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## Data entry – draft starts next page

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## Preface

This standard was prepared by the Rolling Stock Communications Equipment Development Group, overseen by the RISSB Rolling Stock Standing Committee.

## Objective

The objective of this Standard is to identify the different types of communications equipment used on rolling stock, define the high-level functional requirements and performance-based outcomes for the equipment while also considering the asset lifecycle requirements.

The Standard shall support the adoption of advancing technologies in communications equipment.

Equipment identified in this Standard shall support communications equipment requirements already defined in other Standards, codes of practice and guidelines.

## 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.

## Commentary

### Commentary *C Preface*

This Standard includes a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by 'C' preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the Standard.

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## Section 1 Scope and general

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### 1.1 Scope

This Standard applies to communications equipment requirements for new and modified locomotive, freight, passenger, light rail and infrastructure maintenance rolling stock.

The scope of the Standard includes:

- (a) describing the different types of communications equipment used on rolling stock;
- (b) defining the high-level functional requirements and performance-based outcomes for the equipment; and
- (c) asset life-cycle requirements.

This Standard does not specifically cover rolling stock used on ATO networks and cane railways, but items from this Standard may be applied to such systems as deemed appropriate by the relevant RTO.

This Standard excludes 3<sup>rd</sup> party communications systems/equipment between items being transported on board a train that are not part of the actual rolling stock (e.g., refrigerated containers, etc).

It is recognized that some RISSB products referenced in this Standard as either normative or informative do not specifically include light rail vehicles, freight vehicles, infrastructure maintenance vehicles and road-rail vehicles. However, for the purposes of this Standard, these vehicles are included and any referenced standards that do not specifically include light rail vehicles, freight vehicles, infrastructure maintenance vehicles and road-rail vehicles shall be applied as deemed appropriate for this type of rolling stock.

### 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 7450, *Rail Systems Interoperability*
- AS 7470, *Human Factors Integration in Engineering Design – General Requirements*
- AS 7486, *Railway Energy Storage: Rolling Stock Onboard Electrical Energy Storage*
- AS 7502, *Road Rail Vehicles*
- AS 7503, *Rail Vehicle Identification and Markings*
- AS 7510 .1, *Braking Systems – Part 1: Locomotive Rolling Stock*
- AS 7510 .2, *Braking Systems – Part 2: Hauled Rolling Stock*
- AS 7511, *Onboard Train Protection Systems*
- AS 7527, *Event Recorders*
- AS 7528, *Interior Communications*
- AS 7529, *Series - Railway Rolling Stock- Fire Safety*
- AS 7530, *Electrical Systems*
- AS 7660, *Radio Communication in The Rail Corridor*
- AS 7666, *Train Protection and Control Interoperability*
- AS 7702, *Rail Equipment Type Approval*

- AS 7715, *Train Detection*
- AS 7722, *EMC Management*
- AS 7726, *Interface between Train Control Systems and Rolling Stock*
- AS 7770, *Rail Cyber Security*
- AS 4806.2, *Closed Circuit Television (CCTV) – Part 2: Application Guidelines*
- IEC 60050-192, *International Electrotechnical Vocabulary – Part 192: Dependability*
- IEC 60077, *Railway Applications – Electric Equipment for Rolling Stock*
- IEC 61375, *Electronic Railway Equipment – Train Communication Network (TCN)*
- IEC 62279, *Railway Applications – Communication, Signalling and Processing Systems – Software for Railway Control and Protection Systems*
- ISO/IEC 7498-1, *Information Technology – Open Systems Interconnection – Basic Reference Model: The Basic Model – Part 1*
- ISO 15288, *Systems and Software Engineering - System Life Cycle Processes*
- EN 50121 *Railway Applications. Electromagnetic Compatibility*
- EN 50125-3 *Railway Applications – Environmental Conditions for Equipment – Part 3: Equipment for Signalling and Telecommunications*
- EN 50126–1, *Railway Applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS)*
- EN 50155, *Railway Applications – Rolling Stock – Electronic Equipment*
- EN 50159, *Railway Applications – Communication, Signalling and Processing Systems – Safety-related Communication in Transmission Systems*
- EN 50716:2023, *Railway Applications. Requirements for software development*
- *Australian Government Disability Standards for Accessible Public Transport Guidelines (DSAPT)*
- IEEE 802.11, *Information Technology – Telecommunications and Information Exchange between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications*
- IEEE 802.1X, *IEEE Standard for Local and Metropolitan Area Networks – Port Based Network Access Control*
- *RISSB Code of Practice – Distributed Power Freight Trains*
- *RISSB Code of Practice – ECP Braking*
- *AAR S-512 27, Point Control Plug and Receptacle*

**NOTE:**

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

### 1.3 Defined terms and abbreviations

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

#### 1.3.1

##### **accessible information**

information that is provided in alternative formats (such as braille, audible information, raised text signs, hearing augmentation) for people with hearing or vision impairment, intellectual or cognitive impairment

#### 1.3.2

##### **advanced train management system (ATMS)**

a specific type of communication-based train management system

#### 1.3.3

##### **asset life cycle**

the series of stages involved in the management of an asset. Starting with planning stages when the need for an asset is identified and continues all the way through its useful life and eventual disposal

#### 1.3.4

##### **automatic equipment identification (AEI) tag**

radio frequency identification (RFID) device, mounted on the side of a vehicle, containing encoded information used to identify the vehicle to wayside equipment

#### 1.3.5

##### **audio frequency induction loop (AFIL)**

also known as a hearing loop, a system installed on rolling stock that includes the installation of a physical loop wire and transmitter that creates an electromagnetic field to enable users with hearing aids to listen to transmitted information by switching on a telecoil on the hearing aid device

#### 1.3.6

##### **automatic train operation (ATO)**

a system that automatically operates the train's driving controls in accordance with information usually received from the trackside signalling equipment or traffic control system. Also known as autonomous train operation or driverless train operation

