AS 7724:2020

Unauthorized movement protection - Operational requirements

RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

Train Control Systems Standard

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This Australian Standard® AS 7724 Unauthorized movement protection - Operational requirements was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organisations:

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Genesee & Wyoming Australia	Pacific National	Rail Safety Consulting Australia
Queensland Rail	Rio Tinto	

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.

Choose the type of review

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.

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

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This Standard was prepared by the Rail Industry Safety and Standards Board (RISSB) Development Group AS 7724 Unauthorized movement protection - Operational requirements. Membership of this Development Group consisted of representatives from the organisations listed on the inside cover of this document

Objective

The objective of this Standard is to support a consistent approach to identifying engineering processes for the protection of running lines against unauthorized movements of rolling stock.

It includes common causes, the possible hazards of unauthorized movements of rolling stock, operational considerations and identifies situations where protection could be required.

This standard outlines the different engineering controls available within this category of protection.

This standard applies to new and/or upgraded track arrangements. It is recommended that Rail Infrastructure Managers (RIMS) risk assess existing installations against this standard and manage the identified risk in accordance with their safety management system (SMS).

This standard does not address technical aspects of design, manufacture, maintenance, commissioning or decommissioning of catch points, derailers (although there is some discussion on the performance characteristics of derailers as this was largely missing in other sources), crowders, baulks, ballast drags or end of line protection. These requirements are referred to in the AS 1085 series and AS 7642.

Future reviews of this portfolio of documents will provide further information in these areas and is likely to lead to reorganising the content more logically across/between these Standards.

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 could be shared.

Controls in RISSB standards address known railway hazards are addressed in Appendix A.

Contents

Appendix Contents

1 Introduction

1.1 Scope

This Standard provides mandatory and recommended requirements for the differing engineering options to protect running lines against unauthorized movements of rolling stock.

The scope of this Standard includes the following:

(a) Functional requirements.

(b) Design considerations.

(c) Network design and operational requirements.

1.2 Exclusions

The following items are excluded from this Standard.

(a) Onboard systems used for securing rolling stock including hand brakes and chocks.

(b) Train stops and Automatic Train Protection (ATP) systems.

(c) Connection of brake pipe to rail when the train is unattended.

1.3 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:

(a) AS 7718 Signal design process management.

(b) AS 7642 Turnout and Other Special Trackwork.

NOTE: Documents for informative purposes are listed in a Bibliography in Appendix H of this Standard.

1.4 Definitions

For the purposes of this document, the terms and definitions given in RISSB Glossary: https://www.rissb.com.au/products/glossary/ and the following apply:

(a) ***ballast drag***
ballast installed in a wide bed at a point where rolling stock could derail and designed to impede the movement of the rolling stock until it comes to a stop

(b) ***unauthorized movement***
movement of rolling stock that is either uncontrolled or movement that is controlled but exceeds the authorised limit of movement.

2 General operating requirements

2.1 General

Where there is a determined risk of an unauthorized movement of rolling stock fouling a running line or entering an exclusion area a Rail Infrastructure Manager (RIM) shall install a physical method of retarding, restraining or derailing the unauthorized movement.

Unauthorized movements of rolling stock include:

(a) uncontrolled movements of rolling stock;

(b) controlled movements of rolling stock exceeding the limit of the movement authority.

The preferred method of controlling unauthorized movements is to divert the movement to an alternative route through system design solutions such as flank protection, alternative overlaps, self-normalising points or other non-impact solutions. Derailment of an unauthorized movement should be considered as a last resort only.

2.2 Functions of unauthorized movement protection devices

Unauthorized movement protection devices shall be designed to prevent any unauthorized movement of rolling stock proceeding into areas of the railway where there is a high risk of collision with rolling stock or railway infrastructure. These areas include:

(a) running lines;

(b) workshops;

(c) worksites;

(d) areas beyond terminating lines.

This movement may be stopped by derailing the unauthorized movement or stopping the movement on the track by use of baulks, buffer stops or other end of railway devices.

3 Network design and operational considerations

3.1 Determine operational issues and performance requirements

The design requirements and associated train operations requirements should be as detailed in AS 7718 and AS 7642.

The results should be documented as per the Safety Management System (SMS) of the RIM. This may be in documents such as the operations requirements specification and / or the signals functional specification.

These documented requirements should be used as the basis of the design, design verification, principles testing and interface management.

3.2 Risk assessment

System designers and/or RIMs shall undertake a hazard and risk assessment to identify and quantify the risk and consequences for each applicable scenario. The residual risk shall be managed in accordance with the RIM's SMS.

When conducting a risk assessment, a RIM should consider the following risks:

(a) Likelihood of an unauthorized movement.

