Australian STANDARD®

Turnouts and other special trackwork

RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

Infrastructure Standard

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RISSB Office

Phone:	**Email:**	**Web:**
(07) 3724 0000 Overseas: +61 7 3724 0000	info@rissb.com.au	www.rissb.com.au

AS 7642 **Assigned Standard Development Manager**

Name:	**Phone:**	**Email:**
Sudha Niles	**0429 011 672**	sniles@rissb.com.au

This Australian Standard® AS 7642 Turnouts and other special trackwork was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organisations:

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

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

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

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

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Turnouts and other special trackwork

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AS 7642:2021 Turnouts and other special trackwork supersedes AS 7642:2013 Turnouts and other special trackwork.

Objective

The objective of this Standard is to outline requirements that encourage rail organisations to adopt a whole-of-life approach to the management of turnouts and other special trackwork. This approach includes design, supply, construction, maintenance, decommissioning and disposal of turnouts and other special trackwork in order to promote a consistent treatment, across a range of operational track gauges used in Australia.

This standard covers the stages of installation, commissioning, maintenance, disposal and decommissioning of turnouts and other special trackwork, while design and manufacture stages are provided in AS 1085.21: Railway track material Part 21: Turnouts, switches, and crossings.

This paragraph is used to provide statement about this Standard's significant technical changes from any previous edition of the document and/or objective for the revision. … only change this paragraph if it is applicable

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 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

Contents

Appendix Contents

1 Scope and general

1.1 Purpose

The objective of this Standard is to provide the Australian rail industry with a set of mandatory and recommended requirements for the:

(a) general management,
(b) installation,
(c) commissioning,
(d) maintenance,
(e) disposal, and
(f) decommissioning

of turnouts and other special trackwork, in order to promote a consistent treatment.

The requirements for design and manufacture are provided in AS 1085.21: Railway track material Part 21: Turnouts, switches and crossings.

1.2 Scope

This Standard provides the minimum requirements for the life cycle management of turnouts and other special trackwork. The elements of turnouts and other special trackwork components addressed in this Standard include:

(a) turnouts;
(b) crossings;
(c) catch points;
(d) switch rails and switch points;
(e) stockrails;
(f) checkrails;
(g) closure or lead rails;
(h) turnout rails;
(i) flange bearing ramps;
(j) rail baseplates, fasteners and rail joints;
(k) special or transition bearers/sleepers/ in-bearers;
(l) manually operated point lever equipment.

The following components are excluded from this Standard.

(a) Sleepers not part of turnouts and other special trackwork.
(b) Track structure and formation support.
(c) Ballast.
(d) Bearers, plates, fasteners and rail joints, other than those forming components of turnouts and other special trackwork.

(e) Track geometry and alignment, other than the specific requirements for turnouts and other special trackwork.

(f) Interlocking points equipment.

These exclusions are addressed through other Australian standards.

The document adopts a whole-of-life approach to the management of turnouts and other special trackwork, and includes maintenance, decommissioning and disposal, for a range of operational track gauges used in Australia. The design and manufacture aspects of the life cycle are addressed in AS 1085.21 Railway track material Part 21: Turnouts, switches and crossings.

This Standard addresses the following track gauges, as measured between the running faces of the rails at a point 16 mm below the rail head:

(a) narrow gauge of 1067 mm (3' 6")

(b) standard gauge of 1435 mm (4' 8 ½")

(c) broad gauge of 1600 mm (5' 3")

(d) dual gauge assemblies which incorporate two gauges (i.e. 1067 mm (3'6") with 1435 mm (4' 8 1/2"), and 1435 mm (4' 8 1/2") with1600 mm (5'3").

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:

- AS 1085.21: Railway track material Part 21: Turnouts, switches and crossings
- AS 1085 series: Railway Track Materials, including Steel Rails, Fishplates, Sleeper Plates, Fishbolts, Washers
- AS 7630: Railway Infrastructure – Track Classification
- AS 7635: Railway Infrastructure – Track Geometry

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

1.4 Terms and definitions

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

1.4.1

fully cast manganese crossing
cast manganese crossing with legs welded onto the cast crossings (also known as 'monoblock crossing').

1.4.2

heavy-duty switch
switch with thickened switch points, which is required to be used with joggled stockrails to ensure the running face of the running rail is collinear.

1.4.3

heeled (or pivot heeled) switch
switch that pivots about a gapped joint between the switch rail and adjoining closure rail, with the heel block and fishplate at the joint where the switch is bolted designed to allow for this movement.

1.4.4

flexible switch
flexible switch that is machined from longer rails and fixed towards the end of this rail with heel blocks / anti-creep device to the adjacent stockrail. In some cases, a section of the switch rail foot is removed towards the heel and the switch is designed to flex over its length.

1.4.5

rail bound manganese crossing
crossing where the actual crossing area is made from manganese steel castings surrounded by specially machined and set rails.

1.4.6

spiral or transition geometry turnout
where transitions in the internal curve radius of the turnouts have been used to allow for increased forces on the exit and entry to the turnout.

1.4.7

spring wing crossing
switchable V crossing with both a fixed and moveable spring wing leg. The spring wing effectively eliminates the flangeway gap when using the mainline, thus reducing the wheel-generated impact on the crossing. The wheel flange forces the spring wing rail open when taking the siding road.

1.4.8

throw-off rail (catch points)
rail that is provided in a catch point assembly to derail a train at a point clear of the mainline.

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

1.5 Abbreviations

1.5.1

BG
broad gauge

1.5.2

NG
narrow gauge

IRJ
insulated rail joint

1.5.3

RIM
railway infrastructure manager

1.5.4

SG
standard gauge

2 General requirements

2.1 General

All rail transport operators and contractors working in the Australian rail industry shall establish management systems suitable to the scale of their business activities and operations.

Rail infrastructure and operating requirements shall comply with the Rail Safety National Law and, where appropriate, encompass specific safety management requirements for the safe application and use of turnouts and other special trackwork.

Turnouts and other special trackwork shall be designed to meet the functional requirements applicable to the track classification as defined by AS 7630.

The management of turnouts and other special trackwork should incorporate factors relevant to the age and condition of that infrastructure, the operating environment, traffic task, and seasonal climatic conditions.

Turnouts and other special trackwork shall be managed through each stage of their life cycle, as part of an integrated track and civil infrastructure management system that ensures the structures are safe and fit for service.

2.2 Competency management

Rail safety worker competency management procedures, which include particular works to turnouts and other special trackwork, shall be established by the RIM.

The Railway Infrastructure Manager should document training requirements and competency certification required to perform various types of work to turnouts and other special trackwork.

2.3 Interface coordination

To ensure risks to safety are effectively managed, normal operating parameters should be documented for all sections of track and infrastructure, including procedures for handling infringements, and the application of any temporary speed restrictions over turnouts and other special trackwork.

The actual rated parameters for operation (permanent and temporary) over the track and infrastructure should be determined and documented.

The permissible parameters of operation for each train should be compatible with limitations identified for the track and civil infrastructure, including those specifically identified for turnouts and other special trackwork.

The Interface Coordination Plan should include practices for the communication of the permissible parameters of operation to all relevant persons and organisations.

The attention of train operators should be specifically drawn to infrastructure locations that do not meet the standards established for normal operating requirements.

2.4 Documentation and record management

The RIM shall maintain relevant documentation on turnouts and other special trackwork, to ensure that the safety and capacity of the infrastructure to perform its required function as designed can be assured.

The RIM shall establish and maintain local policies and procedures for the maintenance of records, ensuring compliance with the requirements of the rail organisation's own quality management system.

Documentation shall be maintained for turnouts and other special trackwork throughout each stage of the life cycle.

As a minimum, documentation on turnouts and other special trackwork should include:

(a) a database of turnouts and other special trackwork installed on the network,including their type and detailed description;

(b) a system for defining their location on the network;

(c) governing standards, procedures and work instructions applicable to their management through each life cycle stage;

(d) design and rating records required to achieve the specified functional capability;

(e) engineering drawings detailing design layout configurations, component manufacturing details and as-built construction;

(f) hazard locations that have the potential to impact defined functional capacity

(g) inspection and assessment requirements, including records of the inspections and assessments carried out; and

(h) maintenance, modification, repair and renewal works conducted in relation to the structures.

2.5 Component description

2.5.1 Function

The function of points and crossings is to:

(a) provide a means for rolling stock to diverge or converge from one track to another, and

(b) prevent unauthorized movements of trains or rolling stock.

The general layout of typical turnout structures (single and dual gauge), showing the points and crossing areas, is provided in Appendix B.

The following sections describe the main units of special trackwork structures and their component breakdown.

2.5.2 Turnout

A turnout allows rail tracks to converge or diverge, and is an assembly of:

(a) switch and stockrail,

(b) V crossings,

(c) checkrail units (except in swing nose/switchable vee crossings),
(d) closure rails,
(e) bearers,
(f) baseplates and fasteners,
(g) rail joints,
(h) switch operating equipment.

Turnouts can be classed as:

(a) conventional,
(b) tangential, or
(c) high speed spiral or transition geometry turnouts.

Conventional and tangential turnouts can either be:

(a) standard, where one route is straight, or
(b) non-standard (flexed), where the mainline route is curved.

Standard conventional turnouts are defined by the combination of their switch length, heel type and the crossing rate, and are designed with the mainline track straight.

Standard tangential turnouts are defined by the radius of the turnout, and in this type of configuration the turnout has the through road straight and the turnout road, including the switches, continuously curved, with the tangent point located near the toe of the points.

In tangential turnout configurations, the curvature through the crossing can be either a straight or fully curved crossing.

Rail traffic can move through a turnout in a facing or trailing direction.

The facing point of the switch is used to divert the rail traffic on to another track and is determined by whether rolling stock first 'meets' the front (or face) of the switch point when it is travelling over the turnout (facing), or whether it sees the switch point after travelling over the rest of the turnout (trailing).

A turnout can also have a right or left-hand configuration, depending on the way the turnout curves from the point of the switch towards the V crossing.

An example of a left-hand turnout with labelled components is shown in Appendix B of AS 1085.21.

2.5.3 Diamond crossing

A diamond crossing allows rail tracks to cross each other while maintaining continuous support and direction to rolling stock.

Typical layouts for diamond crossings are provided in AS 1085.21.

A diamond crossing is an assembly of rail components comprising:

(a) V crossings,
(b) K crossings,
(c) checkrail units (except in swing nose/switchable vee crossings),
(d) closure rails,

(e) bearers,

(f) baseplates and fasteners, and

(g) rail joints.

Diamond crossings comprise of V and K crossings. These crossings can either be fixed or switchable (swing nose) crossings.

Layouts showing the different types of diamond crossings are illustrated in Appendix B of AS 1085.21.

The diamond crossing can be either:

(a) flange bearing, where the depth of the flange way is reduced so that the wheel flange of the rolling stock run on the surface of the component lifting wheel tread clear of the running rail; or

(b) rail running, where the rolling stock runs on the crown (head) surface of the running rails.

2.5.4 Slip (or compound)

A slip, also known as a 'compound', allows two tracks to cross each other or diverge; but unlike a diamond crossing, it contains sets of switches to allow movement from one line to another.

A single slip configuration has two sets of switch assemblies, and a double slip configuration has four sets of switch assemblies, as illustrated in Appendix B of AS 1085.21.

