AS 7479:2019

Track maintenance and road rail vehicles, Collision avoidance and proximity warning

RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

Operations Standard

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AS 7479:2019 Track maintenance and road rail vehicles, Collision avoidance and proximity warning

This Australian Standard® AS 7479 Track maintenance and road rail vehicles, Collision avoidance and proximity warning was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organisations:

Australian Rail Track Corporation	AusSafe Consulting	BHP
Blue Electronics	Freight Quip	John Holland
KiwiRail	Laing O'Rourke	Public Transport Authority WA
Queensland Rail Rio Tinto	Roy Hill	Select Plant Hire
TasRail	Varley Group	V/Line

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This Standard was prepared by the Rail Industry Safety and Standards Board (RISSB) Development Group AS 7479 Track maintenance and road rail vehicles, Collision avoidance and proximity warning. Membership of this Development Group consisted of representatives from the organisations listed on the inside cover of this document

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 public comment period.

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

Deb Spring
Exec. Chair / CEO
Rail Industry Safety and Standards Board

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Track maintenance and road rail vehicles, Collision avoidance and proximity warning

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Objective

This Standard provides direction to rail transport operators (RTOs) and their contractors of the application of collision avoidance and proximity warning technologies to control the risks imposed by maintenance vehicles operating near other vehicles or nearby workers. These technologies can be fitted to track maintenance vehicles or RSWs and provide an audible, visual and/or vibration alert or warning to the operator and/or workers.

Compliance

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

1. Requirements.
2. 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 is not able to be applied or other controls are more appropriate or 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 are addressed in Appendix A.

Contents

Appendix Contents

1 Scope and general

1.1 Introduction

A range of safety measures are applied to ensure a worksite in the rail corridor is safe, so far as is reasonably practicable (SFAIRP). These include the application of:

- the network owner's safe working rules and procedures,
- safety management systems,
- relevant RISSB Standards,
- controls developed through a risk assessment,
- the wearing of personal protective equipment (PPE).

This Standard focuses on the application of collision avoidance and proximity warning technology to reduce the likelihood of collisions between vehicles or between vehicles and rail safety workers (RSWs). These technologies should be applied along with the safety measures outlined above.

Collision avoidance technology generally relates to devices fitted to a track maintenance vehicle operating on an open network where the speed environment is relatively fast. These devices warn a driver/operator of a track maintenance vehicle of an impending collision with another vehicle or RSW. Depending on the level of integration with the parent vehicle, steps to avoid a collision will either be automatic, or the driver/operator will need to act on the warning.

Proximity warning technology generally relates to a situation where there are multiple vehicles and RSW and the speed environment is relatively slow. The devices can be fitted to either or both track maintenance vehicles and an RSW. They provide a warning to the operator and/or the RSW of the approach of a vehicle into their work area, or that the RSW is entering an unsafe area created by the vehicle's movements. The operator and/or the RSW applies corrective action to remedy the situation.

1.2 Scope

This Standard applies to RSWs and all track maintenance vehicles, including:

(a) road rail vehicles,

(b) vehicles involved in the maintenance of rail infrastructure including track or overhead wiring within the rail corridor.

It applies to:

(a) open line running,

(b) occupations/possessions,

(c) maintenance yards,

(d) sidings, and

(e) the transfer of track maintenance vehicles between worksites.

In relation to coupled vehicles, if the units are coupled so that they cannot collide, collision avoidance devices are not necessary. If the units travel in consist, such as for a tamper and regulator, collision avoidance technology should be fitted to vehicles. It is suggested that when

vehicles that travel a lot of the time in convoy should either be compatible or have a common emergency interface signal.

It is acknowledged that the application of collision avoidance and proximity warning technologies is difficult in some low speed rail applications and this Standard does not apply to:

(a) off track maintenance (except off track plant operating within the rail corridor either in or close to the danger zone),

(b) vehicles designed to be coupled in convoy with light vehicles,

(c) shunting operations,

(d) rollingstock placement,

(e) operational loading and unloading,

(f) rail safety workers being transferred between worksites.

1.3 Application

This Standard is applicable to all rail transport operators (RTOs) during maintenance and operations on the main line, in maintenance yards and sidings.

1.4 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 4292 – Railway safety management.
- AS 7502 – Road Rail Vehicles.
- IEC 26512 – Systems and software engineering - Requirements for acquirers and suppliers of information for users.
- IEC 61508 – Functional safety of electrical/electronic/programmable electronic safety related systems.
- IEC 62061 – Safety of machinery.
- IEC 62290 – Railway applications – urban guided transport management and command/control systems.
- ISO 9241-400 – Ergonomics of human - system interaction - Part 400: Principles and requirements for physical input devices.
- EN 50128 – Railway applications – software for railway control and protection.
- EN 50129 – Railway applications – safety related electronic systems for signalling.