#### 1.3.7

##### **automatic train protection (ATP)**

a system that supervises train speed and target speed, alerts driver of the operating speed requirements, and enforces braking when necessary. The system can be intermittent, semi-continuous or continuous according to its track-to-train transmission updating characteristics

#### 1.3.8

##### **automatic vehicle location system (AVLS)**

a system that automatically detects the location of rolling stock via infrastructure mounted transponders, cell phone towers, aerials and/or GPS. Location data can be either stored on the LRV and/or transmitted to a base station for real time train location monitoring

#### 1.3.9

##### **automatic warning system (AWS)**

a system that provides audible and visual warnings to the driver on the approach to signals, certain level crossings and emergency, temporary and certain permanent speed restrictions. It supervises the driver's reaction to signal caution aspects and indicates to the driver the passing of a clear aspect. Mostly advisory, however it will cause a brake application to be made automatically if the driver fails to react when approaching a restrictive aspect

**1.3.10****availability**

the ability of an item to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided

**1.3.11****cell phone**

a phone with access to a cellular radio system so it can be used over a wide area, without a physical connection to a network. Also known as a mobile phone

**1.3.12****closed circuit television (CCTV)**

a system installed on rolling stock that enables monitoring and/or recording of video imagery both within a passenger and/or crew cab area, and externally

**1.3.13****collision avoidance and proximity warning**

an induction loop device in the track which is operated electromagnetically by the proximity of a rail vehicle above the detector

**1.3.14****commercial off the shelf (COTS)**

hardware, general technology or computer products which are commercially available typically with an open architecture to allow adaption for multiple uses. Does not include equipment which is custom-made or bespoke solutions

**1.3.15****communications based train control (CBTC)**

a modern digital radio-based communications system for the transfer of signalling and other safety critical train control data from track side infrastructure to rollingstock

**1.3.16****condition monitoring**

a system and/or devices that monitor and detect deterioration of equipment before it causes a failure and thus maintaining equipment in a serviceable condition. Can also be used to increase maintenance efficiency and improve life expectancy of assets. Data can be stored onboard the rolling stock for wired connection download or transmitted wirelessly via various means

**1.3.17****crew-crew communications interface**

a human machine interface to enable crew members (e.g., driver and guard) to communicate via a two-way interface. Can include a crew emergency button activation

**1.3.18****crew emergency button**

a press button or similar device that activates a silent emergency function to other crew and/or the network control centre to alert of a potential emergency incident where the alarm is not made obvious to other persons in the vicinity. Can be discretely mounted to allow activation without notifying other persons in the vicinity of a potential threat situation

**1.3.19****cybersecurity**

cybersecurity is the application of technologies, processes, and controls to protect systems, networks, programs, devices and data from cyberattacks. It aims to reduce the risk of cyberattacks and protect against the unauthorized exploitation of systems, networks, and technologies

**1.3.20****design life**

the period of time during which the equipment is designed to work within its specified parameters, also known as the life expectancy of the equipment

**1.3.21****diesel multiple unit (DMU)**

a multiple-unit passenger train in which the propulsion power is provided by diesel engines installed on the vehicles

**1.3.22****disability standards for accessible public transport (DSAPT)**

disability standards for accessible public transport and amendments which states the requirements for transport providers and operators to meet the Disability Discrimination Act

**1.3.23****distributed power (DP)**

the practice of placing locomotives at several locations within a train as distinct from placing all locomotives at the front of the train. This has the effect of reducing in-train forces by distributing traction and braking forces along the train. Can be controlled by wire (incorporated in an ECP cable) or via a secure radio link

**1.3.24****driver supervisory system**

a system fitted to rolling stock that can monitor the driver (or train) condition or performance and apply the train brakes when a measured condition or performance parameter violates a required state or limit. OTPS is a form of a driver supervisory system

**1.3.25****driver advisory system**

a system fitted to rolling stock to optimize the trains speed over a given route to greater efficiencies in energy use given the scheduling (timetable) requirements

**1.3.26****electric multiple unit (EMU)**

a multiple-unit passenger train in which the propulsion power is provided by electric power supplied from an external source such as overhead wires or third rail

**1.3.27****electrical safety**

a system of organizational measures and technical means to prevent harmful and dangerous effects on persons and damage to equipment from electric currents

**1.3.28****electromagnetic compatibility (EMC)**

the ability of electrical equipment and systems to function acceptably in their electromagnetic environment, by limiting the unintentional generation, propagation and reception of electromagnetic energy which can cause unwanted effects such as electromagnetic interference (EMI) or even physical damage to operational equipment

**1.3.29****electromagnetic interference (EMI)**

a phenomenon that can occur when an electronic device is exposed to an electromagnetic field. Electromagnetic interference includes radiated interference due to magnetic induction, capacitive coupling and radio transmissions

**1.3.30****electronically controlled pneumatic (ECP)**

a term to describe electronically controlled brake equipment of a type similar to that described in the AAR S-4200 standards and the ECP braking code of practice. Used on freight trains, ECP braking incorporates electronic controls to activate air-powered brakes on freight rolling stock on the train simultaneously. On an ECP-equipped train, the rolling stock is equipped with a trainline cable that runs down the length of the train providing the control signals

**1.3.31****electro pneumatic (EP)**

a term to describe air brake equipment typically used on EMU and DMU passenger trains incorporating the functional control of vehicle air brakes by electromagnetically operated valves. This is different to ECP brakes as used on freight trains

**1.3.32****environmental conditions**

the conditions that prevail across geographical areas of rail networks on which the rolling stock operates. It can include altitude, temperature, humidity, condensation, wind, rain, flooding, snow, hail, ice, frost, solar radiation, ultraviolet radiation, lightening, dust, air pollution, salt laden conditions, flora, fauna, vermin, insects, biological agents, fire, smoke and chemicals

