditions for equipment - Part 1: Rolling stock and on-board equipment.

(j) EN 50155 Railway Applications - Rolling Stock - Electronic Equipment.

(k) IEC 60050-191 International Electrotechnical Vocabulary. Chapter 191: Dependability and quality of service.

(l) IEC 60268-16:2011 Sound system equipment – Part 16: Objective rating of speech intelligibility by speech transmission index.

(m) IEC 60571 Railway applications – Electronic equipment used on rolling stock.

(n) IEC 62262 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).

(o) IEC 62380 Reliability data handbook - Universal model for reliability prediction of electronics components, PCBs and equipment.

(p) ISO 3381 Railway applications - Acoustics - Measurement of noise inside railbound vehicles.

(q) ISO 9241-303 Ergonomics of human-system interaction – Part 303: Requirements for electronic visual displays.

(r) Industrial Chemicals (Notification and Assessment) Regulations 1990.

(s) MIL-HDBK-217F Notice 2 Military Handbook - Reliability Prediction of Electronic Equipment.

(t) Telcordia SR-332 Issue 4 Reliability Prediction Procedure for Electronic Equipment.

1.4.2 Informative references

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

(a) ISO/IEC 14496-2 Information technology - Coding of audio-visual objects – Part 2: Visual.

(b) ISO/IEC 14496-10 Information technology - Coding of audio-visual objects – Part 10: Advanced Video Coding.

(c) ITU-T Recommendation G.711 Pulse code modulation (PCM) of voice frequencies.

(d) ITU-T Recommendation G.726 Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited linear prediction (CS-ACELP).

(e) ONVIF Profile S Specification.

(f) RFC 2326 Real Time Streaming Protocol (RTSP).

(g) RFC 3261 Session Initiation Protocol.

(h) RFC 3550 Real-time Transport Protocol.

(i) RFC 6241 Network Configuration Protocol (NETCONF).

(j) RFC 6386 VP8 Data Format and Decoding Guide.

(k) RFC 6716 Definition of the Opus Audio Codec.

1.5 Definitions and abbreviations

AFILS: audio frequency induction loops systems.

API: application programming interface.

CCTV: closed circuit television.

Discretionary information and assistance: non-essential information and assistance that can be helpful to a passenger's journey.

DSAPT: Disability Standards for Accessible Public Transport.

DTE: data terminal equipment.

MTTF: Mean Time to Failure.

OEM: Original Equipment Manufacturer.

STI: Speech Transmission Index.

SRAIRP: So far as is reasonably practical.

TCN: Train Communication Network.

RTO: Rail Transport Operator.

2 On train interior communication system context

Figure 1 shows the system context of on-train interior communication systems as a SysML block definition diagram (BDD).

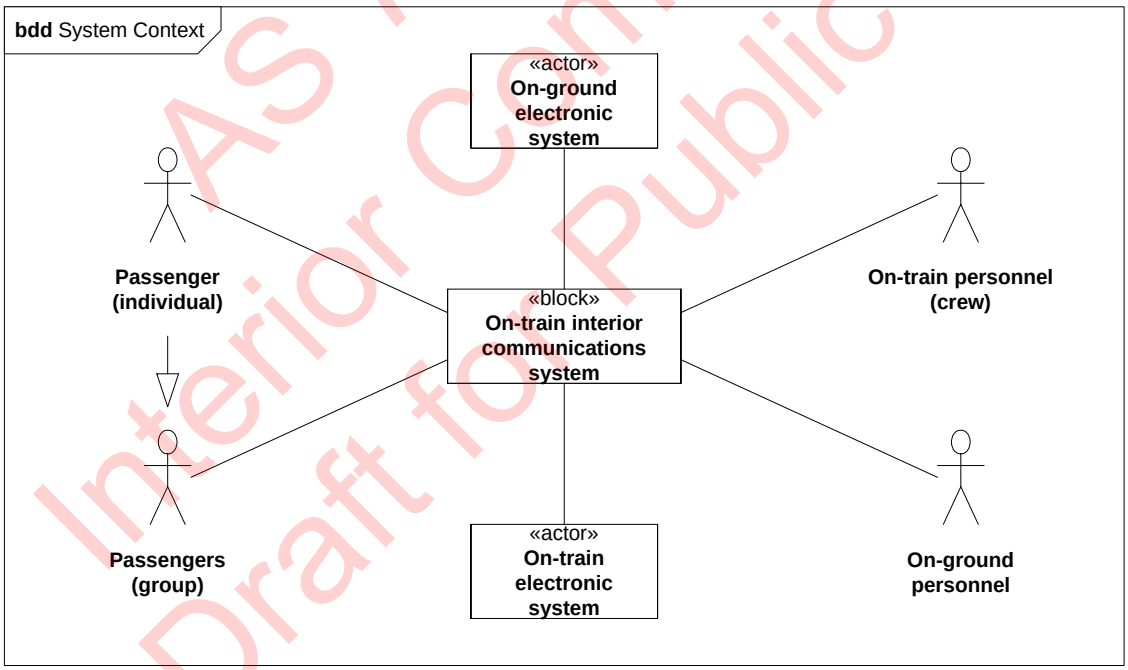

Figure 1 : System context diagram

3 Use cases for interior communication

The RTO shall implement the following mandatory use cases:

(a) Obtain alighting assistance.

(b) Obtain emergency assistance.

(c) Obtain general service information.

(d) Alert of imminent hazards.

(e) Warn passengers of an emergency situation.

(f) Obtain information to operate train.

The RTO may define alternate flows and extensions to the mandatory use cases.

The RTO may define additional use cases.

Some use cases involve on-train personnel (crew) or on-ground personnel.

The RTO shall extend each use case to specify whether on-train personnel (crew), on-ground personnel or both on-train personnel (crew) and on-ground personnel are part of the use case.

The RTO shall extend each use case to specify handling and escalation of communications between actors.

NOTE: It is important to note that the uses cases for interior communication are related to the operations of the railway, for example operational personnel can consist of:

- *On-train personnel (crew) comprising one or more guards and one or more drivers in conventional operations.*
- *On-train personnel (crew) comprising one or more drivers and on-ground personnel in driver-only operations.*
- *On-ground personnel in autonomous operations.*

The following table details use cases characteristics and main success scenario's the RTO shall implement in alighting assistance.