A slip is an assembly of rail components comprising:

(a) V crossings,

(b) K crossings,

(c) checkrail units (except in swing nose/switchable vee crossings),

(d) closure rails,

(e) bearers,

(f) baseplates and fasteners,

(g) rail joints, and

(h) switch assemblies.

2.5.5 Scissors crossover

Two crossovers, in opposite directions, that intersect between the same two tracks being connected. This intersection forms a diamond.

A typical scissors crossover configuration is illustrated in Appendix B of AS 1085.21.

2.5.6 Catch point

A catch point provides a level of protection against train collisions at the junction of sidings and main running lines and is provided when required to conform to a specified safe working requirements.

A typical catch point configuration is illustrated in Appendix B of AS 1085.21.

A catch point might be interlocked with a signalling system, or it is operated via a manual lever.

A catch point is an assembly of:

(a) switch or switches and stockrails,
(b) closure rails,
(c) throw-off rails (where provided),
(d) bearers,
(e) ramp blocks (where provided),
(f) baseplates and fasteners,
(g) rail joints, and
(h) switch operating equipment.

2.5.7 Expansion switch

An expansion switch provides a level of control for rail stresses when tracks are attached to structures or substructures (e.g. steel underbridges) that is subjected to temperature-related expansion and contraction, or differential movements of the track.

A typical expansion switch configuration is shown in Appendix B of AS 1085.21.

An expansion switch is an assembly of:

(a) switches and stockrails,
(b) closure rails,
(c) bearers,
(d) baseplates and fasteners, and
(e) rail joints.

2.5.8 Manual point lever

A manual point lever enables a railway turnout to be operated manually and includes:

(a) throw-over levers,
(b) sprung levers, and
(c) weighted levers.

3 Design, manufacture, and supply

3.1 General

The RIM shall ensure that all manufacturers, contractors, and subcontractors used in the supply of turnouts and other special trackwork component materials are quality assured and have appropriate procedures in place to guarantee quality products.

All turnout and other special trackwork component materials supplied by the manufacturer shall conform to the specifications, type approval and testing requirements specified in AS 1085.21.

All component materials shall be manufactured and supplied in accordance with relevant engineering drawings and specifications, making allowances for variations in rail size and the maximum tolerance limits, as determined by the RIM for the particular track classification, geometry and rail operating environment.

3.2 Marking of components

Turnouts and other special trackwork components should be stamped for identification, in accordance with the requirements specified in AS 1085.

Stamping should include details such as the manufacturer and all relevant product identification details for the respective rail organisation, including product type, reference number, rail size, crossing angle, year of manufacture, heat treatment number (where appropriate), etc.

The RIM shall specify the details required to be included in marking of components.

3.3 Product testing and acceptance

Product testing and acceptance shall be in accordance with AS 1085, and any other relevant procedures defined by the RIM.

All rail organisations shall ensure that they obtain all relevant certificates of compliance, including reports of physical tests and of chemical analysis conducted on component materials from the manufacturers.

3.4 Component assembly and inspection

The method of assembly of components should be specified by the manufacturer and approved by the RIM.

The RIM should direct that a whole item, or any portion thereof, be completely assembled prior to delivery.

The complete assembly should be inspected by the RIM.

4 Installation and commissioning requirements

4.1 Installation

4.1.1 General

This section specifies the construction standards for the installation and acceptance of turnouts and other special trackwork components.

The RIM shall ensure that the finished geometry of all turnouts and special trackwork installations comply with AS 7635.

Specifically, in turnouts and other special trackwork assemblies, the track gauge tolerances should be the nominal (narrow, standard, or broad) gauge, with maximum limits within +/-2 mm.

Gauge widening through the body of sharp curves, as defined by AS 7635 Railway Infrastructure – Track Geometry, with the gauge at the turnout or other special trackwork remaining at the nominal track gauge might be approved by the RIM.

Where gauge widening is required, the track gauge should be widened by moving the inner rail away from the designed track centreline, to ensure alignment continuity along the outer (steering) rail.

When installed on the network, the checkrail effectiveness through turnouts and other special trackwork should be in accordance with:

(a) narrow gauge,

(b) standard gauge, or

(c) broad gauge.

When constructing turnouts and other special trackwork, the checkrails should be installed towards the maximum value of the checkrail effectiveness as specified in AS 1085.21, to allow maximum checkrail wear before readjustment is required.

A guideline on recommended construction acceptance tolerances for turnouts and other special trackwork assemblies is provided in Appendix C Typical construction tolerances.

4.1.2 Turnout

4.1.2.1 General

Tangential turnouts offer higher turnout speed and reduced wear over conventional turnouts and should be used for mainline renewals and new construction works.

Where tangential turnouts are used, the turnouts, and the track for 50 metres either side, should be fully welded.

Renewal and new construction of conventional turnouts should generally be restricted to yards and sidings where there are low speeds and light traffic.

When constructing turnouts which incorporate swing nose crossings, the RIM shall ensure that the switch and the swing nose are aligned prior to the passage of rail traffic, to prevent derailment.

Where standard and special turnouts need to be renewed (e.g. in heavy haul railways) and a high level of performance is required, premium crossings such as manganese crossings should be recommended.

The implications for rail expansion from long span bridges should be addressed in configuration used for turnouts for example:

(a) when turnouts are placed within 30 m of a bridge end (where spans are < 18 m),

(b) when turnouts are placed within 60 m of a bridge end (where one or more spans are ≥ 18 m but < 80 m), the turnout should be aluminothermic welded throughout and a flexible switch used if possible.

The use of non-welded joints (excluding IRJs) should only be permitted for a short period during the initial construction and installation of turnouts.

The installation of crossing units with fixed, swage fastened joints might be approved by the RIM.

For turnouts fitted with dry slide chairs, no oil or grease shall be applied to these chairs during installation.

4.1.2.2 Acceptable tolerances

The finished geometry of the track shall be in accordance with the requirements of AS 7635.

The tolerance limits shall be applicable to the track classification, and any deviation from the defined acceptable tolerance limits shall be subject to the approval of the RIM. Recommended tolerance limits are provided in Appendix C Typical construction tolerances.

4.1.2.3 Installation of switches and switch stops

Switches should be laid up against the stockrail within the following limits, without any applied force. Recommended tolerance limits are provided in Appendix C

The minimum flangeway gap at the end of the switch head planning from the back of the switch to the stockrail should be 50 mm.

Switch operating forces should be checked, with all stretcher bars connected but all operating rods disconnected. An exception this instruction is made where a mechanical back-drive is used.

The force required to operate the switch to reverse should not vary from the force required to operate to normal by more than 10%.

Where an adjustable switch stop is fitted, it should be adjusted to ensure that the switch stop bolt makes contact with the web of the switch in the closed position.

The adjustment should be such that the switch conforms to the true design geometry.

Where a non-adjustable switch stop is used, the stud should have a minimal gap between the switch and the stockrail web.

4.1.2.4 Installation of Bearers

Bearers should be placed in accordance with the spacing plan nominated in the design, with a tolerance of ±2 mm for spacing between adjacent bearers, and ±10 mm of cumulative design position.

The bearer type typically concrete, timber or composite shall be appropriate to the operating environment and track classification as defined by AS 7630.

4.1.3 Diamond Crossing

A finished diamond crossing should meet the requirements as recommended in Appendix C.

Other installation tolerances should be in accordance with the design specification or manufacturer's instructions.

The bearer type (typically concrete, timber, or composite) should be appropriate to the operating environment and track classification as defined by AS 7630.

4.1.4 Catch Point

Where a catch point is required at the junction of a siding and mainline to prevent unauthorized access to the mainline, the finished catch point should be installed to the requirements recommended in Appendix C.

The RIM shall determine whether a throw-off rail is required, and whether any other special provisions are required to ensure the running gauge is not compromised.

The risks associated in determining where a derailed vehicle is to be directed shall be assessed by the RIM when determining the location of the catch point and the need for a throw-off rail and any other special provisions.

The throw-off rail should be located to ensure the wheels of the derailing vehicle travel the correct path, thereby reducing the risk of a derailing vehicle fouling the running line's structure gauge.

Where necessary, additional external guardrails shall be installed, and a ramp installed, to assist derailed wheels to lift over the rail extending forward from the switch rail heel. Alternatively, turnouts can be used as catch points as defined in AS 7724.

The provision of crash barriers should be made available where relevant to ensure a derailed vehicle does not foul the running line's structure gauge.

4.1.5 Expansion Switch

An expansion switch shall be installed where it is necessary to allow relative longitudinal movement of one section of track with respect to the adjacent section (e.g. at a bridge expansion joint).

The switch and gauge should not exceed the design requirements at the limits of expansion and contraction of both the rail and the structure.

The gap between the switch and the stockrail at installation should not exceed 0.5 mm.

The switch rail and stockrail can be welded to adjoining rails.

The function of the expansion switch should not be inhibited, when positioning the welds.

Other installation tolerances shall be in accordance with the manufacturer's instructions.

The bearer spacing and type should be of a standard design suitable to the operating environment and track classification as defined by AS 7630.

The stockrail fasteners should allow unrestrained longitudinal movement of the stockrail whilst preventing lateral and rotational movement of the stockrail.

4.1.6 Manual Point Lever

A manual point lever shall be installed in accordance with the tolerances established by the manufacturer.

4.1.7 Fastenings

Baseplates in turnouts and diamond crossings should be fastened to sleepers with at least the minimum recommended fastening requirements that are appropriate to the different types of bearers (e.g. timber, concrete, steel, or composite).

Minimum fastening requirements for typical baseplate types shall be determined by the RIM.

4.2 Commissioning

All components and unit assemblies shall be checked for compatibility with the connecting infrastructure.

Survey checks shall be carried out to ensure the work is carried out to the correct design geometry, and constructed to the acceptable construction tolerance limits, as appropriate to the track classification as defined by AS 7630.

Before any track is accepted for traffic use, all components and fastenings shall be checked and tightened or re-tensioned, as necessary, to ensure the units are fit for purpose.

The RIM shall ensure that any remedial work required to achieve the construction standards is completed.

All relevant construction and verification certification, and documentation shall be completed before handover and acceptance of the infrastructure.

After the installation of turnouts and other special trackwork, all surplus materials should be removed from the site.

Inspection and test plans and/or other inspection and testing procedures approved by the RIM should be in place for commissioning and remedial works.

5 Monitoring and maintenance requirements

5.1 Inspection and assessment

5.1.1 Inspection practice

The factors that determine the practices for the inspection of turnouts and other special trackwork components include the following.

(a) Frequency of inspection (including whether those frequencies should be based on time intervals or traffic tonnages passing over the infrastructure).

(b) Types of defects and the level, or size, at which they become critical, including

i. wear of running surfaces (switch rails, crossing nose and wing rails),

ii. rail gauge face angle,

iii. the fit of moveable components in all positions (e.g. switch rail/stockrail fit and the impact of rail flow),

iv. worn, cracked, damaged or missing components,

v. track geometry in critical locations (including checkrail effectiveness),

vi. inadequate flangeways and wheel openings,

vii. operation of the moveable components (including the effects of product spillage from freight trains on these components),

viii. inadequate or uneven track conditions, and

ix. switch movement forces.

(c) Defect identification and status of actions to rectify.

(d) Types of inspections required to detect defect type, including inspections for the commissioning of new infrastructure.