(b) The consequence of an unauthorized movement exceeding its authority.

3.2.1 Likelihood considerations

When considering the likelihood of an unauthorized movement a RIM should assess the;

(a) typical characteristics of the likely rolling stock;

(b) traffic frequency;

(c) track gradient;

(d) safe working method;

(e) existing controls;

(f) speed permitted on the protected running line/s;

(g) operational activities that can lead to an unauthorized movement, such as shunting, main line movements and stabling of rolling stock.;

(h) requirements for private sidings;

(i) interfaces between private sidings and the RIM's rail network.

3.2.2 Consequence considerations

When considering the possible consequences of an unauthorized movement a RIM should assess:

(a) possible injury or loss of life;

(b) introduction of new or additional risks;

(c) damage to infrastructure;

(d) damage to rolling stock;

(e) operational impact;

(f) environmental impact;

(g) public relations;

(h) secondary collisions;

(i) impact of recovery operations to the network.

3.3 Functional considerations

A RIM shall evaluate and determine the functional requirements of the controls needed to reduce the risk of an unauthorized movement creating a hazardous situation.

When determining the functional requirements, the following should be considered.

(a) Whether to divert or derail the unauthorized movement.

(b) The normal position of the device (open or closed).

(c) Recovery operations.

(d) Typical traffic movements.

(e) Manual or power operation of the device.

(f) Whether interlocking with other systems is required.

(g) Compatibility with existing infrastructure, policies and procedures.

(h) Indication requirements.

(i) Human factor considerations.

3.4 Performance considerations

When determining performance requirements, the RIM should consider the following.

(a) The likely characteristics of unauthorized movement.

i. Vehicle speed.

ii. Vehicle weight.

iii. Vehicle axle load.

(b) The gradient of the track.

(c) Possible momentum.

(d) Stopping distance.

(e) Whether the movement could be powered or under gravity.

(f) Final preferred position of the rolling stock.

(g) Adjacent infrastructure.

(h) Potential for onboard dangerous goods.

(i) Prevention of inadvertent operation.

3.5 Interface considerations

Interfaces both internal and external to the network should be considered.

The interfaces may include the following.

(a) Detection of the state of the catch point, derailer with crowder or derailer.

(a) Power operation and power requirements of the device.

(b) Release for manual operation of the device.

(c) Interface with infrastructure both inside and outside the rail corridor. This may include:

i. tunnels,

ii. bridges;

iii. buildings;

iv. poles, gantries and other supports;

v. public facilities and other public infrastructure.

(d) Interface with existing safety systems within adjacent infrastructure.

(e) Interface with rolling stock braking systems.

3.6 Operational and recovery considerations

Operational and recovery considerations include all the daily operational needs of a RIM and how a RIM would recover from an unauthorized movement.

An operational impact assessment should include:

(a) impacts caused by derailment of unauthorized movements;

(b) impact to operational services when recovering derailed rolling stock;

(c) access to derailment site for recovery equipment;

(d) the availability of recovery equipment;

(e) preferred recovery methods;

(f) impact of degraded working whilst recovering rolling stock.

4 Derailer and derailer / crowder

4.1 General

A derailer is device designed for low speed derailing operation only.

Derailers may be mounted on either the rail and/or the sleeper/bearer.

Derailers are designed to derail one wheel. The device lifts the flange of one wheel up and over the rail. The other wheel is still constrained within the track gauge and the rolling stock can have momentum to continue travelling towards the point of fouling an adjacent line.

Derailers with crowders have two parts that act in unison on both wheels of an axle to move it to one side. This is more effective on changing the direction of the wheels and twisting the bogie to achieve a derailment. A rigid 3 axle bogie can still resist the movement of the first axle up and over the rail.

Derailers and derailers with crowders are effective when placed on straight track. They are also effective when derailing wheels to the outside on curved track. They are generally ineffective when attempting to derail to the inside of curved track.

Portable derailers can be used where work is being undertaken on running lines and it is necessary to protect the worksite. The derailer or derailers may be installed at each side of the worksite.

Appendix B provides guidance on the operation of derailers.

Appendix C provides examples of types of derailers.

4.2 Operation

Derailers and derailers with crowders can be either power operated or hand operated.

Derailers and derailer crowders can operate either independently or as part of an interlocked signalling system.

4.3 Design requirements for derailers

4.3.1 General requirements

A derailer shall be designed so that it actively lifts and turns a wheel so that it rides up and over the rail and onto the ground outside the running rail. Should this not occur effectively the wheelset can 'steer' itself, re-rail and continue on the track.