Characteristic Information

Characteristic	Description
Name	Obtain alighting assistance
Description	A passenger initiates a request for assistance, such as alighting or emergency assistance.
Actors	Individual passenger, on-train personnel (crew), on-ground personnel
Primary Actor	Individual passenger
Preconditions	None
Triggers	A passenger needs assistance

Main success scenario 1:

Main success scenario	Description
Name	Verbal communication established.
Description	
1	A passenger initiates a request for assistance.
2	The crew or on-ground personnel acknowledge the request.
3	The passenger and crew or on-ground personnel verbally communicate.
Termination outcome	Request for assistance has been received and acknowledged. The specific nature of assistance requested is communicated. The location for assistance is known.

Main success scenario 2:

Main success scenario	Description
Name	Specific needs signalled.
Description	
1	A passenger initiates a request for assistance which signals the specific nature of assistance e.g. by pressing an alighting assistance button.
2	The crew or on-ground personnel acknowledge the request.
Termination outcome	Request for assistance has been received and acknowledged. The specific nature of assistance requested is communicated. The location for assistance is known.

3.1 Use case: Obtain emergency assistance

The following table details use cases characteristics and main success scenario's the RTO shall implement in obtain emergency assistance.

Characteristic information:

Characteristic	Description
Name	Obtain assistance.
Description	A passenger initiates a request for assistance, such as alighting or emergency assistance.
Actors	Individual passenger, on-train personnel (crew), on-ground personnel.
Primary Actor	Individual passenger.
Preconditions	None.
Triggers	A passenger needs assistance.

Main success scenario 1:

Main success scenario	Description
Name	Verbal communication established.
Description	
1	A passenger initiates a request for assistance.
2	The crew or on-ground personnel acknowledge the request.
3	The passenger and crew or on-ground personnel verbally communicate.
Termination outcome	Request for assistance has been received and acknowledged. The specific nature of assistance requested is communicated. The location for assistance is known.

Main success scenario 2:

Main success scenario	Description
Name	Specific needs signalled.
Description	
1	A passenger initiates a request for assistance which signals the specific nature of assistance e.g. by pressing an emergency assistance button.
2	The crew or on-ground personnel acknowledge the request.
Termination outcome	Request for assistance has been received and acknowledged. The specific nature of assistance requested is communicated. The location for assistance is known.

3.2 Use case: Obtain general service information

The following table details use cases characteristics and main success scenario's the RTO shall implement in obtain general service information.

Characteristic information:

Characteristic	Description
Name	Obtain general service information.
Description	Passengers are notified of general service information, such as journey, interchange or destination information. General service information includes regular service information, planned and unplanned disruptions. Requirements for general information about transport services are contained within Part 27 of DSAPT.
Actors	Group of passengers, on-train personnel (crew), on-ground personnel, on-train electronic system, on-ground electronic system.
Primary Actor	On-train electronic system.
Preconditions	None.

Characteristic	Description
Triggers	Service information has been updated or changed.

Main success scenario 1:

Main success scenario	Description
Name	Automatically scheduled message.
Description	
1	On-train electronic system or on-ground electronic system schedules an information message for delivery.
2	Passengers perceive a visual, audio or audio and visual alert.
3	Passengers perceive and comprehend an audio and visual message containing general service information.
Termination outcome	Information is provided in an accessible format. Passengers are able to perceive and comprehend the information provided.

Main success scenario 2:

Main success scenario	
Name	**Description**
Description	
1	Crew or on ground personal schedules an information message for delivery.
2	Passengers perceive a visual, audio or audio and visual alert.
3	Passengers perceive and comprehend an audio and visual message containing general service information.
Termination outcome	Information I provided in an accessible format. Passengers are able to perceive and comprehend the information provided.

3.3 Use case: Alert imminent hazards

The following table details use cases characteristics and main success scenario's the RTO shall implement in alert imminent hazards.

Characteristic information:

Characteristic	Description
Name	Alert to imminent hazards.

Characteristic	Description
Description	Passengers are alerted to imminent hazards, such as moving doors, intended to draw attention to situations where passengers may need to immediately alter their decision making.
Actors	Group of passengers, on-train personnel (crew), on-ground personnel, on-train electronic system, on-ground electronic system.
Primary Actor	On-train electronic system.
Preconditions	None.
Triggers	Imminent hazard.

Main success scenario 1:

Main success scenario	Description
Name	Automatically scheduled alert.
Description	
1	On-train electronic system or on-ground electronic system schedule an alert for priority delivery.
2	Passengers perceive an audio and visual alert.
Termination outcome	Passengers are able to perceive the alert and comprehend the imminent hazard.

Main success scenario 2:

Main success scenario	Description
Name	Manually scheduled alert.
Description	
1	Crew or on-ground personnel schedule an information message for priority delivery.
2	Passengers perceive an audio and visual alert.
3	Passengers perceive and comprehend an audio and visual message containing information about the hazard.
Termination outcome	Passengers are able to perceive the alert and comprehend the imminent hazard.

3.4 Use case: Warn passengers of an emergency situation

The following table details use cases characteristics and main success scenario's the RTO shall implement in warn passengers of an emergency situation.

Characteristic information:

Characteristic	Description
Name	Warn passengers of an emergency situation.
Description	Passengers are warned of an emergency situation and given instructions about how to respond.
Actors	Group of passengers, on-train personnel (crew), on-ground personnel.
Primary Actor	Group of passengers.
Preconditions	None.
Triggers	Emergency situation.

Main success scenario:

Main success scenario	Description
Name	Manually scheduled alert and information message.
Description	
1	Crew or on-ground personnel schedule an information message for immediate priority delivery.
2	Passengers perceive an audio and visual alert.
3	Passengers perceive and comprehend an audio and visual message containing information about the emergency.
4	Crew or on-ground personnel (as applicable) receive confirmation that alrt and message have been successfully delivered.
Termination outcome	Passengers perceive and comprehend the instructions about responding to the emergency situation.