(e) Factors and conditions (general and local) that impact on the rate of defect initiation and growth, includes

i. structure type and age,

ii. service loads,

iii. annual traffic tonnage,

iv. track structure and condition, and

v. speed of train passing over the defect.

In particular, attention should also be given to the geometry in turnouts and other special trackwork where there are discontinuities in the rail and where reliable operation of switch equipment depends on minimisation of track vibration and movement.

5.1.2 Assessment practice

The factors that determine the practices for assessing the condition of turnouts and other special trackwork components include the following.

(a) Action required.

(b) Response time for action to be taken.

(c) Factors and conditions (general and local) that impact on the rate of defect growth (includes factors listed under 'inspection practice').

(d) Factors that affect the consequences of component failure.

5.1.3 Types of inspection

5.1.3.1 General

The RIM shall arrange to conduct different types of inspections (both scheduled and unscheduled, where required) on turnouts and other special trackwork, to ensure they are fit for service at all times.

Unscheduled inspections shall be conducted where an event or circumstance has occurred and has impacted, or has the potential to impact, the integrity of the track and civil infrastructure at the location of turnouts or other special trackwork.

5.1.3.2 Scheduled patrol inspections

A scheduled patrol inspection is a routine visual inspection carried out at a walking pace (i.e. 5km/h or less) and wherever possible, includes walking the track.

Scheduled patrol inspections shall be carried out on turnouts and other special trackwork at intervals or as required determined by the RIM, based on the traffic task, track classification, crossing type, condition, rate of deterioration, and other local and seasonal factors.

This type of inspection shall be conducted to identify defects or conditions that could have the potential to affect the integrity of the track structure, or that indicate a risk of failure to guide rolling stock correctly over the infrastructure.

Scheduled patrol inspections should identify the following types of defects.

(a) Loose or missing components.

(b) Broken crossings, switch blades or rails.

(c) Damage to any component that does not allow it to perform its intended function, including switch operating equipment.

(d) Flangeway and other obstructions.

(e) Track geometry defects (including excessive or abnormal wear or damage to switch blades or other geometry-critical components).

(f) Wheel marks which indicate incorrect wheel/rail interaction.

(g) Rail creep that, for example, lead to displacement of components and rail alignment issues.

(h) Rail pulling, including at the point and splice rails, of fabricated crossings.

(i) Other obvious defects that affect continuity of support and direction to rolling stock.

(j) Switch not home against the stockrail.

(k) Swing nose crossing nose not fully closing against stock/wing rail.

(l) Material flow on the crossing nose and wing rails or on the switch and stockrail.

(m) Rail crippling

5.1.3.3 Scheduled general inspections

Scheduled general inspections are inspections where, typically, measurements are taken when a defect is suspected, and a non-conformance has been recorded for assessment and action.

Scheduled general inspections shall be carried out on the condition of turnouts and other special trackwork in a manner, and at an interval, determined by the RIM, based on the traffic task, track classification, type, condition, rate of deterioration, and other local and seasonal factors.

A general inspection of specific components shall be carried out when suspected defects are identified from conditions determined during patrol inspections.

A scheduled general inspection should identify turnout and other special trackwork conditions requiring action and determine the need for any further specialist inspection.

The RIM shall define and develop guidelines for conducting scheduled general inspections of turnouts and other special trackwork structures, setting out inspection frequencies, method of inspection and actions required for typical defects found.

At locations where deterioration can occur at higher rates due to such factors as curvature, usage, axle load or speed, more frequent inspections should be scheduled.

In addition to routine patrol inspections, scheduled general inspections should identify suspected defects in special trackwork structures, as outlined in table 5-1.

Category	Defects
1. Turnout and diamond assemblies	Missing or broken components Track geometry Track centre to track centre at fouling points
2. Rail condition	Rail and weld defects from visual inspection Rail wear
3. Switches	Gauge at the toe of the switch rail and other locations in the critical area Switch rail throat opening at the junction of heads Switch rail toe/stockrail open-throw dimension Switch rail toe/stockrail closed gap Alignment of switch rails Heel opening Fit of switch stops to stockrail Condition of switch rail stops Switch rail toe break Switch rail and stockrail wear Switch rail cripple Metal flow on all running rails Switch support on chairs and baseplates Heel block condition Anti-creep devise condition Rail chair and baseplate condition Rail joint condition, including bolts

Category	Defects
	Switch / stockrail squareness
4. Switch operation	Hand-operated lever operation (which should be checked, and any identified problems rectified, such as obstructions, incorrect clearances of moveable components, and poor lubrication, condition and visibility) Spreader bars, rods, brackets, and pins/bolts, including: • Spreader bar condition, straightness, insulation, correct adjustment and clearance under rails • Spreader bracket condition, attachment to switches, and pin or bolt connection to bars • Roding and spreader bar clearances to other track structures such as in-bearers • Connecting rod and bar condition, and correct adjustment • Lubrication of all moveable pins and bolts
5. Switch slide plate lubrication and condition of roller bearings	
6. Crossings	Gauge at critical areas Checkrail effectiveness Vertical wear on the crossing nose Flangeway clearances Flangeway depth Wing rail wear Rail alignment (including swing nose alignment, longitudinal displacement and the gap between the swing nose and the stock/wing rail Running rail wear Metal flow Crossing nose condition Crossing cracks Broken or cracked crossing spacer blocks Checkrail spacers Loose or broken checkrail and crossing bolts Swing nose crossing bearing on plates Swing nose rails and rail stops Correct position, wear and damage on checkrail
7. Fastenings	Damage (e.g. from incorrect installation, derailment, vandalism) Missing, ineffective (e.g. corrosion, wear, loose), incorrect types of fastenings (e.g. clips, insulating spacers, metal spacers, pads and special components including gaskets and abrasion plates)
8. Baseplate Pads	Condition under and correct position of baseplate
9. Baseplates and chairs	Worn or broken shoulders, Loose screw spikes Screw spike holes damaged/elongated Broken or cracked

Category	Defects
	Absence of lubrication
10. Bearer condition	Bearer degradation
	Damaged broken shoulders
	Damaged rail seat
	Concrete - damaged screw spike inserts/ferrules
	Timber / composite - damaged/elongated screw spike holes
	Exposed reinforcing tendons
11. Ballast	Ballast profile and depth of ballast beneath bearers (especially plated bearers)
	Ballast condition (especially beneath and around wheel rail impact locations)
	Clearance between ballast and moving parts (e.g. operating rods)
12. Components that can cause track circuit failure (e.g. metal flow at insulated rail joints)	

Table 5-1 Defect identification in general inspection

A general inspection would not normally require switches to be thrown unless problems are suspected from observation.

5.1.3.4 Scheduled detailed inspections

Scheduled detailed inspections are inspections where detailed measurements and observations are recorded for assessment and action.

Scheduled detailed inspections shall be carried out on the condition of turnouts and other special trackwork in a manner and at an interval determined by the RIM, based on the traffic task, track classification, type, condition, rate of deterioration, and other local and seasonal factors.

The items identified for scheduled general inspections should also be inspected as part of scheduled detailed inspections.

The RIM shall develop and put in place standard report forms to record observations and measurements for critical components, such as turnouts and catch points, diamond crossings, slips, and swing nose crossings.

Measurement, or gauging, shall be carried out and recorded for items identified on the standard report forms.

Track geometry measurements shall be carried out at turnouts and other special trackwork structures, at intervals determined by the RIM.

A guideline on typical frequencies for each type of scheduled inspection is provided in Appendix D Inspection frequency.

5.1.3.5 Gauge and cross level readings at turnouts and other special trackwork

If the gauge and crossing level readings in turnouts and other special trackwork are not recorded by the track recording car for the straight and diverging roads, then these

measurements shall be recorded at 2 metre intervals, either manually using a geometry trolley or other similar device.

The frequency of inspections shall be as specified by the RIM.

5.1.3.6 Condition assessment and response

The RIM shall develop and implement condition assessment and response criteria to rectify defects measured, or observed, during all types of inspections.

Guidelines for condition assessments and response actions for typical defects in the switch and crossing areas of turnouts and other special trackwork components can be found in:

(a) Appendix E Switch Area Response

(b) Appendix F Crossing Area Response.

If the cause of the defect is known, and it is known that it will not deteriorate into an unsafe condition, the RIM can authorize an alternative response to the standard response action.

At all times, vertical, lateral, longitudinal, and rotational restraint and support of the rails shall be maintained, to ensure acceptable geometry is presented to the rolling stock operating over the network.

Where defects are found in special trackwork, which are not documented in the rail organisation's standard response actions, they shall be assessed by the RIM to determine the appropriate action.

Typical conditions to be measured and assessed are provided in Appendix G Typical defects

The RIM should develop condition assessment and response criteria for other components critical to the functional support of turnouts and other special trackwork structures, to ensure optimal track infrastructure performance.

Other components include:

(c) rail and rail joints (welded and non-welded),

(d) sleepers and fastenings,

(e) ballast and ballast sub-grade formation support, and

(f) track geometry.

The condition assessment and response criteria for defects relating to these components are addressed by other Australian standards.

5.2 Maintenance tolerances

5.2.1 General

The geometry through turnouts and other special trackwork, as well as other supporting track infrastructure, shall be maintained in accordance with the RIM's maintenance standards, to enable turnouts and other special trackwork to perform to their required functional standards.

The RIM shall apply maintenance limits to turnouts and other special trackwork structures that support their traffic task in the context of their operating environment.

A summary guideline for critical maintenance acceptance limits in turnouts and other special trackwork is provided in Appendix H Typical maintenance limits.

5.2.1.1 Turnout

Maintenance limits shall be applied to the manual re-gauging of turnouts or component renewal.

If the maintenance activity includes longitudinal movement of any crossing, the resulting position of the crossing intersection point (Theoretical Point) should be within ±15 mm of the longitudinal and lateral position defined by reference pegs or survey monuments.

5.2.1.2 Diamond crossing

If the maintenance activity to a diamond crossing includes longitudinal movement of the crossing, the resulting position of the crossing intersection point (Theoretical Point) should be within ±15 mm of the longitudinal and lateral position defined by reference pegs or survey monuments.

5.2.1.3 Component repairs – general

All component repairs shall be non-destructively tested in accordance with the RIM's approved procedures for rail defects and testing requirements.

All non-destructive testing indicators shall be below reportable limits, as detailed in the RIM's approved procedures for rail defects and testing.

5.2.1.4 Component repairs – switches

The repair of switches blades by welding should be prohibited without the authority of the RIM.

There should be no damage in the first 2 m from the tip of the switch blade, deeper than 17 mm from the running surface which extends more than 100 mm along the blade, or consecutive areas of damage less than 100 mm apart forming a length more than 100 mm.

There should be no damage in the first 2 m from the tip of the switch blade, deeper than 19 mm from the running surface.

5.2.1.5 Component repairs – crossings and wing rails

The repair of crossings and wing rails by welding should be by a process approved by the RIM.

Repaired components should meet the design profile and tolerances of the component being repaired.

6 Decommissioning and disposal requirements

6.1 Categorising released materials

'Released' materials should be marked for reuse in turnouts and other special trackwork structures, subject to the local policies and procedures approved by the RIM.

Where released materials are to be reused, the RIM should establish a system that categorizes the component materials.