4.3.2 Derailers and derailer crowders not to be used

Derailers and/or derailers with crowders shall not be used for protecting running lines unless the RIM can provide documented evidence of a qualitative risk assessment showing a derailer or derailer with crowder would provide sufficient protection to the protected running line. This assessment should include calculations showing the likely speed of an unauthorized movement towards the derailer.

4.3.3 Unnecessary or inadvertent derailment

Inadvertent derailing of a train should be prevented when not intended.

Derailers used in non-signalled areas should have a system of locking the derailer in either position. A flag indicator should be used to provide a visual indication to rail traffic crew and shunters.

Derailers used in signal interlocked areas should have an independent electrical detection or a mechanical interlocking arrangement using a key or similar arrangement to ensure that the system integrity is maintained.

5 Catch points

5.1 General

Catch points have different configurations and are more effective in derailing rolling stock than derailers or derailers with crowders.

Any configuration of turnouts and catch points that is designed to derail unauthorized movements of rolling stock is considered as a catch point configuration for the purposes of this document.

Appendix C provides examples of derailer protection.

Appendix D provides examples of typical catch point configurations

5.2 Selection requirements for catch points

5.2.1 Configuration

When determining the catch point configuration for a given situation a RIM should consider;

(a) the topographical configuration of the location;

(b) the track configuration;

(c) any structures within the vicinity;

(d) the operational hazard that is being addressed;

(e) the potential speed of the unauthorized movement;

(f) the mass and length of the unauthorized movement.

For new installations, or where significant trackwork alterations are proposed, a risk assessment shall be undertaken to determine the most effective and appropriate arrangement. The outcome of the risk assessment shall be managed in accordance with the RIM's SMS and engineering standards.

The design requirements and associated train operations requirements should be determined as detailed in AS 7718. The results should be documented as per the relevant standards of the RIM. This may be in documents such as the operations requirements specification and / or the signals functional specification.

These documented requirements should be used as the basis of the design, design verification, principles testing and interface management.

The actual calculations used for the basis of design should be recorded in the design report and be available for the independent design verifier to review.

5.2.2 Location

When determining the location of catch points, a RIM shall assess the risk of the unauthorized movement derailing and impacting with:

(a) embankments;

(b) tunnels;

(c) structures;

(d) railway infrastructure;

(e) buildings;

(f) public facilities and other public infrastructure.

The RIM should also consider the likely speed and momentum of the unauthorized movement at the point of derailment when determining a suitable location.

The RIM shall maintain a record of this assessment in accordance with the RIMs SMS.

Appendix G shows examples of poorly located catch points.

5.3 Typical uses of catch points

5.3.1 Catch point with single blade and an external guiderail

This arrangement should be used where the area that the derailed rolling stock will end up is flat and the likelihood of roll-over is low

5.3.2 Catch point with single blade and an internal guiderail

This arrangement should be used where a single blade with an external guide rail is unsuitable as the run-out area:

(a) has the likelihood of vehicle roll-over;

(b) contains significant infrastructure;

(c) contains an item of major consequence.

The RIM should consider the additional risk that if the rolling stock's momentum is sufficient it can carry into a location that is foul of the adjacent line being protected.

5.3.3 Catch point with double blades and an internal guiderail

This arrangement should be used where the area the derailed rolling stock will end up is flat, the likelihood of a vehicle roll-over is low and approach speeds and/or mass of approaching rolling stock is higher than for a single blade arrangement.

5.3.4 Catch point as crossover with run off track

This arrangement should be used where the derailed rolling stock area is unsuitable either due to:

(a) the likelihood of rolling stock roll-over;

(b) contains significant infrastructure;

(c) where the approaching rolling stock speed and/or mass is too high for other catch point arrangements.

This arrangement may be used as part of the designed flank protection and/or in conjunction with a buffer stop, friction buffer stop and/or baulk in the run-off area to retard the vehicle speed.

A ballast drag should be provided beyond the end of the run-off area.

This arrangement may be used to facilitate the 'sagging back' of trains where couplings expand when brakes are released on stationary trains, and the tail of the train will move towards the run-off area and remain clear of the adjacent line.

5.3.5 Wide to gauge catch point - two individual blades or independent switches

This arrangement is generally only suited on the middle track of a three track arrangement and where the provision of a run-off area is not available. A derailment from the middle track will occur when both crossovers are normal.

6 Ballast drags

The ballast drag is designed to impede the forward motion of derailed rolling stock in a controlled manner.

A ballast drag is made up of loose ballast laid to near rail height. It should be positioned inside and outside the track gauge in the direction of travel of a derailed vehicle. Ballast positioned within the track gauge also gives some protection to the sleepers from damage.

All ballast drags shall be maintained in accordance with the RIM's track maintenance policies and service schedules.