NOTE: Documents for informative purposes are listed in a Bibliography at the back of the Standard (Appendix B).

1.5 Terms and definitions

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

(a) ***alerting time***
a period of time during which a warning (alert) generated by collision avoidance, proximity warning or automatic track warning system is in effect

(b) ***audible signal***
A sound that is audible is at a level that is loud enough to be heard

(c) ***collision avoidance system***
a system installed on a track maintenance vehicle or/and road rail vehicle that detects a potential collision and warns the operator of the vehicle. Collision avoidance technology is either:

- automated in which case the system automatically controls the track maintenance vehicle to avoid a collision OR
- manual where the operator makes a decision to avoid the collision through manual operation of the track maintenance vehicle.

(d) ***item***
a single-track maintenance vehicle, a single road rail vehicle, a single worker or a single object

(e) ***operator***
track vehicle operator

(f) ***proximity warning system***
a system that detects a track maintenance vehicle or road rail vehicle, alerts the driver and operator and RSW about the close proximity of the item

(g) ***rail safety worker (RSW)***
a person who undertakes rail safety work as defined in Section 8 of the Rail Safety National Law

(h) ***safety integrity level (SIL)***
a relative level of risk-reduction provided by a safety function, or to specify a target level of risk reduction

(i) ***track maintenance vehicle (track vehicle)***
a vehicle that runs on track and is designed to conduct maintenance or construction operations within the rail corridor. This can include a hi-rail vehicle which is a vehicle that is capable of running on both road and rail. High-rail equipment is fitted to inspection, personnel carrying vehicles and some track construction and maintenance vehicles

(j) ***warning device***
a device that is capable of providing visual and audible alerts to protect workers from approaching rolling stock. It is a part of an automatic track warning system being activated by a trigger

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

2 General technology

2.1 Collision avoidance

Collision avoidance systems aim to eliminate collisions between track maintenance vehicles. The collision avoidance system may be scalable to the work situation. To determine the level of collision avoidance technology to apply, a risk assessment shall be undertaken, examining the work environment and matters such as speed and braking ability of vehicles.

A collision avoidance system shall be installed on all new track maintenance vehicles.

For older equipment, a collision avoidance system shall be installed on vehicles involved in main line running where this is possible. For older equipment not involved in main line running, the risk assessment shall indicate the level of collision avoidance technology fitted.

2.2 Proximity warning

Proximity warning systems detect a track maintenance vehicle or road rail vehicle or worker, alert the driver/operator/worker about the close proximity of the item and leaves the driver/operator/worker to apply corrective action so that safety issue is avoided.

Proximity warning devices can be fitted to the track maintenance vehicle and/or the worker.

Proximity warning devices shall create a virtual proximity fence, individually around each track vehicle, road rail vehicle, and worker. The shape and size of the proximity fencing in each instance should be determined so that warning time to vehicle operators/workers is sufficient to eliminate unsafe interaction. It needs to take into account issues such as the nature of the work, the environment in which the worksite is established and the speed of the maintenance vehicle.

Proximity warning devices should not lead to false alarms as this could compromise safety. Alarming should only occur when the worker is potentially exposed to the movement of a track maintenance vehicle.

All RSWs operating within a work zone shall be equipped with a proximity warning device that warn the RSW about proximity of track maintenance vehicles and road rail vehicles.

All track maintenance vehicles should be fitted with proximity warning devices.

2.3 Collision avoidance and proximity warning

All collision avoidance or proximity warning system:

(a) shall be tested in a rail environment,

(b) shall not have an adverse impact on other systems,

(c) should operate independently and not be linked to other systems such as active signalling and train control,

(d) should have warning messages to the operator/RSW integrated with other vehicle systems to minimise a potential to provide an incorrect warning message,

(e) shall be integrated into safeworking practices, procedures and protection methods and are not a substitute for other safety applications and procedures and should not compromise existing situational awareness,

(f) shall have trained and competent personnel when introducing, implementing, operating and maintaining the technology,

(g) shall have input from HF specialists in the implementation of new technology or retrofitting existing vehicles,

(h) shall self-monitor its operation and be fail safe through a visual and audible warning to indicate failure.

Care needs to be taken in regard to the original equipment manufacturer (OEM) equipment used – alarming and communications between various OEM systems might not be in a common sharable / detectable format especially for high speed.

Rail infrastructure managers (RIMs) should designate the types of collision avoidance and proximity warning technologies applied.