6.1.1 Materials for reuse / recycling

Components that have been released from the track and assessed as suitable for re-use should be marked in such a manner that their reuse potential is clear and unambiguous.

In particular, the components should be marked and segregated into stacks such as the following:

(a) rail size,

(b) switch type,

(c) crossing number (angle),

(d) checkrail (length).

6.1.2 Materials for refurbishment

Refurbished components should comply with all relevant drawings and specifications prior to reuse in track.

6.1.3 Materials for quarantine

Where components require further classification, they should be quarantined from reusable components.

6.1.4 Materials for disposal

All non-reusable components should be clearly marked and disposed of as soon as practicable, in a controlled manner after release from the track.

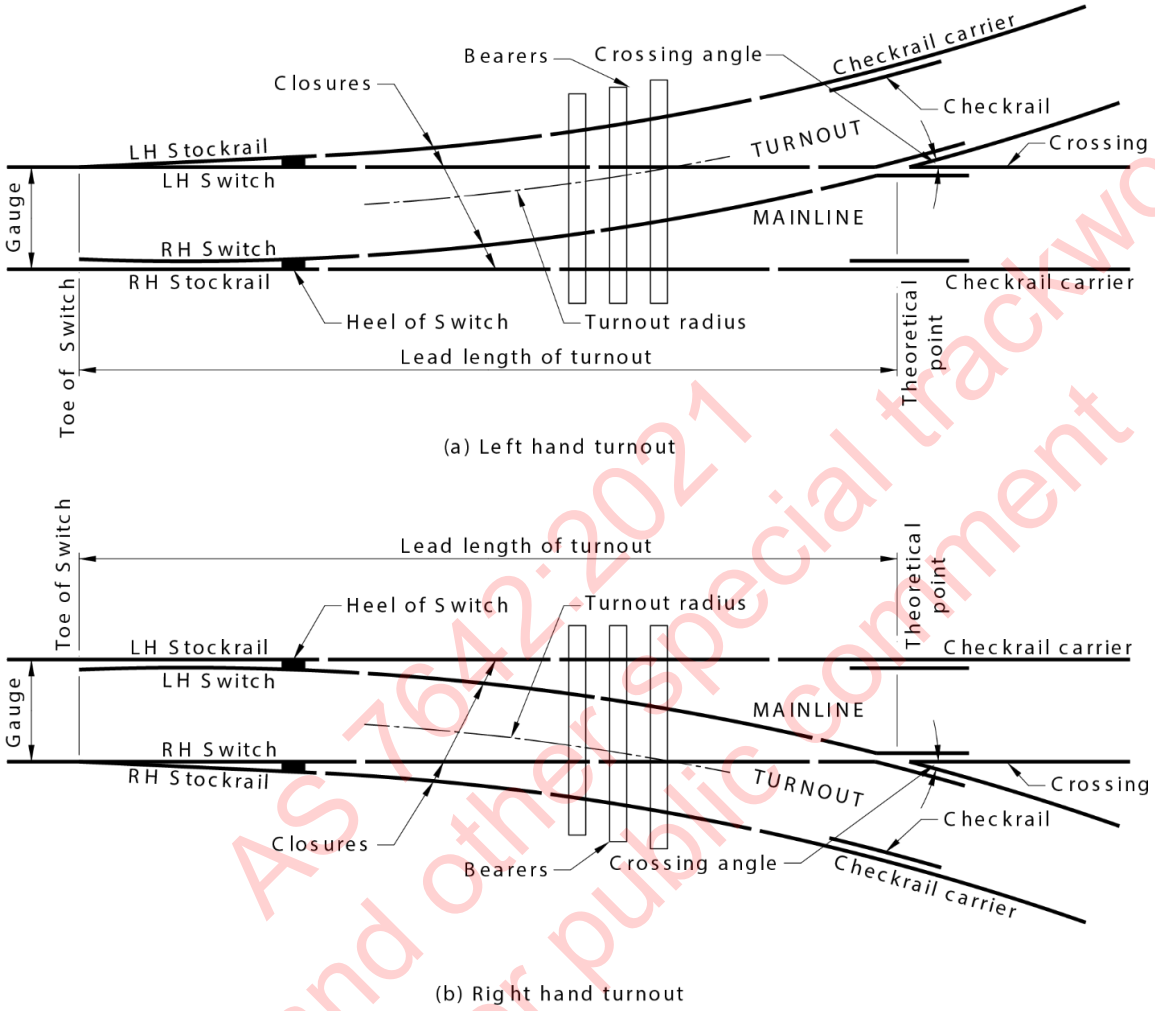
All non-reusable components which are suitable for recycling should be clearly marked and recycled as soon as practicable, in a controlled manner after release from the track.

Appendix A Australian Rail Risk Model (ARRM) risk table

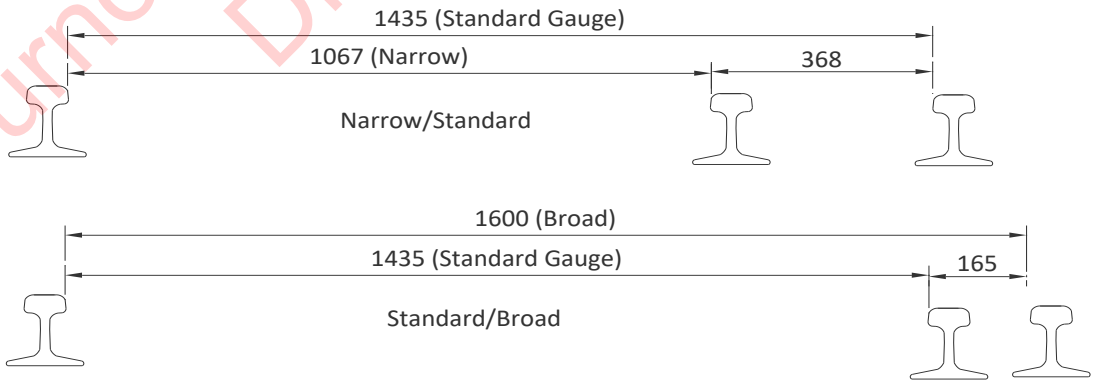
Hazardous event	Publishable consequence / Hazardous event / Publishable precursor
Maintenance vehicle derailment in yard	Points condition (points in wrong position or moving under train, not detectable by signalling/safeworking system)
Maintenance vehicle derailment on running line	Points condition (points in wrong position or moving under maintenance vehicle, not detectable by signalling/safeworking system including point failures)
Non-passenger train derailment in yard	Points condition (points in wrong position or moving under train, not detectable by signalling/safeworking system)
Non-passenger train derailment on running line	Points condition (points in wrong position or moving under train, not detectable by signalling/safeworking system including point failures)
Passenger-train derailment on running line	Points condition (points in wrong position or moving under train, not detectable by signalling/safeworking system including point failures)

Appendix B General layouts

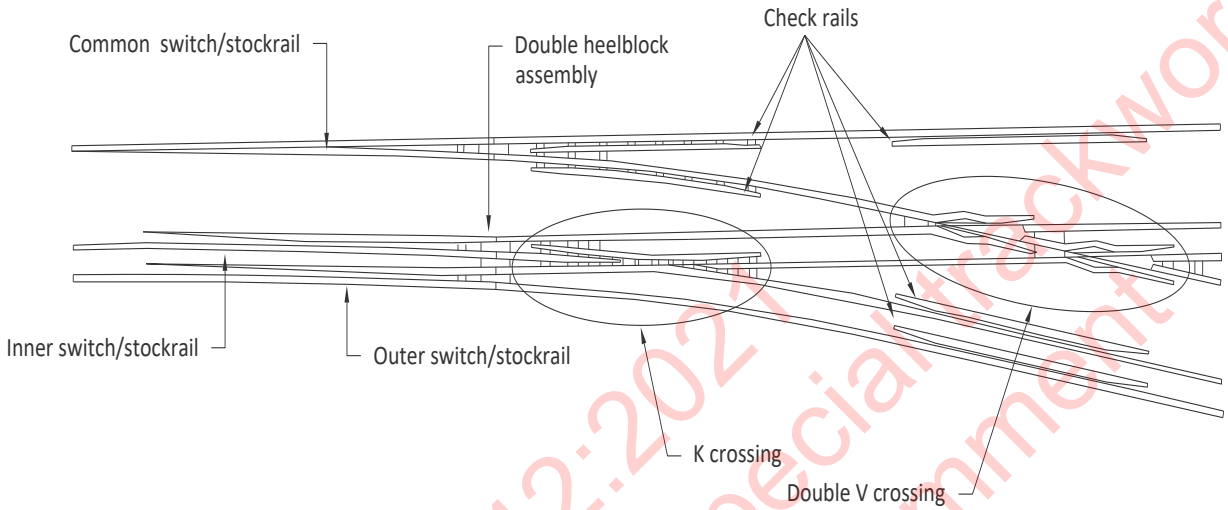
B.1 Example of single gauge turnout arrangement



B.2 Dual gauge cross-sections



B.3 Example of dual gauge turnout arrangement



Appendix C Typical construction tolerances

C.1 Recommended construction acceptance tolerances for turnouts and other special trackwork

Geometry	Limit
Gauge at the switch tips, through turnouts, slips, crossings and in catch points	± 2 mm
Checkrail gap	±1 mm
Checkrail effectiveness	± 2 mm
Switches bearing on baseplates in the closed position	+1 mm – 0 mm
Stockrail supported by rail braces	+1 mm – 0 mm
Lead length of turnouts (Turnout points to crossing theoretical point)	±10 mm
Switches installed square to design	±6 mm
Gap between switch and stockrail in turnouts	< 1 mm
Maximum deviation from throat opening	5 mm
Relative locations of the four crossings in a diamond	±10 mm
Crossing intersection points (Theoretical Point) relative to reference pegs/survey monuments	±10 mm
Gap between the installed switch and the stockrail at expansion switch locations	≤ 0.5 mm
Bearer spacings Cumulative	±2 mm ±10 mm
K Crossing perpendicular offset	±5 mm
V Xing to K Xing (4 dimensions)	±5 mm
Long diagonal	±10 mm
Switch tip opening	As per design

Table C1

The plainline track geometry shall meet the requirements of AS 7635.

The table C1 provides a guide to maximum construction acceptance limits to be applied to geometry tolerances for turnouts and other special trackwork from those specified in the design.

To ensure suitability to the local operating environment, track classification, geometry and engineering practices as constructed tolerances shall be set and approved by the RIM.

Acceptance of any deviation from the rail organisation's construction acceptance tolerances shall be subject to the approval of the RIM.

All component construction tolerances shall be in accordance with the AS 1085.21 design specification or manufacturer's instructions.

RIMS specify the minimum radius for gauge widening.

Appendix D Inspection frequency

D.1 Inspection guideline for critical components in turnouts and other special trackwork

Table D1 provides a guide for recommended inspection frequencies, based on inspection type, traffic task and track classification.

Abbreviations used have the following meaning:

(a) V – Visual inspection (part of scheduled patrol inspections) to assess condition and determine if a response action is required.

(b) M – Inspection by measurement using ruler (as part of a scheduled general inspection where a defect is suspected, or as part of a scheduled detailed inspection) to assess and determine appropriate action response.

(c) G – Inspection by measurement using a gauge (usually as part of a scheduled detailed inspection, but can be as part of a scheduled general inspection) to assess and determine appropriate action response.