The performance requirement for a ballast drag is to reduce the speed of the unauthorized movement and stop the movement prior to collision with any determined hazard. To achieve this performance the length of the ballast drag should be sufficient to retard the rolling stock at its maximum speed.

When calculating the required length of the ballast drag a RIM should consider:

(a) the likely entry speed and potential momentum into the ballast drag;

(b) the axle load of the unauthorized movement;

(c) entry grade into the ballast drag;

(d) the likely number of rail vehicles involved.

7 End of line or siding protection

7.1 General

The end of a line or siding represents a hazard if rolling stock does not stop. Obstructions to prevent an overrun at the end of line include fixed baulks and buffer stops.

A RIM should design the end of line protection to match with the likely rolling stock used on that section of railway. The interface between the rolling stock and the end of line protection should be included in any design risk assessment carried out by the RIM.

Appendix F shows example images of end of line protection.

7.2 Fixed baulk

This is the simplest end of siding device. The baulk is effective only for low speed exceedances. These can be affixed to the rails or can be placed on the rails as an obstruction. Examples of this include a pile of sleepers or a mound of ballast.

7.3 Fixed buffer stops

A fixed buffer stop may be constructed of steel, timber or concrete. These are most effective at low speeds. Buffer stops may have an additional device that can interact with multi function couplers on the rolling stock to activate the train braking system and remove the traction power.

Fixed buffer stops should be preceded with speed reduction methodologies to reduce the impact speed where there is an identified risk of human injury or significant damage to rolling stock.

7.4 Buffer stops with friction controls

The design of this type of buffer stop is engineered with friction controls clamped to the rails. Multiple clamps provide an engineered resistance to the buffer stop moving in a collision and absorb the energy of the rolling stock. These should be engineered to meet requirements of specific locations against operational performance. Buffer stops may have an additional device that can interact with special couplers on the rolling stock to activate the train braking system.

8 Signal design considerations

8.1 General

Derailers or catch points that are mechanically or power operated may be a part of the signalling system. The interfaces may include:

(a) detection of the state of the catch point, derailer with crowder or derailer;

(b) power operation of the device;

(c) release for manual operation of the device;

(d) detection that rolling stock has been derailed at the device;

(e) interlocking of the device with other signalling equipment.

8.2 Track circuit interrupters

A track circuit interrupter is designed to be a sacrificial item such that when a wheel passes over the interrupter it breaks and either directly open circuits the track circuit over that immediate area, or, opens a circuit that is part of the signalling control system.

When a vehicle derails completely, its wheels cease to shunt the track circuit – in these instances the vehicle can still be foul of an adjacent track. Where this has occurred, it is important to maintain the track circuit in the 'occupied' state. To achieve this, a track circuit interrupter can be fitted to one of the run-off rails such that it will be struck by the wheel's flange as the rolling stock passes over the track circuit interrupter and is derailed.

Track circuit interrupters only provide an indication to the Network Control Officer or Signalperson that an unauthorized movement has proceeded beyond a limit of authority.

Track circuit interrupters shall not be used as protection against unauthorised movements. They may be used as a secondary warning system in conjunction with other forms of protection.

Further detail on use and design of track circuit interrupters is located in Appendix E.

Appendix A Hazard register

Hazard number	Hazard
5.2.1.4	Derailment causing collisions with a wayside structure
5.4.1.1	Path infringements
5.7.1.26	SPAD causing collision
5.19.1.7	Driver / shunter error at derailers
6.14.1.8	Use of a derailer
6.14.1.51	Vehicles overturning

Appendix B Methods of operating derailers

B.1 Manually operated

Derailers can ‘flip’ or pivot onto the head of the rail to reach the derailing position. They lie on top of the sleepers off the rail when in the clear position. A handle for the manual positioning of the derailer on the rail may also be used.

The strength and toughness of the derail means that they are heavy and can be awkward resulting in manual handling risks for the operator. The operator is also in the danger zone to operate the device.

The device shall be secured in accordance with individual RIM requirements.

B.2 Lever operated

Lever operated derailers have a rod between the derailer and the lever and allow the operator to be outside of the danger zone. The manual handling risks are reduced along with pinch point hazards. The lever may secure the device in the required position. Key releases or interlocking to other signalling equipment is also possible.

Where derailers or derailer-crowders are to be operated from mechanical levers the design shall ensure that the lever and the person operating it are outside the derailment zone.

B.3 Power operation

Operation of the derailer or the derailer with crowder combination can be achieved with a point motor device. This allows for full integration into the signalling system. The operator is outside of the danger zone and there are no manual handling or pinch point hazards.

