Point locking, Point Drives, and Point Detection

Train Control Systems Standard

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This Australian Standard® AS 7659 Point locking, Point Drives, and Point Detection was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organisations:

ARTC	Wabtec	VicTrack
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The Standard was approved by the Development Group and the Train Control Systems 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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Point locking, Point Drives, and Point Detection

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This Standard was prepared by the Rail Industry Safety and Standards Board (RISSB) Development Group AS 7659 Point locking, Point Drives, and Point Detection. 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 provide a consistent approach to point locking and point detection within the Australian and New Zealand railway industry.

This standard should be read in conjunction with AS 7711 Signalling Principles

Compliance

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

1. Requirements.
2. Recommendations.
3. Permissions.
4. 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 this 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 this 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, and are addressed in Appendix A.

Contents

Appendix Contents

1 Scope and general

1.1 Scope

This Standard provides requirements and recommendations for the prevention of inadvertent movement of points through point locking, and the methods of point position detection.

This Standard also provides guidance on the use of point drive systems.

This Standard relates to points that are part of or directly related to an interlocking system.

The scope of this Standard includes the following:

(a) Design considerations.

(b) Network and operational requirements.

(c) Testing and maintenance requirements.

(d) Commissioning, decommissioning and disposal.

1.2 Exclusions

The following items are excluded from this Standard:

(a) Components not directly involved in the locking or detection of the points

(b) Manually operated points fitted with neither point locking or detection.

1.3 Referenced documents

1.3.1 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 7706 Interface with Points
- AS 7711 Signalling Principles
- AS 7642 Turnouts and other special trackwork

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

1.4 Terms and 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

1.4.1

movable blade:

movable rail component that guides wheels along the selected path. For the purpose of this Standard a movable blade includes movable sections of rail associated with points, catch points and swing nose, switch diamonds or K blade designs.

1.4.2
points
any combination of movable blades and associated fixed track components used to set the path for a rail vehicle movement

1.4.3
points detector
device for proving that points are correctly set, and locked where applicable

1.4.4
trailing only points
points where there is no signalled facing move and no chance of a train setting back over the points

2 General requirements

Where there is a determined risk that the incorrect positioning or unauthorized movement of points could result in derailment of rollingstock a means shall be provided to lock and detect the points in the position required for a movement authority.

The interlocking shall not permit movement authorities to be issued unless the correct position and locking of the points is proven.

Points without point locking shall be secured by other means for facing movements. This movement shall be directly supervised.

Design and installation of points shall comply with AS 7642 and the RIMs own requirements.

3 Design requirements – point drives

Point drives provide the means for the movement of moveable blades from one position to the other when requested by the operator when free to do so or by manual operation where required. In this respect this section excludes mechanically operated points where the normal means of operation is the same as the manual one.

Point drives include all the rodding and associated mechanisms used to drive the point blades from one position to another.

Point drives shall:

(a) provide the means to unlock a set of moveable blades set in one position, move them to the other position, and then lock them in that position;

(b) be capable of being stopped, reversed or obstructed at any stage in the movement without causing any damage to the points or the actuator;

(c) not cause any twisting or deformation of the moveable blades that might cause damage or incorrect operation of their locking or detection status;

(d) be capable of adjustment to provide the required tolerances for locking and detection; and

(e) become disengaged when manual operation is selected.

Point drives shall complete the requirements of (a) above within 5 seconds of the request to do so unless otherwise specified by the RIM.

4 Design requirements – point locking

4.1 General design requirements

Point locking shall provide a means to prevent movement of movable blades other than by a deliberate action by the operator or by manual operation in accordance with AS 7706.

The point lock shall:

(a) constrain all movable blade(s) relative to the stock rail(s) or wing rail(s) when in the required position;

(b) not engage unless the distance between the movable blade and stock rail or wing rail is within the tolerances as prescribed by the RIM;

(c) when engaged be secured in a way that prevents the lock inadvertently becoming disengaged; and

(d) remain effective during all normal operating conditions or power disruptions (including the loss of and restoration of power).

The point lock shall be a positive mechanical device which cannot be disengaged by a force applied external to the point mechanism. This requirement excludes trailable points as described in section 4.2.3

4.2 Point locking not used

Point locking may not be used on:

(a) trailing only points. Point locks may be removed from point mechanisms in accordance with the RIM's organisational policies and procedures.