**1.3.33****environmental management system (EMS)**

a tool for managing the impacts of an organisation's activities on the environment

**1.3.34****European train control system (ETCS)**

a type of ATP system incorporating a three level, unified, modular automatic train protection specification to enhance interoperability across Europe

**1.3.35****event recorder**

a device installed on rolling stock capable of recording multiple input parameters, in digital or analogue format, related to the operation of the rolling stock. Also known as a 'data logger' or 'data recorder'

**1.3.36****fire safety**

the set of precautions, procedures, and measures taken to prevent fires, minimize the risk of fire-related accidents, and ensure the safety of individuals and property in the event of a fire

**1.3.37****future proofing**

the process incorporated into design of equipment that anticipates the future and allows for a degree of expandability or enhancement as technology evolves

**1.3.38****global navigation satellite system (GNSS)**

satellite based navigation systems which typically include global positioning systems (GPS), global navigation satellite system (GLONASS), BeiDou and Galileo

**1.3.39****global positioning system (GPS)**

an accurate worldwide navigational and surveying facility based on the reception of signals from an array of orbiting satellites

**1.3.40****GSM-R**

global system for mobile communications – railways

**1.3.41****human factors**

the scientific discipline that is concerned with the application of information about human characteristics, capacities, and limitations to the design of human tasks, machines, machine systems, and environments

**1.3.42****human factors integration (HFI)**

the formal process to integrate human factors into the system engineering life cycle. It involves applying a systematic and scientific approach to the identification, tracking, and resolution of issues related to human-system interactions. Effective HFI ensures the balanced development of both the technological and human aspects of the system and delivers the desired safety and operational capability

**1.3.43****intercom**

an electrical device allowing one-way or two-way communication

**1.3.44****interoperability**

a term used to describe the possibility of uninterrupted movement of trains across differing countries, states or rail networks across international borders, state borders or rail networks managed by various RIMs

**1.3.45****maintainability**

the ability to be retained in, or restored to, a state to perform as required, under given conditions of use and maintenance

**1.3.46****mobile radio**

a radio mounted in a locomotive, DMU, EMU, track machine or terminal machinery and has an externally mounted antenna. A mobile radio typically has better reception and a stronger transmission signal than an operational portable handheld radio

**1.3.47****multiple unit (MU)**

two or more locomotives, DMUs (diesel multiple unit) or EMUs (electric multiple unit) coupled in such a manner that all the units are controlled by the driver from one control stand, usually in the leading locomotive

**1.3.48****network control centre**

a command and control facility responsible for managing train paths and issuing occupancy for each operating railway or defined sections of a railway. Typically includes a communications link to operating rolling stock and controls the safe operations of the network

**1.3.49****onboard train protection system (OTPS)**

a safety system installed on rolling stock that reduces the likelihood of and protects against the consequences of a failure in the manual onboard functions for safe train operation. OTPSs can include vigilance, overspeed, MTSTGS, ATMS, ATP, AWS, SPS, OES, ETCS and TPWS and monitor the driver (or train) condition or performance and apply the train brakes, and disable traction power when a measured condition or performance parameter violates a required state of limit

**1.3.50****open architecture**

the capacity to accommodate adding, upgrading and swapping components and/or software, without technical or trade constraints related to proprietary systems or technology

**1.3.51****operational portable handheld (OPH)**

a mobile voice and data device that is based upon standard mobile telephone or radio devices that has been modified, generally by firmware enhancement to perform railway specific functions that can be carried by railway personnel on their person

**1.3.52****operator enable system (OES)**

a device that applies emergency brakes and disables traction power if a continuous control input required of the driver or operator is interrupted or not detected

**1.3.53****overspeed system**

an 'overspeed sensor system' as applied to a TPWS or other train control systems to alert and/or ensure operating speed for a particular section of track is not exceeded

**1.3.54****passenger-crew communications interface**

a two-way communications human machine interface to enable a passenger to contact the train crew via voice, signal activation or data and vice-versa. Examples of passenger-crew communications interface equipment include passenger intercoms, emergency help points, wheelchair ramp/assist call buttons

**1.3.55****passenger information system (PIS)**

a manual or automated system for communicating information to passengers on rolling stock about the nature and the state of a service through visual, audio or other media

**1.3.56****power outage**

an electrical discontinuity of power on board rolling stock that can affect operations of one or multiple systems

**1.3.57****redundant array of independent disks (RAID)**

a type of storage that writes data across multiple drives within the same system

**1.3.58****reliability**

the ability to perform as required, without failure, for a given time interval, under given conditions

**1.3.59****reliability, availability, maintainability (RAM)**

design attributes of a system or an asset. Collectively, these parameters are leveraged to improve the productivity of the asset over its life cycle and ultimately, optimizing its overall life cycle costs

**1.3.60****remote control**

a system installed on self-propelled rolling stock that allows limited control of operating functions without requiring an operator in the drivers' cab. Typically uses a radio transmitter and receiver system and can be operated from a ground-based station or mobile via a 'belt pack'

**1.3.61****rolling stock communications equipment**

devices and systems that facilitate communication by transmitting, receiving, or processing information via electronic means installed on rolling stock. These devices and systems enable the exchange of data, voice, control signals and other electronic information via cables and/or wireless means

**1.3.62****safety critical communications**

include both verbal, written and data transmitted communications that are essential to ensuring safe railway operations

**1.3.63****safety integrity**

the probability of a safety-related system performing its required safety function under the required conditions and within the required time interval

**1.3.64****satellite phone**

a type of mobile phone that connects to other phones or the telephone network by radio link through satellites orbiting the Earth instead of terrestrial cell sites. Typically used as a back-up communications device in remote areas not covered by a cell phone network