(d) T – Track recording vehicle (as part of scheduled detailed inspections) to assess condition and determine where response actions are required.

It is the responsibility of the RIM to establish and implement minimum inspection requirements for turnouts and other special trackwork, which are appropriate to the local operating environment, track classification and traffic task.

All plainline track geometry and inspection requirements shall be established by the RIM and comply with AS 7635 Railway Infrastructure – Track Geometry.

For appropriate assessment response, refer to the guides for switch area and crossing area assessment responses for NG, SG and BG tracks.

Defect/ Irregularity Measurement	Method and Type of Inspection	Inspection Frequency (traffic hauled in million gross tonnes)	Inspection Frequency (all mainlines)	Inspection Frequency (off mainlines, e.g. locations with light traffic and low speeds such as yards, sidings)	Response Action
Switch rail throat opening dimension – back of switch rail to stockrail (junction of heads),	V	> 10 mgt	intervals not exceeding 3 months	intervals not exceeding 12 months	Refer to Guide to Switch Area Assessment Response
		< 10 mgt	intervals not exceeding 6 months		
Swing nose heel opening	M	> 10 mgt	intervals not exceeding 12 months	intervals not exceeding 24 months	
		< 10 mgt	intervals not exceeding 24 months		

Defect/ Irregularity Measurement	Method and Type of Inspection	Inspection Frequency (traffic hauled in million gross tonnes)	Inspection Frequency (all mainlines)	Inspection Frequency (off mainlines, e.g. locations with light traffic and low speeds such as yards, sidings)	Response Action
Switch rail toe/stockrail dimension – open throw Swing Nose	V	> 10 mgt	intervals not exceeding 3 months	intervals not exceeding 12 months	Refer to Guide to Switch Area Assessment Response
		< 10 mgt	intervals not exceeding 6 months		
	M	> 10 mgt	intervals not exceeding 12 months	intervals not exceeding 24 months	
		< 10 mgt	intervals not exceeding 24 months		
Switch rail toe/stockrail dimension – gap closed Swing nose point rail closing	V	> 10 mgt	intervals not exceeding 3 months	intervals not exceeding 12 months	Refer to Guide to Switch Area Assessment Response
		< 10 mgt	intervals not exceeding 6 months		
	M	> 10 mgt	intervals not exceeding 12 months	intervals not exceeding 12 months	
		< 10 mgt	intervals not exceeding 12 months		
Track gauge	V ,M, G	-	Refer AS 7635	Refer AS 7635	Refer AS 7635
Checkrail effectiveness – nominal	V	> 10 mgt	intervals not exceeding 3 months	intervals not exceeding 12 months	Refer to Guide to Crossing Areas Assessment Response
		< 10 mgt	intervals not exceeding 6 months		
	M, G	> 10 mgt	intervals not exceeding 12 months	interval not exceeding 24 months	
		< 10 mgt	intervals not exceeding 24 months		
Crossing nose – vertical wear	V	> 10 mgt	intervals not exceeding 3 months	intervals not exceeding 12 months	Refer to Guide to Crossing

Defect/ Irregularity Measurement	Method and Type of Inspection	Inspection Frequency (traffic hauled in million gross tonnes)	Inspection Frequency (all mainlines)	Inspection Frequency (off mainlines, e.g. locations with light traffic and low speeds such as yards, sidings)	Response Action
		<10 mgt	intervals not exceeding 6 months		Areas Assessment Response
	M, G	> 10 mgt	intervals not exceeding 12 months	intervals not exceeding 24 months	
		< 10 mgt	intervals not exceeding 24 months		
Wing rail – vertical wear	V	> 10 mgt	intervals not exceeding 3 months	intervals not exceeding 12 months	Refer to Guide to Crossing Areas Assessment Response
		< 10 mgt	intervals not exceeding 6 months		
	M, G	> 10 mgt	intervals not exceeding 12 months	intervals not exceeding 24 months	
		< 10 mgt	intervals not exceeding 24 months		
Flangeway clearance	V	> 10 mgt	intervals not exceeding 3 months	intervals not 12 months	Refer to Guide to Crossing Areas Assessment Response
		< 10 mgt	intervals not exceeding 6 months		
	M, G	> 10 mgt	intervals not exceeding 12 months	intervals not 24 months	
		< 10 mgt	intervals not exceeding 24 months		
Flangeway depth	V	> 10 mgt	intervals not exceeding 12 months	intervals not 24 months	Refer to Guide to Crossing Areas Assessment Response
		< 10 mgt	intervals not exceeding 24 months		
	M, G	> 10 mgt	intervals not exceeding 12 months	intervals not 24 months	

Defect/ Irregularity Measurement	Method and Type of Inspection	Inspection Frequency (traffic hauled in million gross tonnes)	Inspection Frequency (all mainlines)	Inspection Frequency (off mainlines, e.g. locations with light traffic and low speeds such as yards, sidings)	Response Action
		< 10 mgt	intervals not exceeding 24 months		
Other track geometry limits	T,M, G	-	Refer AS 7635	Refer AS 7635	Refer AS 7635
Switch/points area	V	> 10 mgt	➢ intervals not exceeding 3 months	intervals not exceeding 12 months	Refer to Guide to Switch Area Assessment Response Refer to Guide to Crossing Area Assessment Response
		< 10 mgt	intervals not exceeding 6 months		
	M, G	> 10 mgt	intervals not exceeding 12 months	intervals not exceeding 24 months	
		< 10 mgt	intervals not exceeding 24 months		
Crossing area	V	> 10 mgt	intervals not exceeding 3 months	intervals not exceeding 12 months	Refer to Guide to Crossing Area Assessment Response
		< 10 mgt	intervals not exceeding 6 months		
	M, G	> 10 mgt	intervals not exceeding 12 months	intervals not 24 months	
		< 10 mgt	intervals not exceeding 24 months		
Operation of manually operated points	Manual Test	-	intervals not exceeding 3 months	intervals not exceeding 3 months	Repair or adjust
Switch rail gauge face angle	M, G	>10 mgt	intervals not exceeding 12 months	intervals not 24 months	Refer to Guide to Switch Area Assessment Response
		<10 mgt	intervals not exceeding 24 months		

Table D1

Appendix E Switch area response

The RIM should implement organisational response actions for critical switch area components that are appropriate to the local operating environment, track classification and traffic task.

All plain line track geometry response actions shall be established by the RIM and comply with AS 7635.

The track gauge at the switch tips applies to tight gauge only. For wide gauge, the points area should be treated as plain track and limits applied in accordance with AS 7635.

A rail safety competent worker should assess various individual defects identified for the effectiveness of the bolts.

Pivot heel cracks and breaks should be assessed by a rail safety competent worker.

When a worn switch at the end of its service life is being replaced a new switch and stockrail set should be used.

“Length of damage” to switch blades also applies to the sum of consecutive areas of damage forming a length greater than the lengths specified in the table.

It is recommended the switch corner radius, when measured with the switch tip gauge, be maintained to 6 mm or greater, particularly where manganese or heat treated materials are used. All new switch and switch sets should be manufactured to meet this recommendation.

Where the gauge face angle limit is exceeded, the action should be to replace the switch and stockrail set.

Component	**Parameter**	**Speed (Freight/Passenger) Limits in km/h**					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action** *(Gauge specific application is indicated by NG/SG/BG respectively)*					
Switch rail throat opening dimension (junction of heads)							
Back of switch rail to stockrail (actual dimension)	40 mm and greater	A7	A7	A7	A7	A7	A7
	35 mm to < 40 mm	A6	A6 NG-A4	A4	A4	A4	A4
	< 35 mm	A1	A1	A1	A1	A1	A1
Switch toe/stockrail gap dimension							
Open throw dimension design from 100mm	95 mm and greater	A7	A7	A7	A7	A7	A7
	85 mm to < 95 mm	A6	A6	A6	A6	A6	A6
	80 mm to < 85 mm	A6	A2	A2	A2	A2	A2
	< 80 mm	A1	A1	A1	A1	A1	A1
Closed (blade gap)	< 1 mm	A7	A7	A7	A7	A7	A7

Component	Parameter	Speed (Freight/Passenger) Limits in km/h					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action** *(Gauge specific application is indicated by NG/SG/BG respectively)*					
	1 mm – 3 mm	A6	A6	A6	A6	A6	A6
	> 3 mm	A6	A2	A2	A2	A2	A2
Track gauge (critical areas)		**Refer to AS 7635**					
Track gauge at the switch tip	Up to 5 mm less than design	A7	A7	A7	A7	A7	A7
	5 mm to 8 mm less than design	A6	A6	A6 NG-A4	A4	A4	A4
	8 mm to 10 mm less than design	A6	A2	A2	A2	A2	A2
	Over 10 mm less than design	A1	A1	A1	A1	A1	A1
Swing Nose Crossing point/wing gap dimension							
Closed (point gap)	< 1 mm	A7	A7	A7	A7	A7	A7
	1 mm – 3 mm	A6	A6	A6	A6	A6	A6
	> 3 mm	A6	A2	A2	A2	A2	A2
Track gauge at practical point	Up to 5 mm less than design	A7	A7	A7	A7	A7	A7
	5 mm to 8 mm less than design	A6	A6	A4	A4	A4	A4
	8 mm to 10 mm less than design	A6	A2	A2	A2	A2	A2
	Over 10 mm less than design	A1	A1	A1	A1	A1	A1
Key Component Condition	**Defect**						
Heel block (fixed only) – see Note 8	Cracked	A6	A6	A6	A6	A5	A5
		A4 for Heavy Haul Freight					
	Broken but still effective	A6	A6	A3	A3	A3	A3
	Missing/broken and ineffective	A1	A1	A1	A1	A1	A1
Rail brace/chair	Cracked/loose	A6	A6	A6	A6	A6	A6
	Broken: 1 only	A6	A6	A6	A6	A6	A6
		A4 for Heavy Haul Freight					

Component	Parameter	Speed (Freight/Passenger) Limits in km/h					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action** *(Gauge specific application is indicated by NG/SG/BG respectively)*					
	Broken: 2 consecutive	A6	A6	A6	A5	A5	A5
		A4 for Heavy Haul Freight					
	Broken: > 2 consecutive	A1	A1	A1	A1	A1	A1
Switch stops (to avoid rail rollover)	Cracked/loose	A6	A6	A6	A6	A6	A6
	Missing: 1 only	A6	A6	A6	A6 NG-A5	A5	A5
	Missing: 2 consecutive	A6	A6	A6	A5	A5	A5
		A4 for Heavy Haul Freight					
	Missing: > 2 consecutive	A1	A1	A1	A1	A1	A1
Ineffective bearers/fasteners (in critical area)	1 only	A6	A6	A6	A6	A6	A6
	2 consecutive	A6	A3	A3	A3	A3	A3
	> 2 consecutive	A1	A1	A1	A1	A1	A1
Bolts (critical areas, i.e., blocks and all joints)	Loose: 1 or more	A6	A6	A6	A6	A6	A6
	Missing/broken: 1 only	A6	A6	A6	A6	A6	A6
	Missing/broken 1 or more	A6	A3	A3	A3	A3	A3
Bolts (critical areas, i.e., spreader bar bracket)	Loose: 1 or more	A6	A6	A6	A6	A6	A6
	Missing/broken: 1 only	A6	A3	A3	A3	A3	A3
	Missing/broken 1 or more	A1	A1	A1	A1	A1	A1
Switch rail / stockrail set (conventional switches only) Note: An alternative action to those specified is to prohibit facing train movements on the relevant leg of the turnout.							
Switch blade toe broken/worn	< 6 mm	A7	A7	A7	A7	A7	A7
	6 mm – 9 mm	A6	A6 NG-A3	A3	A3	A3	A3
	> 9 mm	A1	A1	A1	A1	A1	A1
Switch blade damage (anywhere in the switch	Length of damage < 100 mm	A7	A7	A7	A7	A7	A7