Appendix C Examples of derailer protection

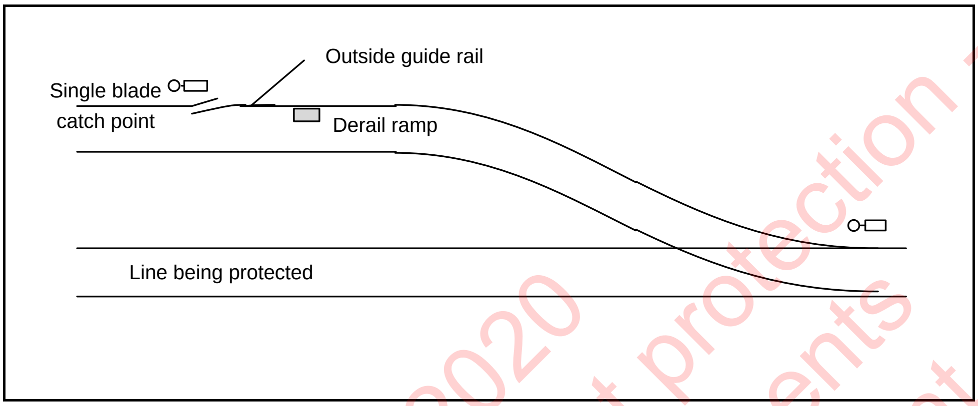
C1:1 - Derailer (upper) and Crowder (lower)

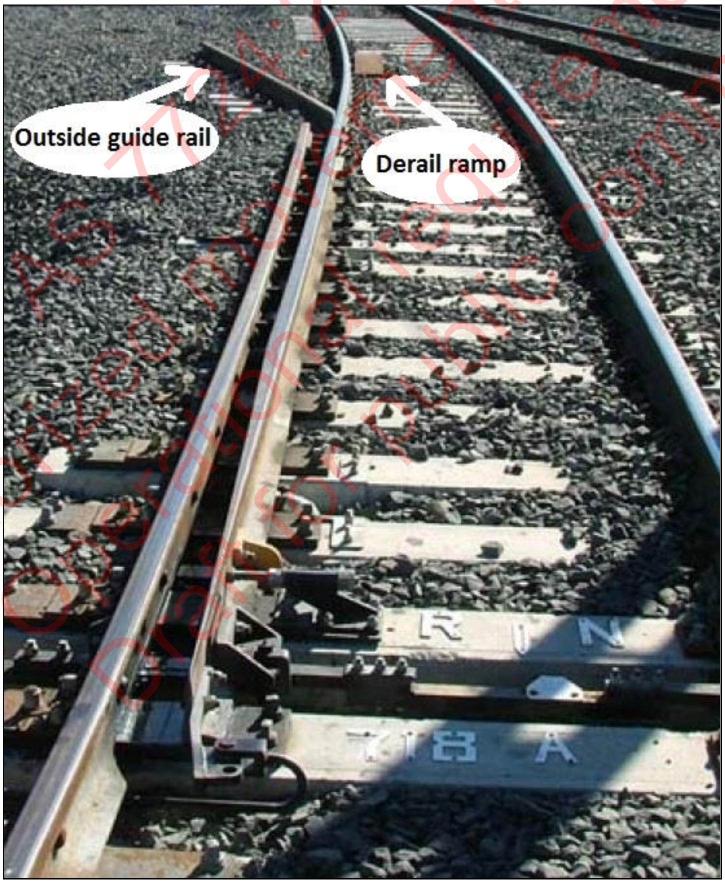
C1:2 - Bi-directional derailer with flag indicator

Appendix D Examples of catch point protection

D.1 Catch point with single blade and an external guiderail

A single blade catch point with a throw-rail provided outside the open blade with an extended outside guide rail to direct the outside wheel away from an adjacent line. A steel ramp shall be provided to assist the inside wheel up and over the fixed rail.