3.5 Use case: Obtain information to operate train

The following table details use cases characteristics and main success scenario's the RTO shall implement in obtain information to operate the train.

Characteristic information:

Characteristic	Description
Name	Obtain information to operate train.
Description	A member of crew requests operational information.
Actors	On-train personnel (crew), on-ground personnel.
Primary Actor	On-train personnel (crew).
Preconditions	None.
Triggers	A member of crew needs operational information

Main success scenario:

Main success scenario	Description
Name	Verbal communication established.
Description	
1	A member of crew initiates a request for operational information.
2	Another member of crew or on-ground personnel acknowledge the request.
3	The parties verbally communicate.
Termination outcome	Request for information has been received, acknowledged and verbal communication is established.

4 Implementation of use case by interior communication system

Interior communications systems can be divided into those that provide one-to-one bidirectional communication to an individual passenger and one-to-many unidirectional communication to a group of passengers.

Systems that provide bidirectional communication between individual personnel and an individual passenger shall implement the following use cases:

(a) Obtain alighting assistance.

(b) Obtain emergency assistance.

Systems that provide unidirectional communication between individual personnel and a group of passengers shall implement the following use cases:

(a) Obtain general service information.

(b) Alert of imminent hazards.

(c) Warn passengers of an emergency situation.

5 Functional requirements for human interaction

5.1 General requirements

Client software and an application programming interface (API) shall be available to manage configuration and state information.

5.2 Individual interactional with an individual passenger or personal

Communication systems can interact directly with an individual passenger, on-train personnel (crew) and on-ground personnel using a number of human-system interfaces.

Where communication systems provide an individual interaction to a passenger it shall comply with the functional requirements for the following human-system interfaces:

(a) Audio input – microphone.

(b) Audio output – speakers.

(c) Hearing augmentation output.

(d) Visual output – indicator lights.

(e) Tactile input – control buttons.

Where communication systems provide an individual interaction to a member of the crew it shall comply with the functional requirements for the following human-system interfaces:

(a) Audio input – microphone.

(b) Audio output – speakers.

(c) Visual output – indicator lights.

(d) Tactile input – control buttons.

Where additional optional interfaces are provided they shall comply with the functional requirements for the relevant human-system interfaces:

(a) Visual input – video camera.

NOTE: The video camera provides video communication between the individual passenger and personnel. It is not to be confused with CCTV used for surveillance purposes.

(b) Visual output – electronic visual displays.

Communication systems provide an individual interaction using discrete units which human users interact with.

NOTE: These units are commonly referred to as 'help points', 'intercoms' or 'passenger communication units'.

A minimum of two units shall be provided in each carriage for passenger use. These units shall be located at opposing ends of each carriage.

A unit shall be provided in each toilet compartment and be designed for a person to request assistance at a seated position or on the floor when the person has fallen accidentally.

The location of the unit used to request alighting or emergency assistance shall be indicated to crew.

Immediate and recognisable audio and visual feedback shall be provided to the user indicating whether the following actions are successful or not:

(a) Request to establish a session has been received and is being processed.

(b) Session has been successfully established.

If half duplex communication is used, the unit shall indicate whether the user is to talk or listen.

Units shall be easily recognisable and distinguishable from the background where they are located. Signage, inclusive of braille and tactile text, shall support the identification and use of the unit.

The RTO shall specify requirements to ensure consistency across rail modes and operators, as applicable.

Units shall be positioned, such that they do not disrupt passenger circulation or emergency evacuation.

Units shall be positioned within a height range of 700 mm to 1250 mm so that the user is able to access the functional components.

Units shall provide a high level of consistency within a rail mode to ensure that customers can rapidly locate, recognise and use help points at any point on a public transport journey.

The design of units shall be sufficiently consistent across different rail modes and operators to eliminate negative transfer between rail modes so far as is reasonably practicable (SFAIRP).

Physical obstructions of the unit should be avoided; however, in areas with restricted space, physical obstructions can be unavoidable. Consistent with DSAPT, an allowance for physical obstruction is defined as 300 mm wide and 900 mm high, in front and centred on the help point, as shown in FIGURE 2 and FIGURE 3.

Where there is restricted clear space, the clear space around the unit shall accommodate either a parallel or forward approach for a wheelchair. The most appropriate approach should be chosen based on the access path.

Units shall be covered by CCTV surveillance.

NOTES:

1. *CCTV surveillance is excluded from the scope of this Standard;*
2. *CCTV surveillance of the communication unit should be activated when a passenger initiates a request for assistance.*

5.2.1 Spatial requirement

An individual passenger shall be able to hear, speak and see the unit from anywhere within the minimum three dimensional aural and visual interaction space, as follows:

(a) 550 mm wide;

(b) 1000 mm to 1750 mm high;

(c) 700 mm long where a parallel wheelchair approach is used;

(d) 1000 mm long where a parallel wheelchair approach is used.

NOTES:

1. *The width is based on the shoulder breadth of a 95th percentile male;*
2. *The height is based on the eye height range from a 5th percentile seated female to 95th percentile standing male;*
3. *The 700 mm length is based on width of a 95th percentile wheelchairs and mobility scooters (parallel approach);*
4. *The 1000 mm length is based on eye position of wheelchair occupant (forward approach).*

This aural and visual interaction space shall be located immediately in front and centred on the unit, accounting for any allowable physical obstruction, as shown in FIGURE 2 and FIGURE 3.

NOTE: The aural and visual interaction space is distinct from the clear space and circulation space requirements.

The RTO shall define the aural and visual interaction space for on-train personnel (crew).

NOTE: The aural and visual interaction space for on-train personnel (crew) is usually specific to the train set.