(b) points where all facing moves will be directly supervised by a hand signaller, shunter or other qualified person (typically in yards, sidings and reverse moves over emergency crossovers) in accordance with the RIM’s network rules.

4.3 Types of point locking

4.3.1 Integrated drive and lock

4.3.1.1 General

Integrated drive and lock mechanisms use an operating bar, slide or tube and one or more cammed or angled locking pieces to both operate and lock the points.

To lock closed, the locking piece/s are forced out of a notch in the operating bar, slide or tube in the course of its movement and engage with a lock face or notch which secures the closed position of the movable blade. The locking pieces cannot be disengaged without the operating bar being moved to a position which allows them to engage with the notches in the operating bar, slide or tube.

The open position of the movable blade is secured either by a stretcher bar connecting it to the closed blade or by the engagement of the locking pieces in the operating bar.

Maintaining the lock requires that the operating bar be secured in its end of stroke position either by a secondary lock, by constant pressurisation of a hydraulic or pneumatic actuator or by a mechanical brake or other mechanical device in an electric point machine.

Integrated drive and lock mechanisms are better suited to trailable designs than plunger type.

4.3.1.2 Types of integrated drive and lock mechanisms

On rail locking integrated drive and lock mechanisms have the lock face of the mechanism directly secured to the stock rail.

This offers the benefit of ensuring that the movable blade is directly secured to the stock rail and provides some additional assurance against any movement of the stock rail.

Off rail locking integrated drive and lock mechanisms have the lock face integrated in the point machine, which is secured to the bearers supporting the stock rails.

Examples of off rail integrated drive and lock mechanisms are detailed in Appendix B.

4.3.1.3 Independent drive and lock

Independent drive and lock mechanisms use separate rodding connections for the point drive and the point lock and typically use a lock plunger which engages in a notched lock slide connected to the movable blades.

In power operated points, the lock plunger is driven by an escapement mechanism integrated with the point drive.

In manually operated points, the lock plunger is typically operated by a separate lever and rodding which is completely independent of the point operating lever. In rare cases, an escapement mechanism is used to allow the point drive and point lock to be operated by a single lever.

Plunger locks offer several benefits over integrated drive and lock mechanisms. The force required to disengage the lock is perpendicular to the force required to move the blades and the rodding connecting the point lock to the blades is separate from that connecting the drive to the blades, providing a higher level of redundancy.

Examples of independent drive and lock mechanisms are detailed in Appendix B.

4.3.2 Trailable points

The point locking of trailable point mechanisms secures the movable blades in such a way that it can be released by pressure applied to the open blade by a rail vehicle traversing the points in a trailing direction.

Pressure on the closed blade cannot release the point lock, thus trailable point mechanisms are not suited to use with swing noses, K crossings or switched diamonds.

5 Design requirements – point detection systems

5.1 General design requirements

Detection shall prove that all movable blades are in a position that permits the safe passage of a rail vehicle along the selected route at the designated speed.

Detection of movable blades shall be independent of the points drive or point locking.

Individual movable blades shall be detected independently.

The design of the detection mechanism shall provide separate contacts for the detection of movable blades and proving of the point lock.

The design of the mechanism shall ensure that if either the point lock or any movable blade is not in the correct or intended position the corresponding contacts cannot be closed.

There should be no mechanical interlocking between the contact actuators for the movable blades and the point lock.

The detection mechanism shall be as close as practicable to the blade being detected.

The mechanical linkage between the blade and the contact actuator shall comprise a single rod of sufficient strength that it cannot bend or break when a force sufficient to operate the contacts is applied.

5.2 Contacts

Contacts shall either be an enclosed type or be enclosed by a housing which is resistant to the ingress of water, dust, or other contaminants.

Contacts shall either be made from an inherently inert material or be surface treated to prevent the development of oxidation or similar surface film that may affect contact resistance.

Cleaning of contacts shall not be required.

Contacts and actuators shall be designed to make and break cleanly without arcing or intermittent connection.

5.3 Proving

Detection shall prove the engagement and security of the point lock. Examples include:

(a) detection of the position of the operating bar in points with integrated drive and locking;

(b) detection of the position of the plunger in points with independent drive and locking;

(c) detection of the engagement of secondary locks securing the lock plunger or operating bar.

5.4 Testing

It should be possible to test the adjustment of the detection without the necessity to disturb or disconnect the point lock and to test the adjustment of the point lock without disturbing or disconnecting the detection.