Collision avoidance and proximity warning technologies are relatively new and their application across rail networks can be hampered by the mix of maintenance vehicle owners and the work environment.

Radio-frequency identification (RFID) identifiers are commonly used in the rail industry and they should be detectable by OEM systems. The passive hardware should be tested across the active parts of different suppliers' systems.

2.4 Human factors

Human factors (HF) shall be taken into account in the system design, application design and implementation of worker, track maintenance vehicle protection technology to ensure:

(a) the protection system is effective;

(b) the system does not distract the driver/operator/worker;

(c) the interface (including the visual display, control/display locations, alarms, sound tones, icons, illuminations, etc.) is designed in accordance with human factors design principles;

(d) any potential additional hazards or violation opportunities (potentially introduced when applying the new protection technology) are identified and addressed.

If retrofitting, the visual display in a track vehicle or road rail vehicle cabin shall not decrease the functionality and visibility of other display systems already installed in the cabin. HF advice should be sought on the appropriate placement of retrofitted displays to ensure that HF design principles are met.

3 Technology operational requirements

3.1 Standards compliance

There are a range of standards that are applicable to collision avoidance and proximity warning technologies:

(a) Track maintenance vehicles and road rail vehicles equipped with collision avoidance and proximity warning technology shall comply with IEC 62061

which covers functional safety of electrical, electronic and programmable electronic control systems.

(b) A rail transport operator should determine the applicability of the IEC 61508 safety integrity levels (SIL) to collision avoidance, proximity warning and automatic track warning systems, and specify the SIL levels for each type of the technology where it is deemed necessary through a risk assessment.

(c) Wherever a collision avoidance or proximity warning system takes control of the vehicle, the system shall comply with IEC 62290. The grade of automation (GoA) level for track maintenance vehicle and road rail vehicle shall be selected by RTO.

(d) Software and firmware of collision avoidance, proximity warning and automatic track warning systems shall comply with EN 50128. Safety related electronics used in those systems shall comply and be implemented in accordance with EN 50129. Systems and software engineering of collision avoidance, proximity warning and automatic track warning shall comply with IEC 26512.

(e) Railway operators and maintainers rules and procedures enhanced to embrace application of the collision avoidance, proximity warning and automatic track warning system shall comply with AS 4292.

(f) Interior and exterior vision in road rail vehicles shall comply with the relevant section of AS 7502.

(g) Collision avoidance and proximity warning input devices relevant for usability including functional, electrical, mechanical, maintainability and safety related properties shall comply with ISO 9241-400.

3.2 Alerting

Collision avoidance technology shall adequately alert an operator and/or driver about a potential collision between track maintenance vehicles.

Proximity warning technology shall adequately alert a driver/operator and worker(s) about the close proximity of a track maintenance vehicle.

Alerting time shall be established in such a way that it allows the driver/operator and worker(s) to make a decision and take action to avoid the potential safety issue. This time will depend on the work environment and factors such as the speed and braking ability of the vehicle.

Alerts/warnings shall be audible, visual and/or vibration based with the choice depending on the work environment. If more than one technology is used at the same time, the alerts/warnings shall be integrated so that interpretation of the alerting message is clear.

3.3 Audible

Collision avoidance and proximity warning technology shall provide at least two distinctly different audible sounds (when in normal operation) to the driver/operator or/and worker(s). The kind, volume level (dB), tone and intensity of audible signals used in those systems shall be selected so that the audible warning can be heard, recognised and distinguished from other sounds.

If both, collision avoidance and proximity warning systems are installed in a vehicle, they should use distinctly different tone or intensity of the warning sounds.

Collision avoidance, proximity warning and automatic track warning systems shall warn the operator/driver/worker(s) with a different audible sound that the technology is malfunctioning. The sound of malfunction shall be different to normal operation and any other audible sounds in range.

3.4 Visual

Displays on either collision avoidance and proximity warning systems shall be mounted in the cabin of the track maintenance vehicle or road rail vehicle. Once a track maintenance vehicle, road rail vehicle, worker and/or other object are detected, the following item(s) should appear on the display:

(a) Vehicle identifier, speed, direction, system starting time, status and current time.

(b) Detected item identifier, distance from the vehicle, speed and direction of the detected item, time and duration the item has been detected.

(c) Acknowledgement status, selection buttons and acknowledgment button.

In abnormal conditions, the display's system status shall indicate the system failure.

3.5 Personnel detection units/personnel carried devices

Where practical, a worker operating in the danger zone shall be equipped with a personnel detection unit / personnel carried device alerting the worker to proximity of a track maintenance vehicle and a road rail vehicle.

If vibration is used as a means to alert the worker, the frequency and intensity of vibrations shall be selected so that it the worker is able to recognise that something is in a close proximity. The frequency and intensity of the vibrations shall not cause any harm to the worker.