Component	Parameter	Speed (Freight/Passenger) Limits in km/h					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action** *(Gauge specific application is indicated by NG/SG/BG respectively)*					
blade, damage deeper than 19mm from the running surface)	Length of damage 100 mm to < 200 mm	A6	A6	A6	A6	A6	A6
	Length of damage 200mm or greater	A1	A1	A1	A1	A1	A1
Switch width at tip as presented to rolling stock wheel (to include effects of side wear)	< 4 mm	A7	A7	A7	A7	A7	A7
	4 mm to 6 mm	A6	A6	A6	A6	A6	A6
	> 6 mm to 8 mm	A6	A2	A2	A2	A2	A2
	> 8 mm	A1	A1	A1	A1	A1	A1
Stock or switch rail gauge face wear angle at the point of wheel flange/rail contact at the switch tip area (Angle measured from vertical axis)	<18 degrees	A7	A7	A7	A7	A7	A7
	18 deg. to < 26 deg.	A6	A6	A6	A6	A6	A6
	26 degrees or greater	A1	A1	A1	A1	A1	A1
Switch rail angle at any point between 19mm and 30mm below the running surface of the stockrail (Angle measured from the horizontal axis)	<40 degrees	A1	A1	A1	A1	A1	A1
Stockrail gauge face wear where the switch rail contacts the stockrail at gauge point (Side wear)	< 2 mm	A7	A7	A7	A7	A7	A7
	2 mm to < 3 mm	A6	A6	A6	A6	A6	A6
	3 mm or greater	A5	A2	A2	A2	A2	A2
Switch tip height measured at the top of the arc at the switch nose (Distance from stockrail running surface to the top of switch rail)	13 mm and greater	A7	A7	A7	A7	A7	A7
	> 12 mm to < 13 mm	A6	A6	A6	A6	A6	A6
	12 mm or less	A1	A1	A1	A1	A1	A1

Table - E1

The table below provides a guide for recommended response actions and maximum permissible speeds that should be applied in response to conditions found through the inspection of key components in the switch area of turnouts and other special trackwork.

The responses are presented as speeds relating to freight operations (shown first) and passenger operations (shown second) separated by a '/'.

The definition of response codes used in the above table means the following.

Response Code	Description	Supporting Notes
A1	Temporary speed restriction of 10/10 with pilot or immediate repair	Where a speed restriction is applied rectification work should be programmed on a priority basis. If repairs cannot be made prior to the passage of the next train the speed restriction should be implemented, along with an increase in the monitoring until actions are taken to restore the track.
A2	Temporary speed restriction of 20/20 or immediate repair	If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented along with an increase in the monitoring until actions are taken to restore the track.
A3	Temporary speed restriction of 30/30 or immediate repair	If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented along with an increase in the monitoring until actions are taken to restore the track.
A4	Temporary speed restriction of 40/40 or immediate repair	If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented, along with an increase in the monitoring until actions are taken to restore the track.
A5	Temporary speed restriction of 60/65 or immediate repair	If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented along with an increase in the monitoring until actions are taken to restore the track.
A6	Follow-up action to restore track and an appropriate increase in the monitoring	Rectification work should be programmed on a priority basis. Where the assessment responses include increased monitoring, knowledge of local factors that can affect the track deterioration rate and performance history is required. The increased monitoring frequency should be determined by these factors, and the increased monitoring should be continued until rectification work is carried out.
A7	Routine inspection	Routine refers to normal scheduled inspections.

Appendix FGuide to crossing area response

The RIM should implement organisational response actions for critical crossing area components that are appropriate to the local operating environment, track classification and traffic task.

All plainline track geometry response actions shall be established by the RIM and comply with AS 7635

For wide gauge through the crossing critical area, plainline track and limits should be applied in accordance with AS 7635.

The transfer length means the length of transfer from the nose to the end of the heel rail closest to the nose of the crossing.

'Cracked: critical' means cracks longitudinally or vertically which could lead to a piece of crossing eventually lifting or breaking out and affecting the running surface integrity.

The end bolts of all checkrails should be effective.

A rail safety competent worker should assess individual defects identified for the effectiveness of the bolts.

The Table F1 does not apply to wheel flange bearing crossing designs.

Flangeways should be checked for blockages and cleared where blocked.

The main effectiveness of the checkrail is its ability to protect the crossing nose. Wheel contact with the crossing nose is therefore a vital observation for inspections. Any sign of excessive damage to the crossing nose is reason for replacement/adjustment of the checkrail regardless of the checkrail wear.

Component	**Parameter**	**Narrow Gauge (1067 mm) Speed (Freight/Passenger) Limits in km/h**					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action**					
Track gauge (critical areas)		Refer to AS 7635					
Checkrail effectiveness							
	≥ 8 mm	A1	A1	A1	A1	A1	A1
	6 mm to 8 mm	A6	A6	A4	A4	A4	A4
	4 mm to 6 mm	A6	A6	A6	A5	A5	A5
	-3 mm to +4 mm	A7	A7	A7	A7	A7	A7
	-6 mm to -3 mm	A6	A6	A6	A6	A6	A6
	-8 mm to -6 mm	A6	A6	A6	A5	A5	A5
	-10 mm to -8 mm	A6	A6	A4	A4	A4	A4
	< 10 mm	A1	A1	A1	A1	A1	A1
Crossing nose							
	< 5mm	A7	A7	A7	A7	A7	A7

Component	Parameter	Narrow Gauge (1067 mm) Speed (Freight/Passenger) Limits in km/h					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action**					
Vertical wear	5 mm – 10 mm	A6	A6	A6	A6	A6	A6
	> 10 mm	A6	A2	A2	A2	A2	A2
Switch area							
Crossing flangeway width (from 43mm)	<+ 3 mm or <- 3 mm	A7	A7	A7	A7	A7	A7
	3 mm to < 6 mm	A6	A6	A6	A4	A4	A4
	6 mm to 10 mm	A6	A6	A6	A6	A6	A6
	> 10 mm	A1	A1	A1	A1	A1	A1
Flangeway depth (from 43mm)	< 5 mm	A7	A7	A7	A7	A7	A7
	5 mm – 10 mm	A6	A6	A4	A4	A4	A4
	> 10 mm	A6	A2	A2	A2	A2	A2
Key Component Condition	**Defect**						
Nose point	Broken: 15 mm – 20 mm	A6	A6	A6	A6	A6	A6
	Broken: 20 mm – 25 mm	A6	A3	A3	A3	A3	A3
	Broken: > 25 mm width	A1	A1	A1	A1	A1	A1
Ineffective bearers/ fasteners (in critical area)	1 only	A6	A6	A6	A6	A6	A6
	2 consecutive or more	A6	A3	A3	A3	A3	A3
	> 2 consecutive	A1	A1	A1	A1	A1	A1
Cracks in crossings	Non-critical	A7	A7	A7	A7	A6	A6
	Critical	A6	A6	A6	A6	A6	A6
	Fully (not affecting the running surface)	A6	A6	A6	A5	A5	A5
	Fully (affecting the running surface)	A1	A1	A1	A1	A1	A1
Wing rails wear	< 5 mm	A7	A7	A7	A7	A7	A7
	5 mm – 10 mm	A6	A6	A6	A6	A6	A4
	> 10 mm	A6	A2	A2	A2	A2	A2
Spacer blocks	Broken/cracked	A6	A6	A6	A6	A6	A6
Checkrail bolts	Loose ≤ 2	A6	A6	A6	A6	A6	A6
	Missing/ineffective: ≤ 2	A6	A6	A6	A6	A6	A6
		A3 Heavy Haul					
	Missing/ineffective: 3	A6	A6	A6	A4	A4	A4
		A3 Heavy Haul					
	Missing/ineffective: > 3	A6	A2	A2	A2	A2	A2
Checkrail bolts	Missing/ineffective: ≤ 2	A6	A6	A6	A6	A6	A6
	Missing/ineffective: > 2	A6	A2	A2	A2	A2	A2

Component	Parameter	Standard Gauge (1435mm) Speed (Freight/Passenger) Limits in km/h					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action**					
Track gauge (critical areas)		Refer to AS 7635					
Checkrail effectiveness							
	≥ 8 mm	A1	A1	A1	A1	A1	A1
	6 mm to 8 mm	A6	A6	A4	A4	A4	A4
	4 mm to 6 mm	A6	A6	A6	A5	A5	A5
	-3 mm to +4 mm	A7	A7	A7	A7	A7	A7
	-6 mm to -3 mm	A6	A6	A6	A6	A6	A6
	-8 mm to -6 mm	A6	A6	A6	A5	A5	A5
	-10 mm to -8 mm	A6	A6	A4	A4	A4	A4
	< 10 mm	A1	A1	A1	A1	A1	A1
Crossing nose							
Vertical wear	< 5 mm	A7	A7	A7	A7	A7	A7
	5 mm – 10mm	A6	A6	A6	A6	A6	A6
	> 10 mm	A6	A2	A2	A2	A2	A2
Switch area							
Crossing flangeway width (from 43mm)	<+3 mm or <-3 mm	A7	A7	A7	A7	A7	A7
	3 mm to < 6 mm	A6	A6	A6	A4	A4	A4
	6 mm to 10 mm	A6	A6	A6	A6	A6	A6
	> 10 mm	A1	A1	A1	A1	A1	A1
Flangeway depth (from 43mm)	< 5 mm	A7	A7	A7	A7	A7	A7
	5 mm – 10 mm	A6	A6	A6	A4	A4	A4
	> 10 mm	A6	A2	A2	A2	A2	A2
Key Component Condition	**Defect**						
Nose point	Broken: 15 mm – 20 mm	A6	A6	A6	A6	A6	A6
	Broken: 20 mm – 25 mm	A6	A3	A3	A3	A3	A3
	Broken: > 25 mm width	A1	A1	A1	A1	A1	A1
Ineffective bearers/ fasteners (in critical area)	1 only	A6	A6	A6	A6	A6	A6
	2 consecutive or more	A6	A3	A3	A3	A3	A3
	> 2 consecutive	A1	A1	A1	A1	A1	A1
Cracks in crossings	Non-critical	A7	A7	A7	A7	A6	A6
	Critical	A6	A6	A6	A6	A6	A6
	Fully (not affecting the running surface)	A6	A6	A6	A5	A5	A5
	Fully (affecting the running surface)	A1	A1	A1	A1	A1	A1
Wing rails Wear	< 5 mm	A7	A7	A7	A7	A7	A7
	5 mm -10 mm	A6	A6	A6	A6	A6	A6