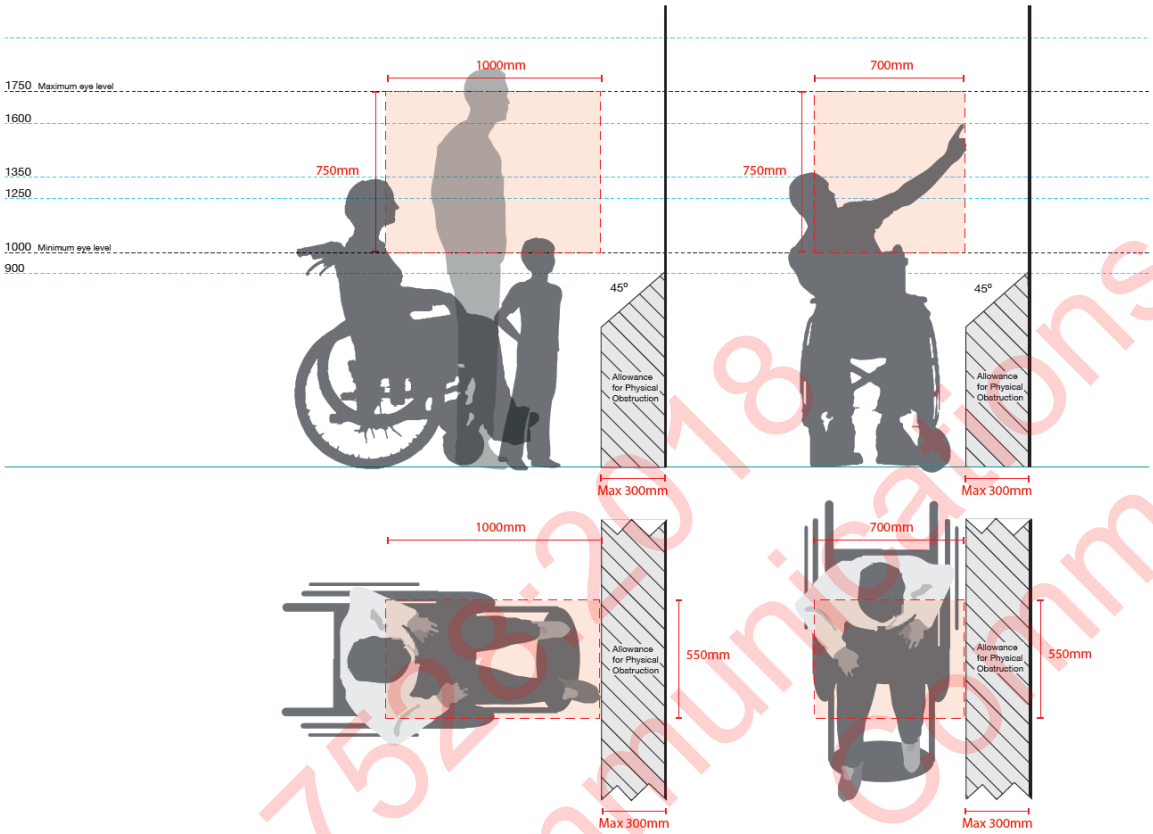

Figure 2: Aural and visual interaction space – sectional elevation and plan views

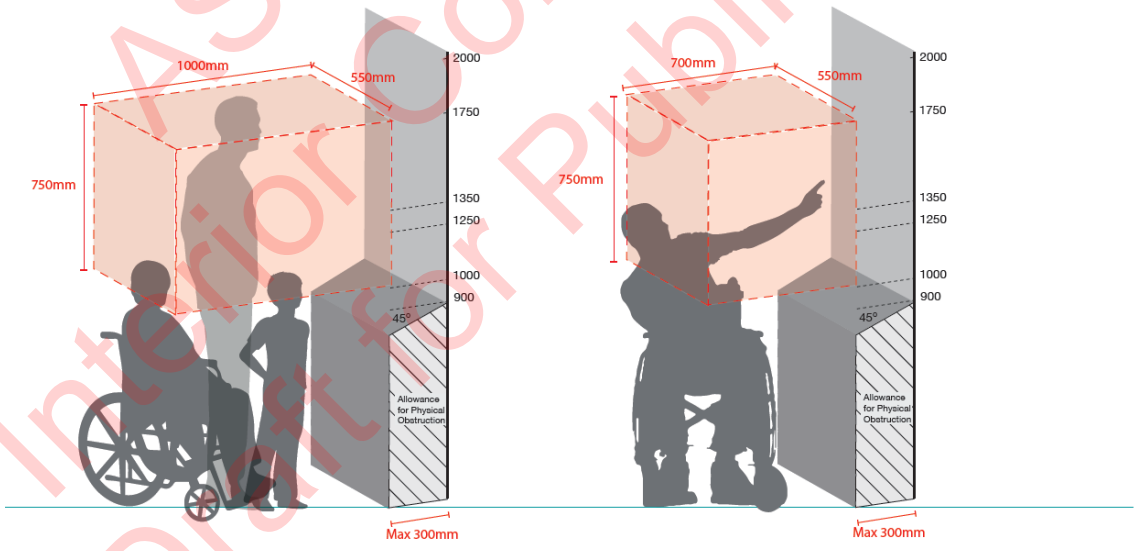

Figure 3 Aural and visual interaction space – Three-dimensional view

5.2.2 Audio input- microphone

The average normalised frequency response shall be as follows:

(a) +3 dB and -6 dB between 200 Hz and 250 Hz;

(b) ± 3 dB between 250 Hz and 7000 Hz.

The microphone subsystem shall support automatic gain control and active noise cancellation.

NOTE: An audio filter may be necessary to remove localised sources of noise.

5.2.3 Audio output- speakers

The speech transmission index (STI) as defined in IEC 60268-16:2011 Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index shall be at least 0.5 using the 'speech transmission index for public address (STIPA) systems with noise' method.

The background noise should not exceed 75 dB(A) at the microphone position described within clause 6.3 of ISO 3381 Railway applications - Acoustics - Measurement of noise inside rail bound vehicles.

The background noise level shall be measured according to ISO 3381 and clause 7.8.2 and clause 7.8.3 of IEC 60268-16:2011.

NOTE: The STI value is consistent with the guidance contained within IEC 60268-16:2011 Annex G category G for 'complex messages, familiar context' and the 'target value for voice alarm systems'.

The average normalised frequency response shall be as follows:

(a) +3 dB and -6 dB between 200 Hz and 250 Hz.

(b) ± 3 dB between 250 Hz and 7000 Hz.

5.2.4 Hearing augmentation output

Audio frequency induction loops systems (AFILS) shall comply with Section 4 and Appendix A of AS 1428.5 Design for access and mobility Part 5: Communication for people who are deaf or hearing impaired.