**1.3.65****station protection system (SPS)**

a system that alerts the driver to stations and other trackside features via the use of track magnets

**1.3.66****train control & monitoring system (TCMS)**

a system that comprises computer devices and software, human-machine interfaces, digital and analogue input/output (I/O) capability and the data networks to connect all these together in a secure and fault-resistant manner. Also referred to as TOS and TMS

**1.3.67****train management system (TMS)**

a form of TCMS

**1.3.68****train operating system (TOS)**

a form of TCMS

**1.3.69****train protection warning system (TPWS)**

a signal enforcement system, functionally the same as a train-stop system, except that it uses a non-contact form of interface (radio frequency) between the track and the train

**1.3.70****train radio**

a radio system used to aid train operations and to provide communications between train crews, train controllers, and track maintenance staff

**1.3.71****upgradability**

the capability of being improved in functionality by the addition or replacement of components and/or software

**1.3.72****vigilance system**

a system that will react by directly initiating an emergency brake application if an acknowledgment input is not received within a specified time increment

**1.3.73****wi-fi**

a wireless networking technology that uses radio waves to provide wireless high-speed Internet access

**1.3.74****wireless local area network (WLAN)**

a group of co-located computers or other devices that form a network based on radio transmissions rather than wired connections. A Wi-Fi network is a type of WLAN; anyone connected to Wi-Fi while reading this webpage is using a WLAN.

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

## Section 2 General requirements

### 2.1 Cybersecurity and alignment with Australian cybersecurity strategy

High level functional requirements and outcomes based on performance criteria shall be in accordance with the requirements set out in AS 7770.

#### Commentary C2.1

Further information regarding cybersecurity can be found in RISSB Code of Practice: Rail Cyber Security for Rolling Stock & Train Control Systems and the RISSB Guideline: Rail Cyber Security (Implementation of AS 7770).

### 2.2 Communication technology standardization

Communication technology standardization shall be in accordance with AS 7702.

Modular technology and future proofing (e.g., allowing for replacement of components and attrition of technology) should be included in the design of the equipment with respect to the expected life of the asset the equipment will operate with.

#### Commentary C2.2

AS 7702 specifies the evaluation of novel or modified products for use on Australasian railway network infrastructure and defines the approval criteria; the submission formats; and the information required. This standard also specifies performance, reliability, as well as maintainability and service life.

### 2.3 Interoperability

Interoperability considerations should be in accordance with AS 7450 and accompanying guideline.

#### Commentary C2.3

AS 7450 provides direction for improving the level of interoperability across the Australian railway industry. While interoperability is not equivalent to sameness, this standard provides recommendations for certain principles regarding the interoperability and compatibility of systems.

### 2.4 Human factors

Human factors is a significant factor for human integration input into the design, development, and procurement of communication equipment in rolling stock and should be incorporated from the inception of the design process. Practitioners undertaking any human factors activities shall be competent in human factors at a level appropriate to each activity.

Human Factors in design, development, and procurements of communication equipment shall be in accordance with AS 7470.

Where the equipment directly interfaces with persons especially passengers, an assessment of should be independently undertaken using a representative sample of end users (including persons with disabilities, parents with small children and the elderly), evaluating the human interactions with the equipment. This process should include the development and use of a questionnaire by the end users surveyed. The results of the survey shall influence the final design and any changes shall be re-assessed by a similar methodology prior to design completion.

**Commentary C2.4**

RISSB Guideline: Integration of Human Factors in Engineering Design provides guidance on the human factors design process to assist in ensuring the asset is efficient and effective, meets its intended performance levels and can deliver the expected benefits to users and customers.

RISSB Guideline: Integration of Human Factors Across the Project Lifecycle provides guidance on the implementation and effectiveness of HF Integration into projects by providing guidance on scaling and managing HF activities across a project lifecycle.

**2.5 Electromagnetic compatibility (EMC)**

Electromagnetic Compatibility requirements for communications equipment shall be in accordance with AS 7722. RTOs shall ensure that any EMC and EMI risks introduced by new or altered systems and products are controlled so far as is reasonably practicable (SFAIRP).

**Commentary C2.5**

AS 7722 defines the requirements for the management of electromagnetic emissions, EMC interface management and susceptibility of devices used in the railway so that all systems used in the railway are electromagnetically compatible. It is to ensure that there is no interference with critical communications regardless of the type of technology selected.

**2.6 Operational environmental factors and equipment durability**

Rolling stock communications equipment shall be able to operate effectively as intended under the full range of environmental conditions that can be expected in the route/area of operation over the expected life of the equipment and/or rolling stock asset.

Where applicable, the equipment, systems and the respective mounting of the hardware to the rollingstock shall be in accordance with AS 7530.

**Commentary C2.6**

RISSB Guideline: Reliability, Availability, Maintainability (RAM) provides information for equipment durability. A tool described within this guideline is the failure modes, effects, and criticality analysis (FMECA).

RISSB Guideline: Requirements for the Procurement of Rolling Stock provides a harmonized, uniform and consistent approach to the process of preparing technical specifications for the procurement of rolling stock, ensuring consistence and providing specific guidance on the form and content.

EN 50155 is another reference Standard that can be considered regarding equipment durability.

**2.7 Software Safety Integrity Levels (SIL), programming and configuration**

Software Safety Integrity Levels (SIL) programming and configuration shall be in accordance with EN 50716.

**Commentary C2.7**

Further guidance around safety integrity levels is provided in the following standards:

EN 50716 defines software safety integrity levels (SIL).

RISSB Guideline: Firmware, Software, and Configuration Management of Operational Rail Assets should be considered and provides detailed information and guidance around configuration management of firmware and software as well as future change control.

AS 61508.1 – AS 61508.7 provides guidance around determining safety integrity levels for the functional safety of electrical, electronic, and programmable electronic safety-related systems.