6 Application design requirements

6.1 General requirements

The setting and subsequent detection of the position of movable blades and point lock engagement in the requested position are vital interlocking functions.

The interlocking shall be designed in accordance with AS 7711.

The circuit design shall be fail-safe. Any loss of power or component failure shall result in a loss of detection.

The design of point detection circuits shall facilitate ease of maintenance, fault-finding and minimize the need for personnel to work in the danger zone. Individual detection elements should be cabled directly to/from the controlling location with connections to the other elements made there.

Where multiple ends and other detection elements exist within a detection circuit, e.g., crossovers, supplementary detectors, 3rd rail and K blade detectors in dual gauge, swing nose crossings, etc., consideration should be given to providing separate detection circuits, e.g., for A and B ends, to improve reliability and reduce complexity in testing.

The position of all movable blades, the engagement of the point lock and the correct operation of the detection mechanism contacts shall be proved.

Emergency or manual operation shall be integrated into the detection circuit to ensure that the detection circuit remains broken whilst the points are in manual operation mode.

6.2 Interlocking requirements for point operation

Interlockings shall:

(a) move points to the position as set by a movement authority request or individual point setting request from the train control system, by activation of the point drive;

(b) disengage the point drive when the points become detected and locked in the set position, or after a time set by the RIM if the points fail to become locked and detected in the set position; and

(c) prevent simultaneous calls to move points to both the normal and reverse positions at the same time.

6.3 Detection and locking requirements

Specifically in this section locking refers to the locking of points as an interlocking function rather than the mechanical locking of individual point operating mechanisms, and detection refers to both that of the blades and the locking mechanism.

Indications to train control systems shall prove correspondence between the requested and detected point position.

Issue of movement authorities shall prove correspondence between the requested and detected point position, and shall prove the points are locked in the interlocking.

General principles for the detection and locking of points are generally set out in AS 7711 section 5 and Appendix B, which requires that, for the issue of a movement authority:

(a) points located within a requested movement authority, inclusive of all individual point elements associated with the points whether directly within the movement authority or not, shall be proved to be locked and detected in the required position;

(b) the detection and locking requirements for points located within the overlap of a movement authority, where overlaps are required by a RIM's standards and policies, shall be in accordance with AS 7711 Appendix B; and

(c) points required for flank or trapping protection, where this is required by a RIM's standards and policies, shall normally be proved locked and detected in the required position before the issue of the movement authority.

6.4 Alternative setting, detection and locking options

RIM's may, subject to risk assessment, adopt one or more of the following options in combination for the setting, detection and locking of points outside the current movement authority:

(a) No setting, detection or locking.

(b) Self-Normalisation of points.

(c) Soft calls, i.e., a setting request is made but not monitored.

(d) Setting only.

(e) Setting and detection only.

(f) Setting and detection at time of clearing only.

6.5 Independent detection and operation

Crossovers and points normally have their own detection. However, in the event of failure of either end (A or B) both are shown as being undetected. This ensures that the failure or manual operation of one end does not increase the risk of collision due to the loss of flanking protection.

Crossovers and points used for flank protection may be provided with an independent mode, so that the failure or manual operation of one end does not affect the normal operation of the opposite end. This allows for one end to be maintained or be in a failed state whilst allowing normal traffic operation over the opposing end.

Independent detection and operation removes flank protection which increases the risk of rail vehicle collision due to breaches of clearance envelopes. Prior to introducing independent detection and operation the following shall be evaluated and resolved:

(a) How will the collision risk introduced due to loss of flank protection be mitigated?

(b) When will independent operation mode be permitted, and under what circumstances?

(c) Are additional track circuits or axle counters required to detect fouling of the adjacent line?

(d) How will network controllers identify when a crossover is being independently detected and operated?

Policies, procedures and training shall be provided to all personnel involved in using independent detection and operation modes.

7 Tolerances

7.1 Point lock tolerances

7.1.1 General requirements

Point lock tolerances shall be specified by the RIM based on an evaluation of wheel profile, rail profile and flange back clearance. The tolerances shall be compatible with all permissible conditions of rail and/or wheel wear.

System reliability shall be evaluated when specifying point lock tolerances.

Tolerances shall be specified for point locks securing the tip of the blade and for any additional point locks provided in association with supplementary drive mechanisms.