For the purpose of applying AS 1428.5 the 'listening area' shall be considered the aural and visual interaction space.

5.2.5 Visual output: indicator lights

Immediate and recognisable visual feedback shall be provided to the user.

5.2.6 Tactile input: control buttons

If a unit provides an emergency assistance function, then one dedicated control button shall be provided for emergency assistance.

Controls shall comply with the relevant Sections of DSAPT, in particular, Part 8 and Part 21.

The unit shall have a maximum of two control buttons.

When two control buttons are provided the design shall minimise the potential for the wrong button being selected and mitigate the error with a provision of adequate feedback.

The use of buttons shall be clearly distinguishable, and they shall be sufficiently physically separated in order to minimise inadvertent operation.

The force to activate the control button shall be between 2 N and 5N inclusive.

In accordance with DSAPT, where practicable, control buttons should have a minimum dimension of 35 mm. Otherwise control buttons should have a minimum dimension of 25 mm.

In accordance with AS 1428.1, where practicable, control buttons should be raised proud of the surface and activate the control before the button becomes level with the surrounding surface.

Controls button shall be protected against accidental activation.

Where practicable, the height of the control buttons should be at a nominal height of 1000 mm and within the range of 900 mm to 1100 mm from finished floor level.

NOTE: An emerging common practice is to use a green button for an emergency function and a blue button for information. The use of red is increasingly restricted to fire alarms and controls.

In toilet compartments an additional control button shall be located between 150 mm and 300 mm from the finished floor level designed for a person to request emergency assistance when the person has fallen accidentally.

5.2.7 Visual input: video camera

The requirements of this section apply where a video camera is integrated into the unit.

Video cameras shall provide coverage of the customer using the unit for the face recognition (FR) application objectives and resolution at a recording frequency of at least 12 frames per second.

5.2.8 Visual output: electronic visual display

The requirements of this section apply where an electronic visual display is integrated into the unit.

Except for character height requirements, displays shall comply with the relevant requirements of ISO 9241-303 Ergonomics and human-system interaction – Part 303: Requirements for electronic visual displays.

Character height requirements shall comply with Table 2 of AS 1428.2.

Displays shall be legible by those with reduced vision (6/12 visual acuity). The minimum contrast ratio (CRmin) shall be adjusted accordingly using a multiplier of 1.5.

Minimum contrast ratio requirements do not apply for text and images that do not convey statutory or key information. This includes text and images that are decorative or that form part of a logo or branding.

Display luminance shall be adjusted relative to ambient illumination to prevent discomfort and disability glare.

The minimum luminance levels for displays shall be calculated using equation D.11 from ISO 9241-303.

NOTE: The relationship between the inherent capabilities of the display, illuminated environments, colours and the resultant luminance levels is complex.

Refer to Table 1 for minimum luminance levels for displays in special case where the lightest and darkest colours are used to present statutory and key information. The use of any other colour requires a higher display luminance.

Indoor	11 cd/m2	15 cd/m2	20 cd/m2	50 cd/m2
Shaded	180 cd/m2	340 cd/m2	640 cd/m2	Not suitable

Table 1: Display luminance high state (LH) at end of life for various reflectance (p) values

NOTES:

1. *In the special case, the low state (LL) refers to the darkest colour that the display can produce in a given environment: black or off pixel.*
2. *In the special case, the high state (LH) refers to the lightest colour that the display can produce in a given environment: white or on pixel.*
3. *These levels are calculated using the adjusted CRmin and equation D.11 from ISO 9241-303.*
4. *The illuminance level (E) for indoor is assumed 500 lux based on a maintained illuminance of 320 lux from AS/NZS 1680.2.1 Interior and workplace lighting Part 2.1: Specific applications—Circulation spaces and other general areas with a system margin applied for degradation.*
5. *The illuminance level (E) for shaded is assumed 40,000 lux consistent with that of shade in bright daylight.*
6. *The specular reflected luminance (RS) is assumed to be negligible.*

5.3 Group interactions

Communication systems can interact with a group of passengers using a number of human-system interfaces.

Where communication systems provide a group interaction it shall comply with the functional requirements for the following human-system interfaces:

(a) Audio output – speakers.

(b) Hearing augmentation output.

(c) Visual output – indicator lights.

(d) Visual output – electronic visual displays.

NOTE: Unidirectional communication systems are commonly referred to as 'passenger information systems'.

5.3.1 Audio output: speakers

The audio output should be suitable for customers with normal hearing and the following particular needs:

(a) Non-native listeners with intermediate experience.

(b) Mild hearing loss without hearing aids.

(c) Mild to moderate hearing loss with hearing aids.

The audio coverage shall include all passenger use areas.

The speech transmission index (STI) as defined in IEC 60268-16 Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index shall be at least 0.54 using the 'speech transmission index for public address (STIPA) systems with noise' method.

The background noise should not exceed 75 dB(A) at the microphone positions described within clause 6.3 of ISO 3381: Railway applications - Acoustics - Measurement of noise inside railbound vehicles.

The background noise shall be measured according to ISO 3381 and clause 7.8.2 and clause 7.8.3 of IEC 60268-16.

NOTE: The STI value is consistent with the guidance contained within IEC 60268-16:2011 Annex G category F for "good quality PA systems'.

The average normalised frequency response shall be as follows:

(a) +3 dB and -6 dB between 200 Hz and 250 Hz;

(b) ± 3 dB between 250 Hz and 8000 Hz;

(c) +3 dB and -6 dB between 8000 Hz and 10,000 Hz.

Where used, pre-recorded speech shall be normalised using the method defined in ITU R BS.1770 3 Algorithms to measure audio programmed loudness and true-peak audio level.

The audio levels of zones shall be software configurable.

The equivalent A weighted noise level (LAeq) of a typical announcement shall not exceed 80 dB(A).

NOTE: The maximum LAeq is based on an announcement duty cycle of 25% and an 8-hour average daily noise exposure levels (LAeq,8h) below 75 dB(A) as recommended by the Managing Noise and Preventing Hearing Loss at Work Code of Practice.