## 2.8 Asset life cycle requirements including Reliability, Availability, and Maintainability (RAM)

Asset life cycle requirements including Reliability, Availability and Maintainability (RAM) should be in accordance with EN 50126 – Railway Applications and/or ISO 15288 as applicable.

### Commentary C2.8

RISSB Guideline: Reliability, Availability, Maintainability (RAM) Guideline provides a consistent approach for the process of selection and use of appropriate RAM strategies for railway assets and systems, based on industry accepted international standards to deliver appropriate programs for railway systems and assets. The Guideline additionally references the provision of redundancy within a system to identify single points of failure that have been identified through increasing levels of design detail and maturity.

Another standard providing guidance around reliability, availability and maintainability is, IEC 60300 – Dependability Management Application Guide – Maintainability.

## 2.9 Commercial off the shelf (COTS) equipment

Software and hardware should employ open architecture where possible which allows for multiple option for the supply of components and component assemblies whilst also supporting open architecture software interfaces.

### Commentary C2.9

Utilising COTS equipment ensures supply chain resilience, more competition and enhanced after-market service support for the equipment.

RISSB Guideline: Reliability, Availability, Maintainability (RAM), and RISSB Guideline: Firmware, Software, and Configuration Management of Operational Rail Assets provide additional information.

## 2.10 Future proofing and upgradability

Rolling stock communications equipment design and supply should anticipate foreseeable future technology evolutions and allow for a degree of expandability or enhancement to improve functionality by the addition or replacement of components and/or software.

### Commentary C2.10

RISSB Guideline: Reliability, Availability, Maintainability (RAM) provides guidance around future proofing and upgrade strategies for communications assets.

## 2.11 Fire safety performance

Fire safety performance of shall be in accordance with AS 7529.

Test results from an appropriately certified testing laboratory demonstrating compliance with AS 7529 shall be documented as part of the requirements for verification.

### Commentary C2.11

The EN 45545 series of standards provides further fire safety performance guidance of rolling stock equipment.

The EN 50264, EN 50306 and EN 50382 series of standards provide further fire safety performance guidance of cables used in rolling stock equipment.

## 2.12 Electrical safety

Electrical safety including protection of electrical circuits from damage and protection of persons from electric shock shall be in accordance with AS 7530 and other applicable standards.

**Commentary C2.12**

The EN 50122, EN 50153 and IEC 61991 series of Standards provide further guidance on rolling stock electrical safety.

**2.13 Power outage functionality**

Power outage functionality for safety critical communication systems (see Section 3) and train control communications systems (see Section 4), where fitted should be in accordance with AS 7486.

**Commentary C2.13**

Power outage functional requirements should be determined on a risk-based approach. It is recommended that at least radio and/or emergency intercom functionality is retained in the event of a power outage (e.g., in an incident).

**2.14 Environmental Management Systems (EMS) and sustainability**

Environmental Management Systems (EMS) for the design, manufacture, maintenance, disposal and end of asset life recycling capability should comply with the relevant requirements of the organisation procuring the rolling stock communications equipment (which can be part of a whole of train procurement).

The EMS should evaluate and minimize environmental impact over the whole lifecycle of the asset for:

- (a) energy use and greenhouse gas emissions in manufacture;
- (b) energy use and greenhouse gas emissions in transportation;
- (c) materials and waste;
- (d) pollution control; and
- (e) end of asset life disposal and recycling.

Local (in-country) manufacturing and/or assembly should also be assessed as part of the EMS.

**Commentary C2.14**

EMS elements can include management plans, procedures and protocols, checklists, training and awareness programs. The EMS should be appropriate to the scale, nature and impacts of the project activities. Any documents incorporated into the EMS need to be concise and practical for the intended user (contractors, subcontractors and workforce).

Depending on the environmental issues, risks and client (user) requirements, the EMS can be certified as consistent with standard AS/NZS ISO 14001. The EMS may also form part of a broader integrated management system, which can cover other aspects including safety and quality. Ensuring the head contractor's EMS is certified is considered to be good practice. This facilitates setting and achieving of objectives and targets and allows risk and opportunities assessments of key elements of an EMS.

A full description of the requirements of an EMS is described in AS/NZS ISO 14001.

For further guidance on EMS and sustainability, refer to:

- *RISSB Requirements for the Procurement of Rolling Stock Guideline*; and
- *Australasian Railway Association - Sustainability Guide*.

## Section 3 Safety critical communications

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Safety critical communications of rollingstock shall be in accordance with AS 7660.

Safety critical communication systems installed on rolling stock can also include:

- (a) cell phone;
- (b) crew emergency button;
- (c) digital data transmission systems;
- (d) global navigation satellite system (GNSS);
- (e) global positioning system (GPS);
- (f) operational portable handheld radio;
- (g) satellite phone;
- (h) satellite data communications equipment; and/or
- (i) train radio.

### Commentary C3

RISSB Code of Practice: Safety Critical Communications provides further information regarding safety critical communications.

EN 50159 "Railway applications - Communication, signalling and processing systems - Safety related communication in closed transmission systems" is another resource that defines a 'safety-layer' to be deployed externally to the transmission system or built in within the application to allow for safety related communications via 'non-trusted' communications system.

There is a legal obligation on RTOs to ensure safe operation of the railway. While each RTO will satisfy this obligation in accordance with their own safety management system, some aspects of communication require coordination and consistency between RTOs.

AS 7660 sets out a set of basic requirements for wireless communication between those whose work is in or associated with the rail corridor. It applies to wireless communication between network controllers, train crews and persons working in the rail corridor.

RIMs responsible for some track sections can possibly interact with multiple RSOs. RSOs might, in turn, be interacting with several RIMs. With the potential for rolling stock, train crews, operators and maintainers to work on many different sections of track, and with more than one RIM, a consistent operation of wireless communication systems is very important. Use of consistent technology is desirable, but the rate of technology change and the independent approach of RIMs means this can not always be achieved.