7.1.2 Closed blade

The point lock tolerance for the closed blade shall ensure that:

(a) when the point lock is engaged the closed blade cannot open sufficiently to permit a wheel flange to strike the tip of the blade;

(b) the point lock will not engage if any obstruction or fault condition holds the tip of the closed blade open sufficiently to permit a wheel flange to strike the tip of the blade;

(c) the point lock will not engage if any part of the closed blade is open sufficiently to reduce gauge through the points beyond the minimum permitted by the RIM.

7.1.3 Open blade

The point lock tolerance for the open blade shall ensure that:

(a) when the point lock is engaged the open blade cannot close sufficiently to permit a wheel flange to strike any part of the blade. Trailable point mechanisms which rely on the open blade being free to move are exempt from this requirement.

(b) the point lock will not engage if any obstruction or fault condition prevents the open blade from opening to a position that will permit clear passage of a wheel without the wheel flange striking any part of the blade.

7.1.4 Permitted tolerance ranges

Point lock tolerances shall be specified as a minimum/maximum range such that:

(a) the maximum ensures that the above conditions are met; and

(b) the minimum allows for some minor variances in track or adjustment conditions for the purpose of preventing unnecessary disruption to services.

The RIM may, on the basis of risk assessment and control, permit increased point lock tolerances for trailing only points.

7.2 Point detection tolerances

7.2.1 General requirements

Point detection tolerances shall be specified by the RIM based on an evaluation of wheel profile, rail profile and flange back clearance. The tolerances shall be compatible with all permissible conditions of rail and/or wheel wear.

System reliability shall be evaluated when specifying point detection tolerances.

Tolerances shall be specified for detectors proving the position of the tip of the blade and for any supplementary detectors provided through the length of the blade.

7.2.2 Closed blade

The point detection tolerance for the closed blade shall ensure that the detection contacts are open if:

(a) the closed blade is sufficiently distant from the relevant stock rail to permit the tip of the blade to be struck by a wheel flange; and

(b) any part of the closed blade is open sufficiently to reduce gauge through the points beyond the minimum permitted by the RIM.

7.2.3 Open blade

The point detection tolerance for the open blade shall ensure that the detection contacts are open if:

(a) the open blade lies sufficiently close to the relevant stock rail to permit a wheel flange to strike any part of the blade; and

(b) the open blade is not in a position that proves the engagement of the point lock in integrated drive and lock arrangements where the open blade detection is used to prove the position of the operating bar.

7.2.4 Permitted tolerance ranges

Point detection tolerances shall be specified as a minimum/maximum range such that:

(a) the maximum ensures that the above conditions are met; and

(b) the minimum will not permit the detection contacts to open while a correctly adjusted point lock is engaged for the purpose of preventing unnecessary disruption to services.

The RIM may, on the basis of risk assessment and control, permit increased tolerances for trailing only points.

8 Points not in use

8.1 Securing of points not in use

8.1.1 General requirements

Where points are installed in an operating line but not in use, they shall be secured to prevent them from moving out of their correct position. This section is applicable to:

(a) points that have been installed but not yet commissioned.

(b) points that have been decommissioned but not yet removed.

(c) points that are booked out of use for an extended period.

8.1.2 Point blades

The closed blade of points not in use shall be secured at a minimum of two points. Securing shall take the form of:

(a) one or more point-clips and safeworking locks; or

(b) spiking of the closed switch; or

(c) engagement of the point lock where the point lock is connected.

The open blade of points not in use shall be secured at a minimum of two points. Securing shall take the form of:

(d) one or more stretcher bars connected to the secured closed switch; or

(e) engagement of the point lock where the point lock is connected.

8.1.3 Securing points with point lock

In cases where the point lock is used as a method of securing points out of use, action shall be taken to prevent the point lock being inadvertently disengaged. Appropriate actions include but are not limited to:

(a) disconnection of the operating circuit of electric points;

(b) disconnection of the pump and/or solenoid operating circuits of hydraulic points which do not require pressure to be maintained in the actuator to secure the lock;

(c) disabling the facing point lock lever on mechanical points;

(d) mechanically secure the facing point lock;

(e) isolating the air supply to pneumatic points which do not require pressure to be maintained in the actuator to secure the lock;

(f) disconnection of the solenoid controls for the operation of the points to the opposite position where hydraulic or pneumatic points require pressure to be maintained in the actuator to secure the lock.