5.3.2 Hearing augmentation output

The hearing augmentation output is intended to be suitable for customers with hearing loss that use a T-switch capable hearing aid.

Hearing augmentation shall be wherever public-address systems are installed in accordance with the DSAPT.

The total hearing augmentation coverage within a customer messaging area shall not be less than 10% in accordance with the DSAPT.

AFILS shall comply with Section 4 and Appendix A of AS 1428.5 Design for access and mobility Part 5: Communication for people who are deaf or hearing impaired.

NOTE: Compliance with other Sections of AS 1428.5 is not required. The coverage requirements of Section 3 of AS 1428.5:2010 do not apply as the requirements differ from DSAPT and Section 21.1 of AS 1428.2:1992 Design for access and mobility – Part 2: Enhanced and additional requirements – Buildings and facilities.

The boundaries of listening areas shall be designated by signs compliant to the symbols and signage requirements of Section 16 and Section 17 of AS 1428.2.

NOTE: The signage requirements of Section 5 of AS 1428.5 do not apply as the requirements differ from DSAPT and Section 21.1 of AS 1428.2-

The system shall be capable of automatic gain control.

5.3.3 Visual output: indicator lights

Immediate and recognisable visual feedback shall be provided for visual alerts.

5.3.4 Visual output: electronic visual displays

The visual output is intended to be suitable for customers with normal vision and particular needs:

(a) Reduced vision (6/12 visual acuity)

(b) Colour vision deficiencies

The visual output may be suitable for customers with low vision (6/18 visual acuity) as standard displays can be directly approached without obstruction.

NOTE: Ensuring that displays present information in such a way to meet legal requirements and customer needs is complex in the transport environment due to the diversity of viewing conditions (stationary and mobile) and physical environments (indoor and outdoor).

The heights of letters given in Table 2 of AS 1428.2: are interpreted as capital 'I' heights consistent with AS 1744 Standard alphabets for road signs.

For viewing distances not specified in Table 2 of AS 1428.2, the height (h) of letters in millimetres for arbitrary viewing distance (d) in metres may be calculated as h=3.2xd.

NOTE: The requirements of Section 17.3 in AS 1428.2 are not applicable where light emitting displays are used. However, the intent is fulfilled by an alternate luminance contrast methodology from ISO 9241-303 Ergonomics and human-system interaction – Part 303: Requirements for electronic visual displays.

Except for character height requirements, displays shall comply with the relevant requirements of ISO 9241-303 Ergonomics and human-system interaction – Part 303: Requirements for electronic visual displays.

Character height requirements shall comply with Table 2 of AS 1428.2.

Displays shall be legible by those with reduced vision (6/12 visual acuity). The minimum contrast ratio (CRmin) shall be adjusted accordingly using a multiplier of 1.5.

Minimum contrast ratio requirements do not apply for text and images that do not convey statutory or key information. This includes text and images that are decorative or that form part of a logo or branding.

Display luminance shall be adjusted relative to ambient illumination to prevent discomfort and disability glare.

The minimum luminance levels for displays shall be calculated using equation D.11 from

ISO 9241-303.

NOTE: The relationship between the inherent capabilities of the display, illuminated environments, colours and the resultant luminance levels is complex.

Refer to Table 1 for minimum luminance levels for displays in special case where the lightest and darkest colours are used to present statutory and key information. The use of any other colour requires a higher display luminance.

Areas	Anti-reflective glass (ρ=0.5%)	Anti-reflective glass (ρ=1%)	Anti-reflective glass (ρ=2%)	Float glass (ρ=8%)
Indoor	11 cd/m2	15 cd/m2	20 cd/m2	50 cd/m2
Shaded	180 cd/m2	340 cd/m2	640 cd/m2	Not suitable

Table 1: Display luminance high state (LH) at end of life for various reflectance (ρ) values

NOTES:

1. *In the special case, the low state (LL) refers to the darkest colour that the display can produce in a given environment: black or off pixel.*
2. *In the special case, the high state (LH) refers to the lightest colour that the display can produce in a given environment: white or on pixel.*
3. *These levels are calculated using the adjusted CRmin and equation D.11 from ISO 9241-303.*
4. *The illuminance level (E) for indoor is assumed 500 lux based on a maintained illuminance of 320 lux from AS/NZS 1680.2.1 Interior and workplace lighting Part 2.1: Specific applications - Circulation spaces and other general areas with a system margin applied for degradation.*
5. *The illuminance level (E) for shaded is assumed 40,000 lux consistent with that of shade in bright daylight.*
6. *The specular reflected luminance (RS) is assumed to be negligible.*

Statutory and key information shall be displayed within the comfortable common viewing zone defined in Section 25 of AS 1428.2 unless the display can be temporarily obscured by crowding as noted in Section 17.4 of AS 1428.2.

Statutory and key information shall be legible and readable from the defined minimum viewing distances by the 5th percentile seated female and 95th percentile standing male, with visual acuity of 6/12, allowing for moderate neck and torso movement.

Considerations should be given to the location of displays, in particular at locations adjacent to walkways and stairways to prevent the degradation of customer movement and circulation.

The suitability, minimum viewing distance and viewing height of displays in conveyances are shown in Table 2.

Characteristic	Interior display	Exterior front display	Exterior side display
Suitability	Suitable for viewing information once on board from a seated or standing position	Suitable for providing the destination to customers on approach of conveyance	Suitable for providing the destination to customers immediately prior to boarding
Minimum viewing distance	10 m	35 m	4 m
Viewing height	Part 17.3 of the DSAPT	Above windscreen in accordance with Part 17.3 of the DSAPT	Clearly visible in accordance with Section 17.4 of AS 1428.2

Table 2 Viewing characteristics of displays

Interior displays shall be fitted in all customer use areas.

Exterior front displays shall be fitted on control or driving carriages except where the destination is static and destination signage is visible at boarding points.

Exterior side displays shall be fitted if the intended operation includes one or more of the following operational scenarios:

(a) Operates on routes with where dynamic information may not otherwise be provided on stations.

(b) Multiple trains are stacked on the same platform that proceed to different destinations.

(c) Trains split and proceed to different destinations.

(d) Passengers are required to board a particular carriage or range of carriages, such as to disembark on short platforms, for booked services and to identify the class of service.