## Section 4 Train control communication systems

### 4.1 Train Control and Monitoring Systems (TCMS)

Train Control and Monitoring Systems (TCMS) shall be in accordance with AS 7530, AS 7715, AN 7726, EN 50121, EN 50128, EN 50155, EN 50159, IEC 60077, IEC 61375 and IEC 62279.

#### Commentary C4.1

The TCMS (also known as the TOS or TMS) is the backbone system that controls all systems on the rolling stock. It has 3 main functions:

1. control of communications between equipment;
2. interfacing with the rolling stock via input/output channels and executing train logic; and
3. supervision, monitoring and recording of train performance.

Modern rolling stock train control systems typically incorporate a CAN bus for control of train systems. It is acknowledged that older fleets typically use wired/train lines for the control of systems. This Standard applies to new rolling stock or rolling stock to be substantially modified (e.g., replacing a train wired control system with a more modern CAN bus system).

Refer to EN 61375 for CAN bus (control area network bus) controls area networks prohibiting unauthorized access to critical network functionality – safety critical functionality and architecture and segregation for different networks – separating passenger control systems and safety critical systems). CAN bus is a non-secure technology and needs safeguards applied to it.

Refer to AS 7770 to consider potential vulnerabilities of communication systems and have effective logical and physical segregation of network zones and devices based on safety integrity levels.

### 4.2 Electronically Controlled Pneumatic (ECP) braking functionality requirements

Electronically Controlled Pneumatic braking shall be in accordance with AS 7510.1, AS 7510.2 and the RISSB code of practice for ECP braking.

### 4.3 Distributed power for freight trains functionality requirements

Distributed power requirements for multiple unit operation trains shall be in accordance with the RISSB code of practice for distributed power freight trains.

### 4.4 Driver supervisory and advisory systems

Where applicable driver supervisory and advisory systems shall be in accordance with AS7502, AS 7511, AS 7666 and AS 7726, and include but not be limited to:

- (a) operator enable systems (OES);
- (b) vigilance system;
- (c) automatic train protection systems (including ATP, ATMS, ETCS and CBTC);
- (d) train protection warning systems (including TPWS);
- (e) automatic warning systems (AWS);
- (f) station protection system (SPS);
- (g) overspeed systems;
- (h) collision avoidance and proximity warning; and
- (i) on board train protection systems (OTPS).

**Commentary C4.4**

As part of the development of driver supervisory systems, AS 7450 should be considered as part of providing interoperability of these systems, including OES, vigilance, ATP, ATMS, ETCS, TPWS, AWS, SPS, CBTC, overspeed systems as well as collision avoidance and proximity warning.

**4.5 Event recorders**

Event recorders shall be in accordance with AS 7527, except for road rail vehicles which shall be in accordance with AS 7502.

**4.6 Control wire cabling between locomotives/DMU/EMU**

Control wire cabling between locomotives, between DMUs and between EMUs shall be in accordance with AS 7530 as applicable.

Control wire cabling between locomotives that does not include ECP and/or wired DP shall be in accordance with:

- (a) the standard 27 pin MU receptacles and pin designations as per AAR S-512; or
- (b) as defined by the RSO.

**Commentary C4.6**

The majority of diesel electric locomotives operating on the ANZ rail networks utilize the AAR S-512 defined functionality for connection and control compatibility. However, it is recognized that some networks (e.g., using electric locomotives) utilize different control wire connections, plugs and receptacles between compatible operating locomotives.

Additionally, it is recognized that some locomotives with AAR S-512 27 pin receptacles are possibly not fully operationally compatible with other locomotives from different manufacturers and/or older fleets.

For recovery of disabled trains, connectivity to allow basic train safe operating functions in a degraded mode should be incorporated into the design and tested for compatibility to define operational procedures when rescuing disabled trains. This can include adaptor couplings to allow connection between different types of rolling stock.

Control wire cabling between locomotives in consists of utilising ECP and/or wired DP configuration should comply with code of practice - distributed power freight trains, and/or code of practice – ECP braking.

Control wire cabling between EMUs and between DMUs should be integrated into an electrical head which is part of the inter-car coupler system. Couplers and electrical connections should be compatible with other rolling stock operated by the RTO to allow for flexibility of operations and emergency recovery.

**4.7 Remote control**

Remote control systems (typically used for slow speed shunting, maintenance and loading/unloading of bulk commodities) if fitted shall be in accordance with the applicable sections of AS 7660 and AS 7770.

In particular, the remote control system should:

- (a) ensure secure communications between the remote control unit and equipment;
- (b) prevent unauthorised commands or responses to be infiltrated between the remote control unit and equipment;
- (c) allow explicit pairing of control units to the equipment being operated;

- (d) allow explicit authentication of the operator; and
- (e) include a driver supervisory system (e.g., OES, vigilance and/or trip sensors)

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## Section 5 Passenger interface systems

### 5.1 General

Passenger interface systems shall be in accordance with AS 7528, AS 7660, AS 7770 and the Disability Standards for Accessible Public Transport (DSAPT), and include but not be limited to:

- (a) passenger information systems (including automated audio and/or visual passenger information);
- (b) passenger to crew communications interface (including intercoms);
- (c) two-way passenger to network control centre interfaces (normal operations or in case of an emergency with unresponsive train crew);
- (d) emergency (discrete) help points;
- (e) wheelchair assist call systems;
- (f) passenger audio frequency induction loops;
- (g) crew to passenger intercom and public address systems; and/or
- (h) passenger entertainment systems.

#### Commentary C5.1

Passenger interface information systems that provide unidirectional communication between crew and all passengers should implement use cases that include obtaining general service information; alerting of imminent hazards; and warn passengers of an emergency.