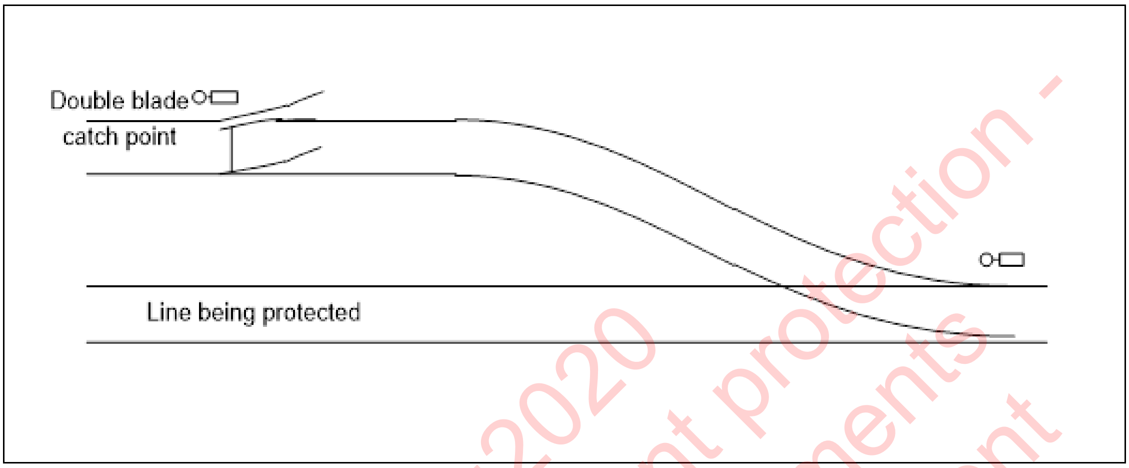


D1:1 - Catch point single blade with external guide rail

D.2 Catch point - double blade with an internal guide rail and ramp

A double-bladed catch point with a ramp in which the internal switch rail acts as an extended guide rail guiding the derailed vehicle away from the protected location with the ramp lifting the wheel over the outside fixed rail.

The ramp should be designed and engineered for the purpose as defined by the RIM.

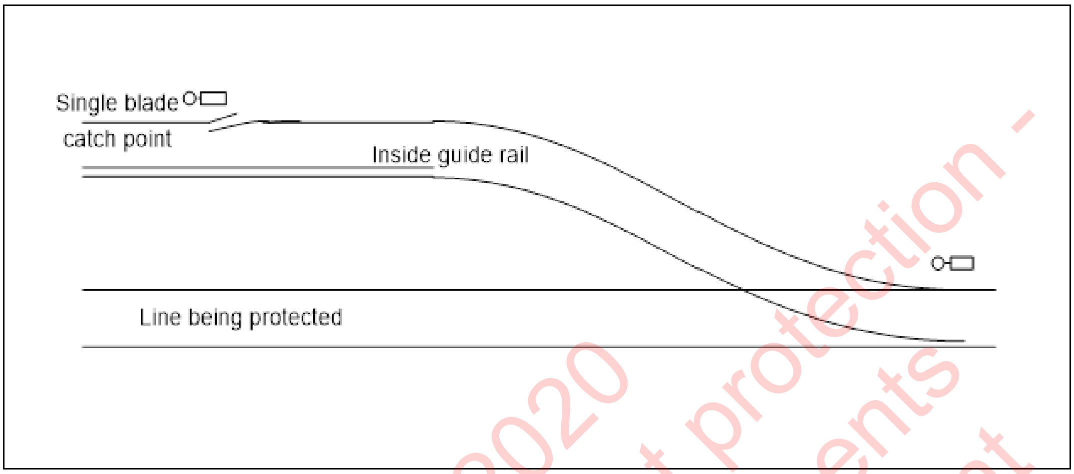


D2:1 - Catch point – double blade with an internal guide rail

D.3 Catch point with single blade and an internal guiderail

A single blade catch point with an internal guide rail provided opposite the catch point blade between the rails to keep the derailed wheels within the proximity of the track gauge.

An extended outside guide rail is not provided in this arrangement.