NOTE: Exterior side displays provide customers with confirmation of the destination immediately prior to boarding. This assists customers who have difficulty in reading the front exterior display when the train is in motion.

If shortening of information is required, the short form used shall be consistent across all displays.

Line of sight to at least one display shall be maintained free of obstructions from defined viewing positions.

Displays shall support static, scrolling and refreshed text.

The rate of refreshing and scrolling text shall be specified by the RTO in accordance with Part 17.5 of the DSAPT.

Displays shall present a minimum of 2 lines of 22 characters of static text without refreshing or scrolling.

Characters should be represented by an upper-case letter H for monospace fonts and N for proportional fonts in accordance with ISO 9241-303.

The user interface design for transport service messages shall include the information units shown in Table 3.

Information Unit	Application	Example
Destination	Does not apply if the destination is static and is shown on wayfinding signage	Hornsby via Macquarie Uni
Next stop	Applies to all services	Shellharbour Jn. This stop
Current stop	Applies to all services	Shellharbour Jn. This stop.
Stopping pattern	Applies t services that operate a variable stopping pattern	Stopping at …
Carriage identifier	Applies where exterior side displays are fitted.	1 A

Table 3: Information units

6 Functional requirements for system interaction

6.1 General requirements

Electronic equipment shall comply with IEC 60571 Railway applications – Electronic equipment used on rolling stock or EN 50155 Railway Applications - Rolling Stock - Electronic Equipment, where:

(a) the altitude for normal service conditions shall be A1, unless otherwise specified by the RTO;

(b) the ambient temperature and relative humidity for normal service conditions shall be class T1, unless otherwise specified by the RTO.

Electronic equipment shall comply with the Australian Communications and Media Authority (ACMA) regulatory requirements.

6.2 Data communication network

Interior communications systems that require network communications shall interface to the train communication network (TCN) as data terminal equipment (DTE).

DTE shall provide at least one 100BASE-TX or 1000BASE-T ethernet interface as defined in IEEE 802.3.

DTE shall comply as a powered device (PD) with the data terminal equipment (DTE) power via media dependent interface (MDI) as defined in IEEE 802.3.

DTE shall comply with internet protocol (IP) and internet control message protocol (ICMP) as defined in IETF STD 5 Internet Protocol.

Open standards shall be used to synchronise the time of day.

Open standards shall be used to control, deliver, encode and decode audio and visual messages.

NOTE: Refer to informative references for relevant open standards.

6.3 Degree of protection

Equipment shall be protected against ingress of solid objects and liquids; and mechanical impacts:

(a) Minimum IP code rating of IP54 as defined in AS 60529 Degrees of protection provided by enclosures (IP Code);

(b) Minimum IK code rating of IK08 as defined in IEC 62262 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).

6.4 Real time transit information exchange

Open standards protocols should be used to deliver real-time transit information over the TCN.

Where open standards are not used, the protocol shall be fully documented and an open source reference implementation available.

7 Non-functional requirements

7.1 General requirements

Electronic equipment shall comply with in IEC 60571 Railway applications – Electronic equipment used on rolling stock or EN 50155 Railway Applications - Rolling Stock - Electronic Equipment.

7.2 Availability

The minimum availability for the ‘obtain emergency assistance’ use case to and individual communication unit is 99.9%.

The minimum availability for the ‘alert of imminent hazards’ use case to an individual carriage is 99%.

The minimum availability for the ‘warn passengers of an emergency situation’ use case to an individual carriage is 99.9%. The RTO shall specify the availability requirement for use cases.

7.3 Maintainability

The design and location of the equipment should take into account the human factors for those maintaining and cleaning the equipment.

If emergency assistance is provided by a communication system, it shall implement built-in diagnostics to detect and notify of functional and conditional failures of subsystems necessary for the emergency assistance function.

The communication system shall provide a built-in test able to perform by a single person to verify the correct operation of the system.

7.4 Manageability

Open or industry standards protocols should be used for fault, configuration, accounting, performance and security management of electronic equipment over the TCN. Where open or industry standards are not used, the protocol shall be fully documented and an open source reference implementation available.

The system shall perform the following operations to manage configuration and state information within the performance requirements specified by the RTO:

(a) Send configuration change to a set and fleet.

(b) Activate configuration change on a set and fleet.

(c) Schedule the activation of a configuration change on a set and fleet.

(d) Retrieve configuration or state information from a set.

7.5 Performance

Performance requirements with confidence levels and confidence intervals shall be specified by the RTO for acoustic and AFILS performance within the defined coverage area.

The confidence level should be 95% or greater.

The confidence interval (margin of error) should be 0.1 or less.

The acoustic and AFILS performance shall be analysed using a simulation tool.

The acoustic and AFILS performance shall be verified by dynamic testing against the confidence levels and confidence intervals.

7.6 Reliability

Failure models inclusive of the failure distribution and required parameters for all field replaceable units (FRU) that comprise a system shall be specified.

A common failure model is the constant failure rate (CFR) with exponential distribution and mean time to failure (MTTF). The CFR is the period in the life of a non-repaired item during which, the failure rate is approximately constant as defined in IEC 60050 191 International Electrotechnical Vocabulary. Chapter 191: Dependability and quality of service.

The MTTF of all CFR field replaceable units shall exceed 150,000 hours.

NOTE: The MTTF is not to be confused with the life expectancy.

Failure model parameters shall comply with the yearly average temperature for RAMS calculations as defined in EN 50125 1 Railway applications – Environmental conditions for equipment – Part 1: Rolling stock and on-board equipment.

NOTE: Acceptable methods for predicting the failure model for electronic equipment, as stated in the following standards, shall be followed:

- *IEC 62380 Reliability data handbook - Universal model for reliability prediction of electronics components, PCBs and equipment;*
- *telcordia SR-332 Reliability Prediction Procedure for Electronic Equipment;*
- *MIL-HDBK-217F Notice 2 Reliability Prediction of Electronic Equipment.*

Where multiple MTTF estimates are available, the lowest estimate shall be used.

Failure models shall be justified by stating the data source, methodology, environment, assumptions and parameters.