Individual passenger to crew (or network control centre) systems should provide an individual interaction using discrete units (commonly referred to as 'help points', 'intercoms' or 'passenger communication units').

### 5.2 Passenger Wi-Fi and WLAN

If installed, the passenger wi-fi network (or WLAN) shall be in accordance with IEEE 802.11, ISO/IEC 7498-1, and IEC 60050-192.

#### Commentary C5.2

To ensure optimum Wi-Fi and phone connectivity throughout trains, correct access point placements connecting passengers and crew to the network including identifying "dead zones" where Wi-Fi will not properly function.

Also to ensure critical updates of information or bulletins are able to be accessed to train crews and passengers.

## Section 6 Crew to crew communication system

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Internal crew to crew interfaces shall be in accordance with AS 7528 as AS 7770.

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## Section 7 Operational information communication systems

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Operational information communications between the train and network control centre shall be in accordance with AS 7726 and AS 7770, and include but not be limited to:

- (a) train running information;
- (b) automatic vehicle location system (AVLS);
- (c) European train control system (ETCS)/European rail traffic management system (ERTMS);
- (d) Communication-based train control (CBTC); and
- (e) passenger loading information.

### Commentary C7

AS 7533 should be considered for the operational environments and noise levels to ensure effecting crew to train control and communications interface.

## Section 8 Vehicle communication system telemetry and location systems

Onboard train condition monitoring systems (including automated health monitoring systems) shall be in accordance with AS 7726, AS 7450, AS 7486, AS 7666 and AS 7770 and include but not be limited to monitoring and data transmission of:

- (a) driver supervisory systems;
- (b) driver advisory systems to provide guidance for efficient train operation;
- (c) train control and management systems;
- (d) emergency alarms;
- (e) CCTV (within vehicle and external);
- (f) safety critical communications equipment;
- (g) brake systems (including wheel slide protection (WSP) and sanding deployment systems);
- (h) ride quality and on-board dynamics (including derailment detection);
- (i) wheel bearing temperature and acoustic monitoring;
- (j) fuel system management system monitoring; and energy storage management system;
- (k) passenger loading information;
- (l) radio distributed power/wireless distributed power; and/or
- (m) crew radio alert messages from wayside monitoring systems, e.g. hot bearing detection, in-motion weighbridge out of balance mass information, dragging equipment detection warning of loose equipment potentially damaging rail infrastructure.

AEI tags (if installed) shall be in accordance with AS 7503.

### Commentary C8

RISSB Guideline: Condition monitoring of rolling stock provides on guidance on various condition monitoring systems, including wayside monitoring and in -train monitoring and influencing maintenance and reliability strategies for the rollingstock assets.

Train Communication system diagnostic should be capable of remote transmission to maintainers.

Example – ECP cross talk detection and response – ECP Code of practice.

## Section 9 Security and emergency communication systems

### 9.1 CCTV and onboard recording of passenger intercoms

Closed Circuit Television and on board recording for security purposes shall comply with AS 4806.2 Closed Circuit Television (CCTV) – Part 2: Application guidelines.

The system and recording shall allow for the gathering of admissible evidence for the purposes of the Evidence Act 1995 (New South Wales) or other applicable legislation for area of operation.

The CCTV and/or onboard recording system shall record the audio from all emergency passenger intercom activations.

The CCTV and/or onboard recording system should employ an open secure architecture to integrate with other electronic security technologies and utilize Open Network Video Interface Forum provide and promote standardized interfaces for effective interoperability.

The CCTV and/or onboard recording system data storage should be able to retain 31 days of recorded data before the oldest data is over written. The CCTV and/or onboard storage systems should be crash hardened and installed in a location on the rolling stock that should not become damaged during collision and/or derailment.

All recorded images should be stored in multiple systems on a set to provide redundancy of storage in the event of equipment failure and accidents/incidents. This can be achieved by storage on multiple vehicles in a train set, or via a RAID system.

Storage units shall not lose data under any power failure conditions.

The surveillance equipment shall provide a self-test functionality and report that the system is functioning correctly to the TCMS.

#### Commentary C9.1

As part of the guidance around train security recordings, *Code of Practice - Rail Cyber Security for Rolling Stock & Train Control Systems* should be considered.

### 9.2 Crew emergency button

If fitted, a crew activated emergency button may be installed in a discrete location in a position that cannot be inadvertently or accidentally activated. If activated, the crew emergency button shall immediately notify the network control centre of an emergency. This also should automatically allow access to live CCTV and Passenger information communication interface systems.

#### Commentary C9.2

The intended application of the crew emergency button is in the event of an unlawful or other event on the train that needs to be notified to the network control centre without alerting the potential threat on the train that the network control centre has been alerted.