If personnel detection unit / personnel carried device contains a battery pack, the unit / device should use a different frequency vibration to inform the worker that the battery needs recharging or replacement.

Personnel detection unit / personnel carried devices shall be equipped with:

(a) a power on/off;

(b) a test function; and

(c) data logging capability.

3.6 Identification

A personnel protection device, a track maintenance vehicle and a road rail vehicle shall contain and carry a unique identifier that lets collision avoidance and proximity warning systems locate and track the item to understand the item(s) proximity, speed and direction of movement.

3.7 Acknowledgment

The driver/operator shall verbally and/or visually acknowledge the detection of an item in a range of the vehicle if the hazard does not clear.

3.8 Installation and configuration

Collision avoidance and proximity warning devices shall:

(a) be provided with an installation manual ;

(b) be initialised automatically when switching on the vehicle;

(c) not be able to be modified without approval to ensure configuration management and integrity are maintained at all times and in all conditions;

(d) be equipped with technology testers, buttons and indications, so that the technology can be tested when required. When testing the technology, collision avoidance, proximity warning and automatic track warning shall remain active and in normal operation;

(e) be installed by trained and competent personnel. This is an RTO's responsibility but involvement of the manufacturer or supplier as appropriate should be considered;

(f) not interfere with other safe working technology.

3.9 Operational conditions

Collision avoidance and proximity warning should be capable of working in the following operational conditions:

(a) Track works being conducted adjacent to live tracks.

(b) RSWs on ground.

(c) RSWs working close to machinery.

(d) Track works being conducted in tunnels.

(e) Track works being conducted during the day and night.

(f) Track works being conducted on live tracks.

(g) The signalling system can be either operational or non-operational during the track works.

(h) Normal environmental conditions including expected temperature ranges.

When an automatic collision avoidance system is operating in abnormal conditions, the technology shall allow the operator/driver to manually control the system.

If the collision avoidance or proximity warning systems system is operating incorrectly, an alert shall inform the operator / driver of the track maintenance vehicle and road rail vehicle, and workers who have the equipment.

3.10 Maintenance

The systems shall be supplied with a maintenance manual (that includes fault codes instruction and procedures of bringing the technology to normal operation).

The collision avoidance, proximity warning and automatic track warning systems should be maintained in accordance with the manufacturer's instructions. As part of maintenance, there should be regular validation maintenance checks to ensure the system is functioning correctly.

3.11 Technology operation records

The collision avoidance or proximity warning system shall record operations electronically in a non-volatile memory on the system.

The recorded data should include as a minimum the following information time and date stamped:

(a) Power on/off.

(b) Operation of the test function.

(c) Positional information with speed and heading.

(d) Any abnormal condition.

(e) Collision or proximity warnings and with whom.

(f) Collision or proximity alerts and with whom.

(g) Alarm acknowledgment.

(h) Software/firmware updates.

(i) System bypasses.

(j) Time without a signal/GPS/communications link.

The recorded data shall be:

(a) easy to download and decode from those systems by the user:

(b) readable in one of the standard formats (e.g. txt, MS Excel, MS Word or MS Access).

The technology shall allow both remote and local access to download the log files.

Appendix A Hazard register

Hazard number	Hazard	Heading number(s)
5.3	Harm to persons (hazard context – 5.0 rolling stock)	2.4, 3.5
5.4	Harm to rolling stock (hazard context – 5.0 rolling stock)	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11
5.7	Path Infringement (hazard context – 5.0 rolling stock)	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11
5.8	Collision (hazard context – 5.0 rolling stock)	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11
5.19	Derailment (hazard context – 5.0 rolling stock)	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11
5.40	Person/s being crushed (hazard context – 5.0 rolling stock)	2.4, 3.5
6.6	Harm to track & civil infrastructure by rolling stock (hazard context – 6.0 infrastructure)	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11
8.0	Derailment or collision (hazard context – 8.0 operations)	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11
8.4	Injury or death of an employee (hazard context – 8.0 operations)	2.4, 3.5

Appendix B Bibliography

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

- HB 59-1994 Rec:2016 - Ergonomics - The human factor - A practical approach to work systems design

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The Standards development process is rigorous and transparent.

Authors work with RISSB's Standards Development Managers and Development Groups to ensure that products are acceptable to industry. Standing Committees oversee this work and ensure that proper governance and process is followed. The products are exposed to the public and industry for comment and validated by an independent validator.

Once agreed by the Development Groups, Standing Committees and Validator, the drafts are passed to the RISSB Board for approval.

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Standards Development and Accreditation Committee

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