7.7 Security

Systems shall comply with the physical security and cybersecurity requirements of the RTO.

The design and location of the equipment should take into account vandalism and tampering.

Tamper resistant fasteners shall be used in passenger use areas.

7.8 Supportability

The RTO may require equipment to be type approved.

The supportability life cycle parameters shall be specified by the RTO.

An advance notice shall be issued by the original equipment manufacturer (OEM) more than six months (180 days) prior to the end of sale (EOS). The EOS is the date when the original equipment manufacturer withdraws a product from sale, both directly and through its authorised points of sale.

Equipment shall only be proposed for use or submitted for type approval (if applicable) if the following two supportability requirements are met:

(a) The OEM guarantees that EOS is at least 'I' years from the date of proposed commissioning.

(b) The equipment has been first offered for sale (FOFS) for less than 'S' years from the date of proposed commissioning.

NOTE: The FOFS date is the date when the OEM first offers a product for sale in the Australian market.

While product is available for sale, full software (if applicable) and hardware repair and replacement services shall be available.

Software support services for operating system software shall be commercially available for at least 'U' years following EOS.

Hardware repair and replacement services shall be commercially available for at least 'U' years following EOS.

The use of existing installed products should continue while software support and hardware repair and replacement services are available after EOS.

The use of existing installed products or assets should be discontinued when software support or hardware repair and replacement services are unavailable after EOS.

Where discontinuation is not reasonably practicable, associated risks including increasing hardware failures, software functionality defects and security vulnerabilities shall be managed in accordance the RTO's risk management process.

Figure 4 shows the supportability life cycle based on time until EOS and Figure 5 shows the supportability life cycle based on time from FOFS.

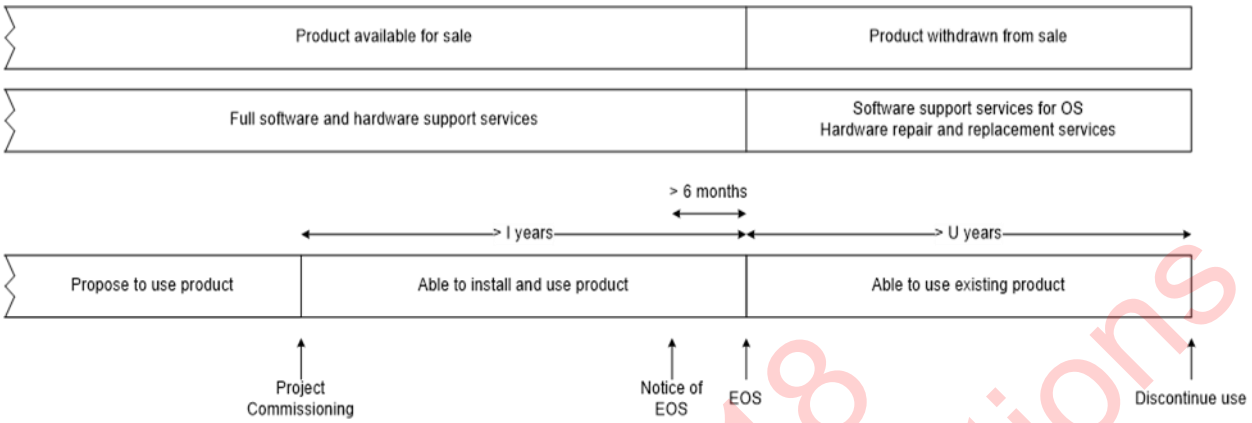

Figure 4: Supportability lifecycle based on time until EOS

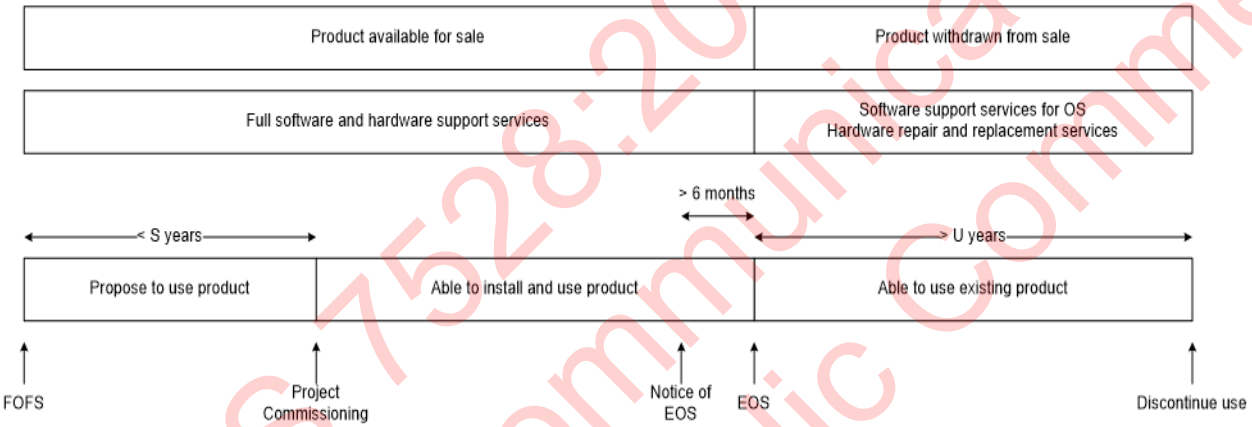

Figure 5: Supportability lifecycle based on time from FOFS

7.9 Sustainability

Materials and substances used at any stage of the asset life cycle throughout the entire supply chain shall comply with the prohibited and restricted materials as defined in Industrial Chemicals (Notification and Assessment) Regulations 1990.

Appendix A Hazard table

RISSB Hazard reference	Hazard	Addressed by section
5.3	Harm to persons	3.1, 3.2, 3.3, 3.4, 3.5, 3.5, 4, 5, 6, 7.
5.4	Harm to Rolling Stock	3.1, 3.2, 3.3, 3.4, 3.5, 3.5, 4, 5, 6, 7.
5.5	Harm to Rolling Stock Related Processes, Reducing the consequences of in-train safety incidents.	2, 3.1, 3.2, 3.3, 3.4, 3.5, 3.5, 4, 5, 6, 7.

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