8.1.4 Verification of point securing methods

In cases where the point lock is used as a method of securing points out of use the point lock shall first be certified for the position in which the points are to be secured and shall be periodically recertified in accordance with the signalling safeworking procedures of the RIM.

The RIM may permit an extension to the recertification interval for points which are secured out of use provided an alternative method is applied to assure the continuing integrity of the point lock. This may include substituting visual inspection for recertification testing.

Mechanisms for securing of points out of use shall be periodically inspected to confirm that they remain effective. The inspection frequency shall be specified by the RIM on the basis of a risk assessment.

8.2 Detection of points not in use

In signalled areas, points not in use shall be detected and the detection circuit connected to the interlocking.

Point detection of points not in use shall be certified for the position in which the points are to be secured and shall be periodically recertified in accordance with the RIM's signalling safeworking procedures. This certification shall include confirmation of the correct operation of lock proving contacts where the point lock is being used as a method of securing the points out of use.

The RIM may permit an extension to the recertification interval for points which are secured out of use provided an alternative method is applied to assure the continuing integrity of the detection. This may include substituting visual inspection for recertification testing.

The point detection circuit shall not be connected to the interlocking until the detection has been certified in order to prevent signals being cleared over the points prior to certification.

9 Test and Commissioning

Prior to commissioning of points the points shall be inspected, tested, and certified to confirm correct operation of the point locking and point detection functions.

Detection circuits shall be tested in accordance with the RIM's inspection and testing procedures. All frig wiring and stage work wiring shall be removed prior to certification testing of the points.

Testing shall confirm that the detection circuit has been installed and is functioning as per design.

Point locking and detection components shall be inspected prior to testing to confirm that they are undamaged and operate as designed.

Point lock adjustment shall be tested to confirm compliance with the tolerances specified by the RIM.

Detection adjustment shall be tested to confirm compliance with the tolerances specified by the RIM.

Testing shall prove correspondence between the controls, panel indications and the position and locking status of the points.

Testing shall prove that movement authorities cannot be issued over points that are out of position or unlocked.

The RIM shall retain and have available records of all certification testing undertaken prior to commissioning of points.

10 Maintenance, inspection and monitoring

Point locks shall be periodically tested and recertified. Recertification intervals shall be determined by the RIM.

Detection shall be periodically tested and recertified. Recertification intervals shall be determined by the RIM.

Components of the point lock and point detector shall be inspected to ensure their integrity. Typical items to be inspected include, but are not limited to:

(a) wear on locking faces of lock slides, lock plungers and integrated drive/lock mechanisms;

(b) wear or play in bearings and/or guides;

(c) wear, including flat spots on rollers and cams, in the point detector actuator mechanism;

(d) loose, damaged or degraded components;

(e) damage to wire and/or cable insulation;

(f) excessive play or free movement of slides;

(g) contamination including migrated lubricants, water, dust and metallic material that may provide a conductive path allowing inadvertent energisation of detection circuits;

(h) security and integrity of connections to movable blades.

Components of the point lock and point detector shall be lubricated in accordance with the manufacturer's instructions or the RIM's maintenance manuals.

The RIM shall retain and have available records of all maintenance and certification activities conducted on all points.

Appendix A Hazard register

Informative

Hazard number	Hazard
9.8.1.1	Points detection being inconclusive or incorrect (e.g. N&R showing together or normal showing for reverse and reverse for normal (consistent through set))
9.30.1.4	Points not operating properly due to lack of thorough testing, causing derailment
9.50.1.1	Points blades remain open with detection made and FPL (facing point lock) locked - wrong side failure - leading to accidents

Appendix B Examples of point locking

Informative

The table below provides guidance on common types and names for point locking systems.

The common names are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by RISSB of these products.

Table B:1 Type of Point locking

Type of point locking	Common names
On rail integrated drive and lock mechanisms	Claw lock, clamp lock and Spherolock ®
Off rail integrated drive and lock mechanisms	Unistar and EBI switch
Independent drive and lock mechanisms	Combined electric machines such as the Siemens and Ansaldo M3/M23, GEC HW, and Nippon KA1200; mechanical points operated by lever frames; and Signal Branch/branch line EP points.

Appendix C Bibliography

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

- AS 7716 Signal Testing Process

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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.

The same process is used in developing other RISSB products, although Guidelines are not exposed to the public for comment or validated, given their non-binding nature.

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