Component	Parameter	Standard Gauge (1435mm) Speed (Freight/Passenger) Limits in km/h					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action**					
	> 10 mm	A6	A2	A2	A2	A2	A2
Spacer blocks	Broken/cracked	A6	A6	A6	A6	A6	A6
Checkrail bolts	Loose ≤ 2	A6	A6	A6	A6	A6	A6
	Missing/ineffective: ≤ 2	A6	A6	A6	A6	A6	A6
		A3 Heavy Haul					
	Missing/ineffective: 3	A6	A6	A6	A4	A4	A4
		A3 Heavy Haul					
	Missing/ineffective: > 3	A6	A2	A2	A2	A2	A2
Checkrail bolts	Missing/ineffective: ≤ 2	A6	A6	A6	A6	A6	A6
	Missing/ineffective: > 2	A6	A2	A2	A2	A2	A2

Component	Parameter	Broad Gauge (1600mm) speed (Freight/Passenger) Limits in km/h					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action**					
Track gauge (critical areas)		Refer to AS 7635					
Checkrail effectiveness							
	≥ 8 mm	A1	A1	A1	A1	A1	A1
	6 mm to 8 mm	A6	A6	A4	A4	A4	A4
	4 mm to 6 mm	A6	A6	A6	A5	A5	A5
	-3 mm to +4 mm	A7	A7	A7	A7	A7	A7
	-6 mm to –3 mm	A6	A6	A6	A6	A6	A6
	-8 mm to –6 mm	A6	A6	A6	A5	A5	A5
	-10 mm to –8 mm	A6	A6	A4	A4	A4	A4
	< 10 mm	A1	A1	A1	A1	A1	A1
Crossing nose							
Vertical wear	< 5 mm	A7	A7	A7	A7	A7	A7
	5 mm – 10 mm	A6	A6	A6	A6	A6	A6
	> 10 mm	A6	A2	A2	A2	A2	A2
Switch area							
Crossing flangeway width (from 43mm)	<+ 3 mm or <- 3 mm	A7	A7	A7	A7	A7	A7
	3 mm to < 6 mm	A6	A6	A6	A4	A4	A4
	6 mm to 10 mm	A6	A6	A6	A6	A6	A6
	> 10 mm	A1	A1	A1	A1	A1	A1

Component	Parameter	Broad Gauge (1600mm) speed (Freight/Passenger) Limits in km/h					
		20/20	40/40	60/65	80/90	100/115	115+
Critical Dimensions	**Dimension Limit from Design**	**Response Action**					
Flangeway depth (from 43 mm)	< 5 mm	A7	A7	A7	A7	A7	A7
	5 mm – 10 mm	A6	A6	A6	A4	A4	A4
	> 10 mm	A6	A2	A2	A2	A2	A2
Key Component Condition	**Defect**						
Nose point	Broken: 15 mm – 20 mm	A6	A6	A6	A6	A6	A6
	Broken: 20 mm – 25 mm	A6	A6	A3	A3	A3	A3
	Broken: > 25 mm width	A1	A1	A1	A1	A1	A1
Ineffective bearers/ fasteners (in critical area)	1 only	A6	A6	A6	A6	A6	A6
	2 consecutive or more	A6	A6	A3	A3	A3	A3
	> 2 consecutive	A1	A1	A1	A1	A1	A1
Cracks in crossings	Non-critical	A7	A7	A7	A7	A6	A6
	Critical	A6	A6	A6	A6	A6	A6
	Fully (not affecting the running surface)	A6	A6	A6	A5	A5	A5
	Fully (affecting the running surface)	A1	A1	A1	A1	A1	A1
Wing rails wear	< 5 mm	A7	A7	A7	A7	A7	A7
	5 mm - 10 mm	A6	A6	A6	A6	A6	A6
	➢ 10 mm	A6	A2	A2	A2	A2	A2
Spacer blocks	Broken/cracked	A6	A6	A6	A6	A6	A6
Checkrail bolts	Loose ≤ 2	A6	A6	A6	A6	A6	A6
	Missing/ineffective: ≤ 2	A6	A6	A6	A6	A6	A6
		A3 Heavy Haul					
	Missing/ineffective: 3	A6	A6	A6	A4	A4	A4
		A3 Heavy Haul					
	Missing/ineffective: > 3	A6	A2	A2	A2	A2	A2
Checkrail bolts	Missing/ineffective: ≤ 2	A6	A6	A6	A6	A6	A6
	Missing/ineffective: > 2	A6	A2	A2	A2	A2	A2

Table F1

The below table provides a guide for recommended response actions and maximum permissible speeds that should be applied in response to conditions found through the inspection of key components in the crossing area of turnouts and other special trackwork.

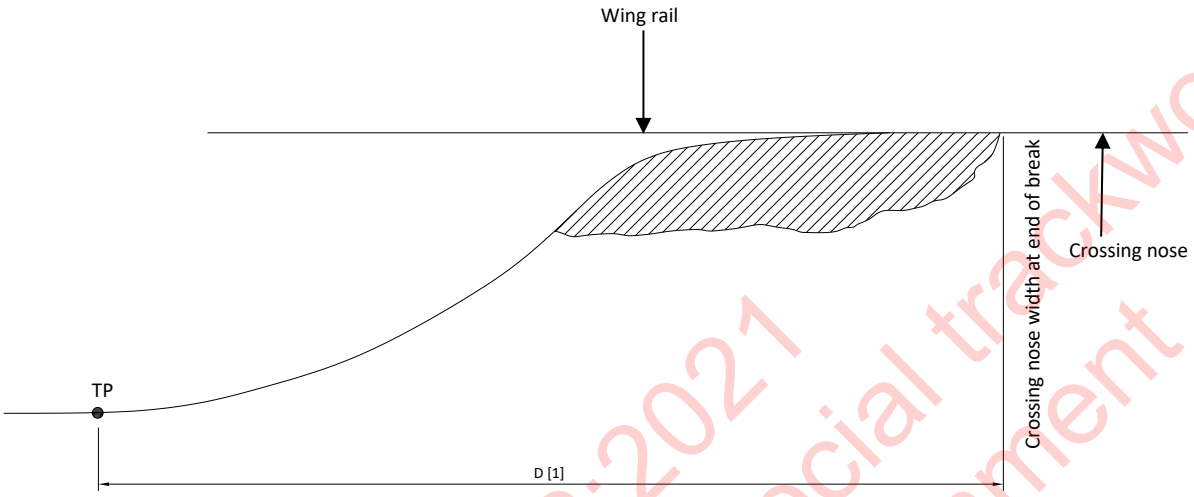
The responses are presented as speeds relating to freight operations (shown first) and passenger operations (shown second) separated by a '/'.

The definition of response codes used above means the following.

Response Code	Description	Supporting Notes
A1	Temporary speed restriction of 10/10 with pilot or immediate repair	Where a speed restriction is applied, rectification work should be programmed on a priority basis. If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented along with an increase in the monitoring until actions are taken to restore the track.
A2	Temporary speed restriction of 20/20 or immediate repair	If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented along with an increase in the monitoring until actions are taken to restore the track.
A3	Temporary speed restriction of 30/30 or immediate repair	If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented along with an increase in the monitoring until actions are taken to restore the track.
A4	Temporary speed restriction of 40/40 or immediate repair	If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented along with an increase in the monitoring until actions are taken to restore the track.
A5	Temporary speed restriction of 60/65 or immediate repair	If repairs cannot be made prior to the passage of the next train, the speed restriction should be implemented along with an increase in the monitoring until actions are taken to restore the track.
A6	Follow-up action to restore track and an appropriate increase in the monitoring	Rectification work should be programmed on a priority basis. Where the assessment responses include increased monitoring, knowledge of local factors that could affect the track deterioration rate and performance history is required. The increased monitoring frequency should be determined by these factors, and the increased monitoring should be continued until rectification work is carried out.
A7	Routine inspection	Routine refers to normal scheduled inspections.

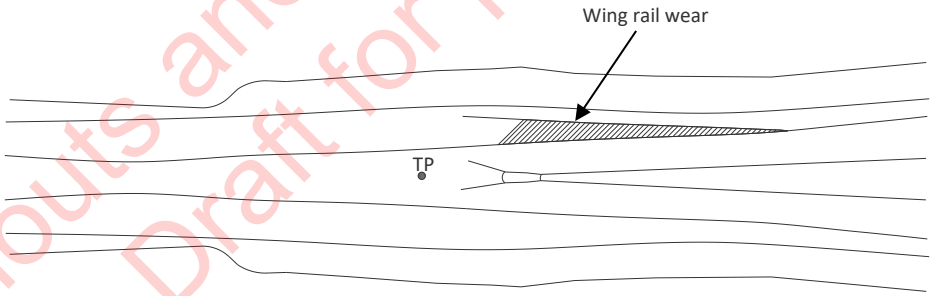
Appendix G Typical defects

G.1 Measurement of nose breaks

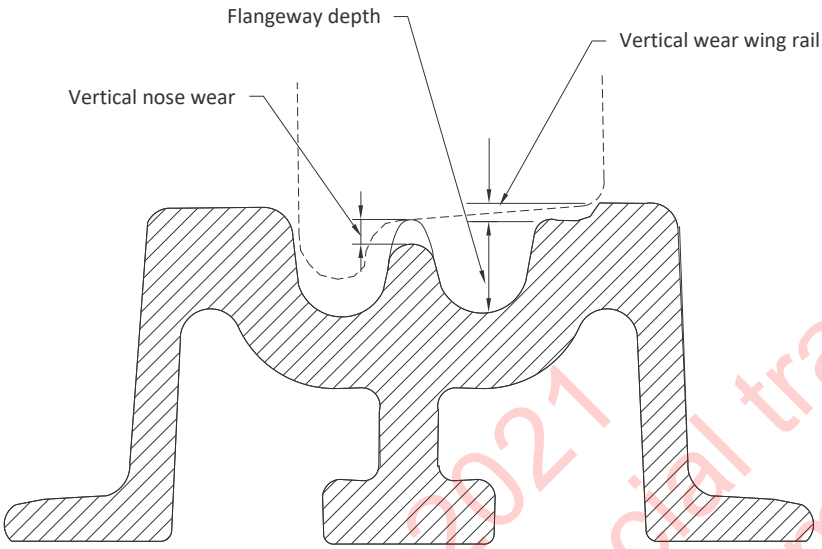


Note: *The distance (D) from the Theoretical Point (VP) is defined as follows:*
D = (width of the break gauge line) x (crossing angle)
Eg: D = 128 for a 16mm wide break on a 1 in 8 crossing.