## Appendix A Hazard register (Informative)

Hazard Number	Hazard
3.1.1.21	Security - Poor personal security - Human Error, Track Failure, Track Obstructions, Design Failure, Organizational SMS Failure, Vandalism and or Injury or Death - Cyberattack
3.2.1.34	Security - A breach of Security - Injury or Death, Organisational SMS Failure and or Vandalism - Cyberattack
3.3.1.5	Security - Harm to an Organisation - Human Error, Organisational SMS Failure - Cyberattack
5.2.1	Rolling Stock - Harm to infrastructure by rolling stock - Derailment or Collision, Human Error, Design Failure, Security Breach, Loads not Secure, and or Vandalism
5.3.1	Rolling Stock - Harm to persons - Derailment or Collision, Human Error, Design Failure, Security Breach, Loads not Secure, and or Vandalism
5.4.1	Rolling Stock - Harm to rolling stock - Derailment or Collision, Human Error, Design Failure, Security Breach, Loads not Secure, and or Vandalism
5.5.1	Rolling Stock - Harm to Rolling Stock Related Processes - Derailment or Collision, Human Error, Track Failure, Track Obstruction, Design Failure, Health Failure, Organisational SMS Failure, Security Breach, Load not Secure and or Vandalism
5.6.1	Rolling Stock - Out of Control Trains - Human Error, Design Failure, Health Failure, Organisational SMS Failure, Security Breach and or Vandalism
5.9.1	Rolling Stock - Signal Passed at Danger - Human Error, Track Failure, Design Failure, Health Failure, Lack of Training and or Vandalism
5.10.1	Rolling Stock - Brakes being Inadequate when Moving - Derailment and Collision, Human Error, Design Failure, Organisational SMS Failure, Security Breach and or Vandalism
5.11.1	Rolling Stock - Brakes being Inadequate when Stationary - Derailment and Collision, Human Error, Design Failure, Organisational SMS Failure, Security Breach and or Vandalism
5.14.1	Rolling Stock - Alerting system failure - Design Failure, Security Breach and Vandalism
5.15.1	Rolling Stock - Failure of the deadman system - Human Error, Design Failure, Health Failure, Organisational SMS Failure, Security Breach and or Vandalism
5.16.1	Rolling Stock - Train protection system failure - Derailment or Collision, Human Error, Track Failure, Track Obstruction, Design Failure, Health Failure, Organisational SMS Failure and or Vandalism
5.20.1	Rolling Stock - Driver fatigue - Human Error, Design Failure, Health Failure and Organisational SMS Failure
5.22.1	Rolling Stock - Overspeed - Design Failure, Health Failure, Organisational SMS Failure, Load not Secure, Vandalism and or Threat

Hazard Number	Hazard
5.32.1	Rolling Stock - Fire - Derailment or Collision, Human Error, Track Failure, Track Obstructions, Design Failure, Health Failure, Organisational SMS Failure, Security Breach, Load not Secure and or Vandalism
5.41.1	Rolling Stock - Radiation - Derailment or Collision, Human Error, Track Failure, Design Failure, Health Failure, Organisational SMS Failure, Security Breach, Load not Secure and or Vandalism
5.42.1	Rolling Stock - Electric shock - Failure of protection - Derailment or Collision, Human Error, Track Failure, Track Obstructions, Design Failure, Health Failure, Organisational SMS Failure, Environmental Impact, Security Breach, Load not Secure, and or Vandalism
5.46.1	Rolling Stock - Excessive acceleration - Human Error, Design Failure, Health Failure, Organisational SMS Failure, Security Breach and or Vandalism
5.47.1	Rolling Stock - Brakes being applied too little or too late - Organisation's SMS Failures, Human Error and Health Failure
5.50.1	Rolling Stock - Uncommanded brake applications - Human Error, Design Failure, Health Failure, Security Breach and or Vandalism
5.52.1	Rolling Stock - The inability to determine the cause of rolling stock incidents - Derailment or Collision, Track Failure, Track Obstructions, Design Failure and or Environmental Impact
10.3	Degraded Working - "Authority" execution error - Human Error, Design Failure, Health Failure, Organisational SMS Failure, Environmental Impact, Security Breach, Vandalism and or Threat - Workstation technology failure / unavailable
10.4.1	Degraded Working - Overspeed Operation - Human Error, Design Failure, Health Failure, Organisational SMS Failure, Environmental Impact, Security Breach, Vandalism and or Threat - Workstation technology failure / unavailable
10.5.1	Degraded Working - Network status / data error - Human Error, Design Failure, Health Failure, Organisational SMS Failure, Environmental Impact, Security Breach, Vandalism and or Threat - Workstation technology failure / unavailable
10.6	Degraded Working - Unsafe Authority - Human Error, Design Failure, Health Failure, Organisational SMS Failure, Environmental Impact, Security Breach, Vandalism and or Threat
10.7	Degraded Working - Authority communication error - Human Error, Design Failure, Health Failure, Organisational SMS Failure, Environmental Impact, Security Breach, Vandalism and or Threat

## Appendix B Bibliography (Informative)

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

- AS 7533 Series, *Australian Railway Rollingstock – Driving Cabs*
- AS 61508 Series, *Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems*
- IEC 60300, *Dependability Management Application Guide – Maintainability*
- IEC 61991, *Railway Applications – Rolling Stock – Protective Provisions Against Electrical Hazards*
- ISO 14001, *Environmental Management Systems*
- BS EN 50155:2017, *Railway Applications – Rolling Stock – Electronic Equipment*
- EN 45545 Series, *Railway Applications – Fire Protection on Railway Vehicles*
- EN 50122 Series, *Railway Applications – Fixed Installations – Electrical Safety, Earthing and the Return Circuit*
- EN 50153, *Railway Applications – Rolling Stock*
- EN 50264 Series, *Railway Applications – Railway Rolling Stock Power and Control Cables Having Special Fire Performance*
- EN 50306 Series, *Railway Applications – Railway Rolling Stock Cables Having Special Fire Performance – Thin Wall*
- EN 50382 Series, *Railway Applications – Railway Rolling Stock High Temperature Power Cables Having Special Fire Performance*
- RISSB *Code of Practice – Rail Cyber Security for Rolling Stock & Train Control Systems*
- RISSB *Code of Practice – Safety Critical Communications*
- RISSB *Guideline – Condition Monitoring of Rolling Stock*
- RISSB *Guideline – Firmware, Software, and Configuration Management of Operational Rail Assets*
- RISSB *Guideline – Integration of Human Factors Across the Project Lifecycle*
- RISSB *Guideline – Integration of Human Factors in Engineering Design*
- RISSB *Guideline – Rail Cyber Security (Implementation of AS 7770)*
- RISSB *Guideline – Reliability, Availability, Maintainability (RAM)*
- RISSB *Guideline – Requirements for The Procurement of Rolling Stock*
- *Australasian Railway Association – Sustainability Guide*