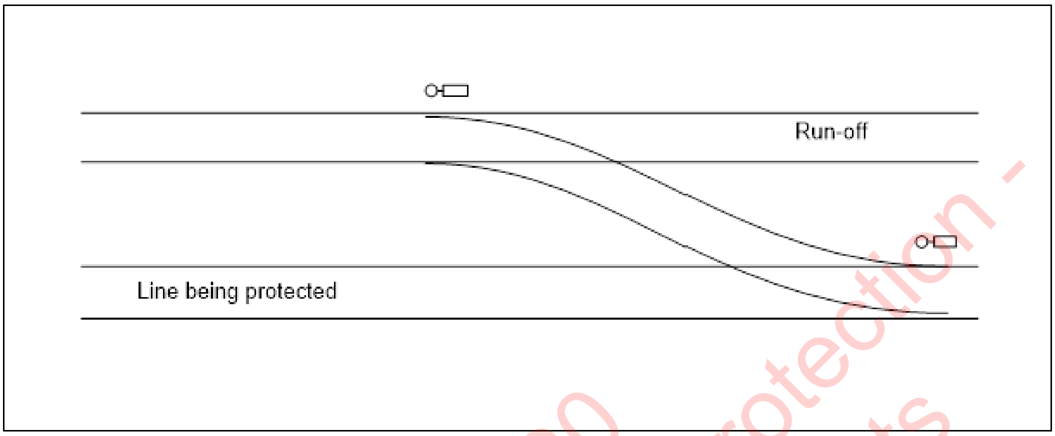


D3:1 - Catch point – single blade with an internal guide rail

D3:2 - Catch point – single blade with an internal guide rail

D.4 Catch point – double blade with a run-off

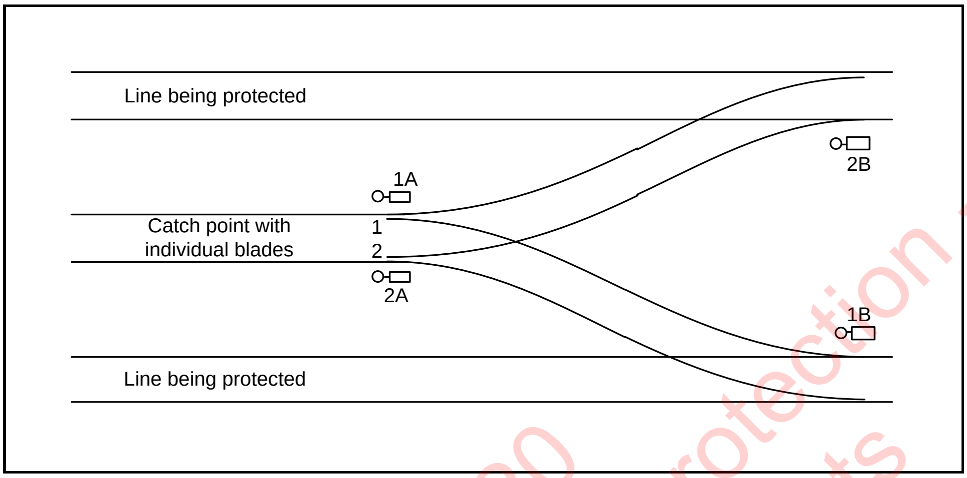
This arrangement is a crossover with runoff rails. A ballast drag, buffer stop or other suitable end of siding device should be located at the end of the runoff area.

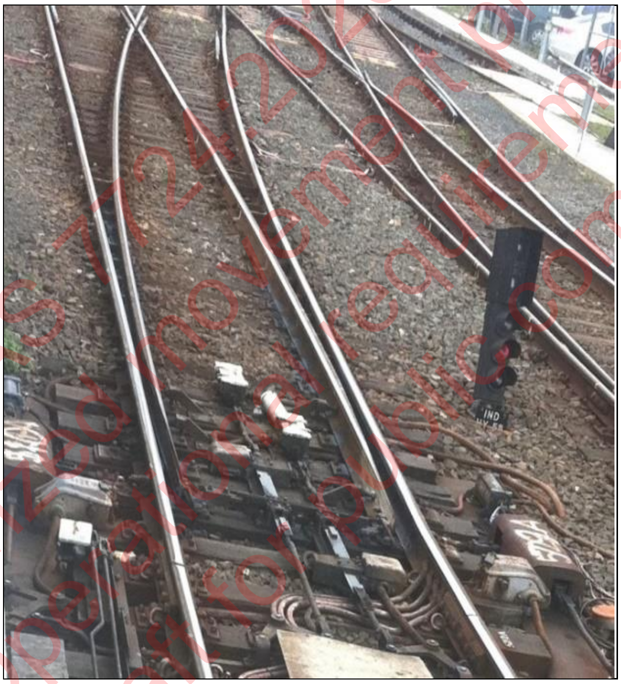


D4:1 - Catch point – double blade with run-off

D.5 Wide to gauge catch point – two individual blades or independent switches

This arrangement is provided with two independent blades of two separate crossovers.





D5:1 - Catch point – two individual blades or independent switches

Appendix E Track Circuit Interrupters

E.1 Design and Installation

A track circuit interrupter is fitted to the rail as per the arrangement shown below:

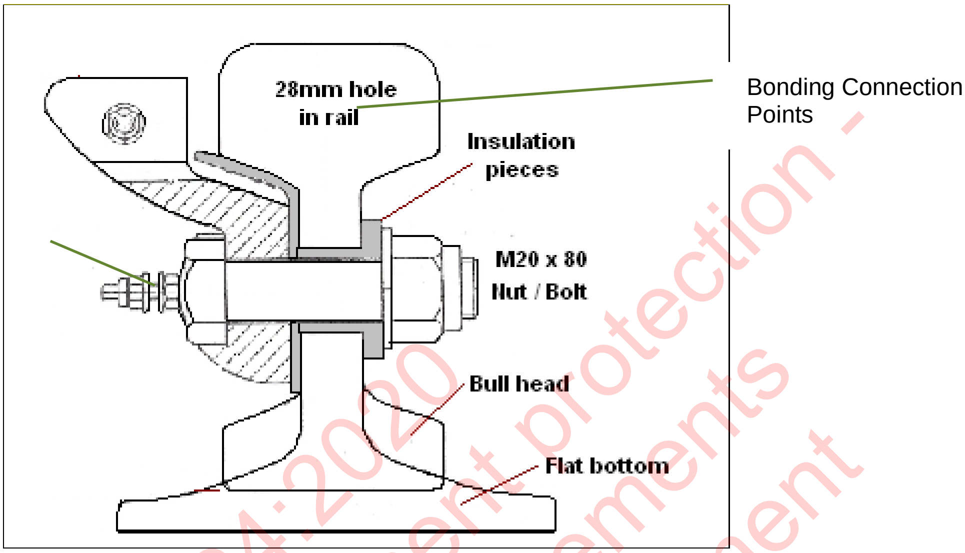


Figure E1.1 Track circuit interrupter design

Where used as part of a catch point arrangement, the interrupter is attached within the track circuit so that the cast section is adjacent to the running face of the stock rail.

E.2 Mounting arrangements – diverting catch points

In the case of catch points, the interrupter is attached within the track circuit to the track gauge side of the stock rail (see below). It shall not be fixed to the switch rail.

The interrupter shall be fixed as close to the main running rail as possible without conflicting with the mainline and operation of the points.

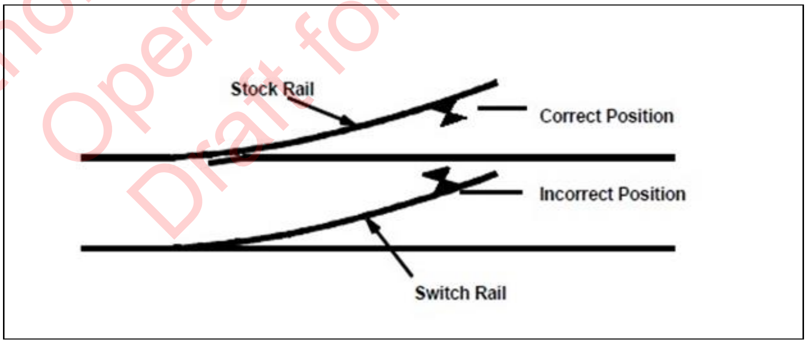


Figure E2:12 Mounting locations – catch points

E.3 Mounting arrangements – Wide-to-gauge catch points

At wide-to-gauge catch points, several interrupters are required to ensure operation, as the course of a derailed vehicle is unpredictable. In the case of series bonding, each interrupter shall be wired in series in the appropriate leg of the track circuit, obeying the opposite polarity rule. Otherwise, all the interrupters shall be wired in series in an interrupter relay.

The interrupters shall be fixed as close to the main running rails as possible without conflicting with the mainline and operation of the points.

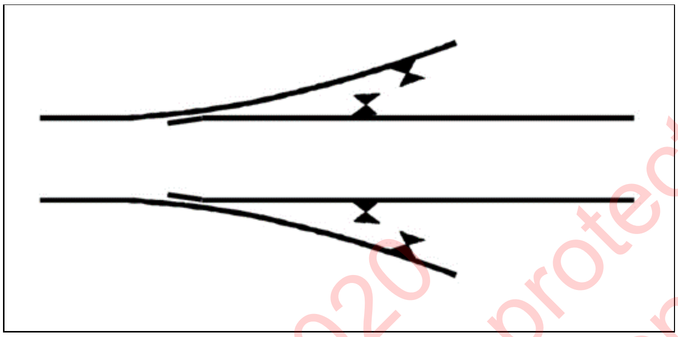


Figure E3:1 Mounting locations – wide to gauge catch points

Appendix F Examples of end of line or siding protection.

F1:1 - Fixed Bulk

F1:2 - Buffer Stops

F1:3 Buffer Stops with Friction Controls

Appendix G Inappropriate controls

The following are some examples where the protection has been installed in the wrong location or is inappropriate for the location.

Inappropriate locations for a catch point:

Derailment will impact bridge abutment and be foul of the running line.

G1:1 Poorly located catch point

Derailed train is foul of the running line.

G1:2 – Derailment through catch point – rolling stock on mainline

Derailed locomotive is in danger of rolling over.

G1:3 - Poorly located catch point – on embankment

End of siding protection did not work

G1:4 – Ineffective end of siding protection

Partially effective end of siding protection.

G1:5 Ineffective end of siding protection

Appendix H Bibliography

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

(a) AS 7515 Rolling stock.

(b) AS 7711 Signalling principles.

(c) AS 7702 Railway equipment type approval.

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