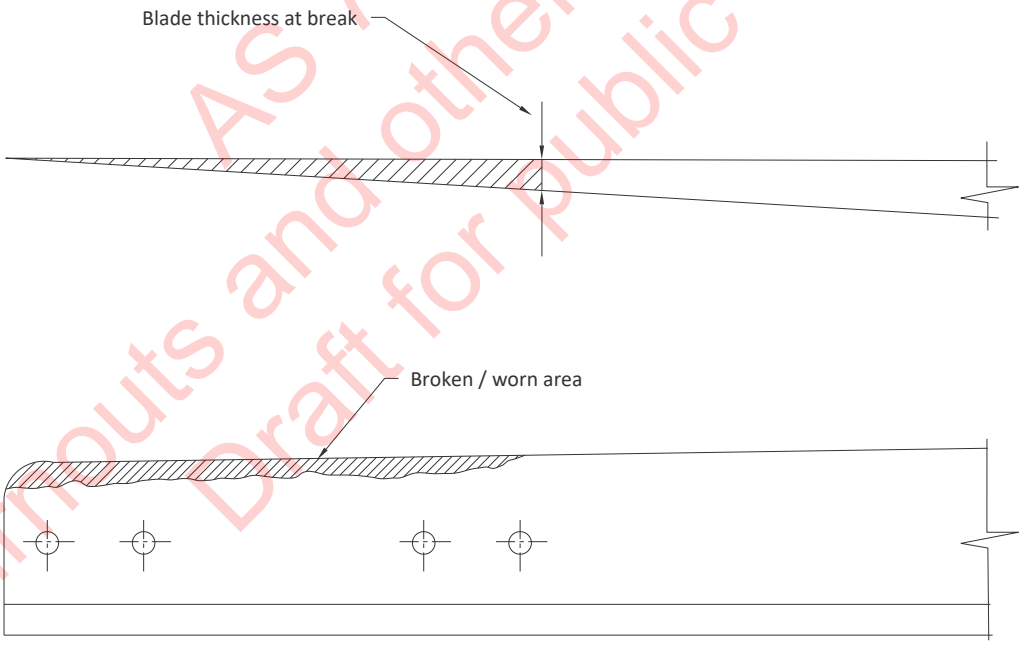
G.2 Crossing nose measurements (a)



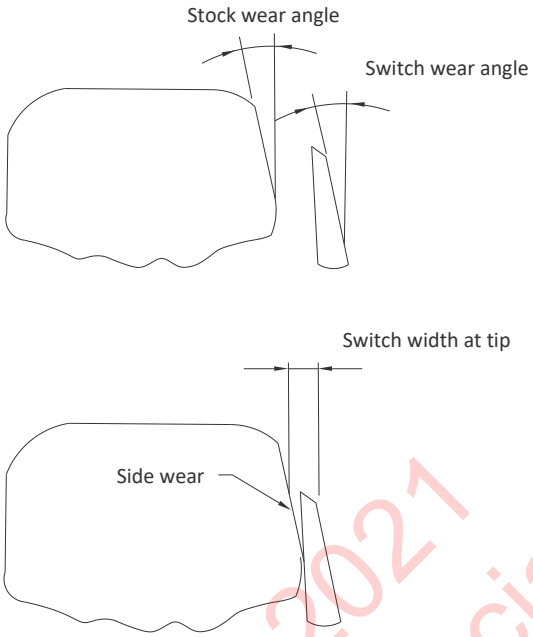
G.3 Crossing nose measurements (b)



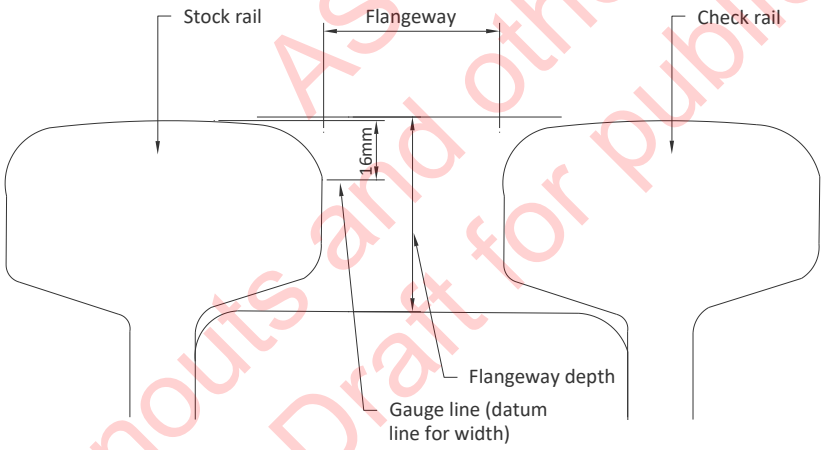
G.4 Measurements in switch blade breaks



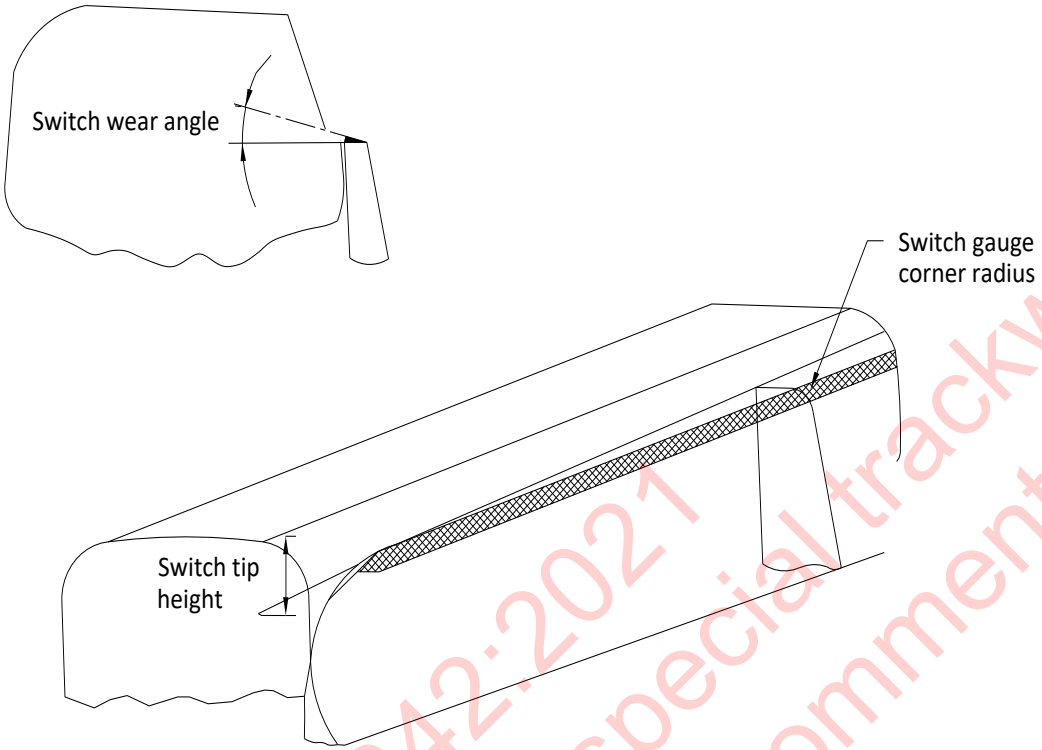
G.5 Measurements in switch blade breaks



G.6 Flangeway depth and clearance diagram



G.7 Measurement of switch component parameters



Appendix H Typical maintenance limits

H.1 Guide to maintenance acceptance limits (manual re-gauging or component renewal)

The below tables are a guide for recommended maintenance acceptance limits for manual regauging or component renewal in turnouts and other special trackwork structures.

All maintenance limits shall be reviewed, risk assessed and set by the RIM to ensure suitability to the local operating environment, track classification and engineering practices.

All plainline track geometry maintenance limits shall be established by the RIM and comply with AS 7635.

Acceptance of any deviation from the rail organisation's allowable tolerances shall be subject to the approval of the RIM.

Plain Track Geometry
The maintenance limits for finished track geometry shall comply with plain track geometry requirements defined in AS 7635, with the following additional requirements for turnouts and other special trackwork.

Turnouts
For non-interlocked points the clearance between the back of an open switch point and the gauge of the running stockrail should comply with the design +4 mm, -2 mm. House switches should conform to the design ±1mm of the specified parameters. If the maintenance activity includes longitudinal movement of any crossing, the resulting position of the crossing intersection point (Theoretical Point) should be within 15 mm of the position defined by reference pegs or survey monuments.

Turnout Limits	V Crossing	K Crossing
Flangeway depth (mm)	38 mm min, 45 mm max	38 mm min, 45 mm max
Crossing flangeway width (mm)	42 mm +4 mm, -2 mm	42 mm +4 mm, -2 mm
Checkrail flangeway width (mm)	42 mm +4 mm, -2 mm	N/A
Gauge (mm)	nominal (Narrow, Standard, Broad) gauge +2mm, -4mm	nominal (Narrow, Standard, Broad) gauge +2 mm, -4 mm
Checkrail effectiveness limits (mm)	+4 mm, -3 mm	+4 mm, -3 mm

Diamond Crossings
If maintenance activity includes longitudinal movement of any crossing, the resulting position of the crossing intersection point (Theoretical Point) should be within 15 mm of the position defined by the reference pegs or survey monuments.

Slips

For non-interlocked switches/points, the clearance between the back of an open switch point and the gauge of the running stockrail should conform to the design +2 mm, -4 mm.

If the maintenance activity includes longitudinal movement of any crossing, the resulting position of the crossing intersection point (Theoretical Point) should be within 15 mm of the position defined by reference pegs of survey monuments.

Catch points

For non-interlocked points, the clearance between the back of the switch point and the gauge of the running stockrail shall conform to the design +2 mm, -4 mm.

Switches

Repair of switches by wire feed welding is prohibited. Switch profile and condition should only be repaired by grinding.

Switch Tip Limits	Standard	Heavy duty	Undercut	Asymmetric
Switch tip radius	≥ 13 mm	≥ 13 mm	NA	NA
Switch angle (to vertical)	≤ 18^0 (3:1)	18^0 (3:1)	-	-
Switch tip height (below top of rail)	≥ 13 mm	≥ 13 mm	≥ 1 mm below the top of the undercut	-
Switch tip width (at top of switch)	≤ 4 mm	The whole of the switch tip should sit within the gauge line of the joggled stockrail	The top of the switch tip shall sit within the face of the stockrail	
			No part of the running surface of the switch blade, between 17mm and 30mm from the head of the rail, is to form a plane at an angle of less than 40^0 to the horizontal.	

Crossings and Wing Rails

Repair to crossings and wing rails by wire-feed welding is an approved repair method. Repair components should meet the design profile and tolerances of the component being repaired.

Appendix I Bibliography

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

(a) AS 1110: ISO Metric Hexagon Precision Bolts and Screws

(b) AS 1111: ISO Metric Hexagon Commercial Bolts and Screws

(c) AS 1112: ISO Metric Hexagon Bolts

(d) AS 1252: High-strength Steel Bolts with Associated Nuts, Headlocks and Washers for Structural Engineering

(e) AS 1275: Metric Screw Threads for Fasteners

(f) AS 1442: Carbon Steels and Carbon Manganese Steels – Forgings

(g) AS 1554: Structural Steel Welding

(h) AS 1816: Metallic Material – Brinell Hardness Test

(i) AS 1830: Grey Cast Iron

(j) AS 1831: Ductile Cast Iron

(k) AS 1832: Malleable Cast Iron

(l) AS 2074: Cast Steels

(m) AS 3678 / AS 3679.1: Structural Steel (Rolled Steel Sections, including Bar for Rivets)

(n) AS 3834: Quality Requirements for Welding – Fusion Welding of Metallic Materials

(o) AS 7639: Railway Infrastructure – Track Structures & Support

(p) AS 7640: Railway Infrastructure – Rail Management (All Parts)

(q) AS 7641: Railway Infrastructure – Guardrails and Check Rails

(r) AS 7643: Railway Infrastructure – Track Stability

(s) AS 7646: Railway Infrastructure – Trackside Equipment.

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For information regarding the development of Australian Standards developed by RISSB contact:

Rail Industry Safety and Standards Board

PO Box 518
Spring Hill, QLD, 4004

T +61 7 3724 000
E Info@rissb.com.au

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