

AS 7642: 2013



RAIL INDUSTRY SAFETY AND STANDARDS BOARD

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Australian Railway Infrastructure

Accredited Australian Standards
Development Organisation

AS 7642 Turnouts and Other Special Trackwork

STANDARD



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This Australian Railway Standard AS 7642 was prepared by the RISSB *Turnouts Development Group*. It was signed off by the RISSB *Turnouts Development Group* and *Infrastructure Standing committee* in May 2013 and subsequently by the Development Advisory Board (DAB) in June 2013. The DAB confirmed that the process used to develop the standard was in accordance with the RISSB accredited development process. On the 05th June 2013 the RISSB Board approved the Standard for release. This Standard was published on the RISSB website (www.rissb.com.au) on the 15th August 2013.



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Australian Railway Infrastructure – Turnouts and Other Special Trackwork

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Contents

1	PREFACE	1
1	INTRODUCTION	2
1.1	DISCLAIMER	2
1.2	DOCUMENT CONTROL	2
1.3	CONTENT	3
1.4	PURPOSE: AS7642 TURNOUTS AND SPECIAL TRACKWORK	4
1.5	SCOPE	5
1.6	EXCLUSIONS	6
1.7	COMPLIANCE	6
1.8	REFERENCED DOCUMENTS	6
1.9	DEFINITIONS	7
2	GENERAL REQUIREMENTS FOR THE MANAGEMENT OF RAILWAY TURNOUTS AND OTHER SPECIAL TRACKWORK	8
2.1	GENERAL	8
2.2	COMPETENCY MANAGEMENT	8
2.3	INTERFACE COORDINATION	8
2.4	DOCUMENTATION AND RECORD MANAGEMENT	9
3	DESIGN AND RATING REQUIREMENTS	9
3.1	FUNCTION	9
3.2	COMPONENT DESCRIPTION AND ASSEMBLY	10
3.3	DESIGN SPECIFICATION	13
3.4	DESIGN AND RATING REQUIREMENTS	14
3.5	DESIRABLE CONFIGURATIONS	17
3.6	UNDESIRABLE CONFIGURATIONS	17
3.7	DOCUMENTATION REQUIREMENTS	18
4	MANUFACTURE AND SUPPLY REQUIREMENTS	18
4.1	GENERAL	18
4.2	USE OF SERVICEABLE RAIL IN TURNOUTS AND OTHER SPECIAL TRACKWORK	18
4.3	MARKING OF COMPONENTS	19
4.4	PRODUCT TESTING AND ACCEPTANCE	19
4.5	COMPONENT ASSEMBLY AND INSPECTION	19
4.6	PREPARATION FOR DISPATCH	20
4.7	DOCUMENTATION REQUIREMENTS	20
5	CONSTRUCTION AND COMMISSIONING REQUIREMENTS	20
5.1	CONSTRUCTION	20
5.2	COMMISSIONING	24
5.3	DOCUMENTATION REQUIREMENTS	24

6	MONITORING AND MAINTENANCE REQUIREMENTS	25
6.1	INSPECTION AND ASSESSMENT.....	25
6.2	MAINTENANCE TOLERANCES	30
6.3	DOCUMENTATION REQUIREMENTS.....	31
7	DECOMMISSIONING AND DISPOSAL REQUIREMENTS.....	32
7.1	CATEGORISING RELEASED MATERIALS.....	32

Appendix Contents

A	DEFINITIONS.....	33
B	GENERAL LAYOUTS	40
B.1	Example of Single Gauge Turnout Structure Showing Points Area and Crossing Area 40	
B.2	Standard/Narrow and Broad/Standard Dual Gauge Cross-sections	40
B.3	Example of Dual Gauge Turnout Structure showing points area and crossing area	41
C	GENERAL DESIGN GUIDE	42
D	LH TURNOUT	43
D.1	Example Standard Turnout Configuration	43
E	TURNOUT DESIGN RATING	44
E.1	Guide for Design Parameters in Narrow Gauge Turnouts.....	44
E.2	Guide for Design Parameters in Standard Gauge Turnouts.....	44
E.3	Guide for Design Parameters in Broad Gauge Turnouts.....	45
F	SG CTO CONFIGURATION EXAMPLES	46
G	SG TTO CONFIGURATION EXAMPLES	47
H	SWITCH AREA DEFINITIONS.....	48
I	STRAIGHT AND CURVED SWITCH	49
I.1	Straight Switch Configuration (Flexible 53kgs).....	49
I.2	Straight Switch Configuration (6100, 9150 Flexible).....	50
J	FLEXIBLE AND HEELED SWITCH	51
J.1	Flexible Switch Turnout Diagram.....	51
J.2	Heeled Switch Turnout Diagram.....	52
K	CROSSING TYPE DIAGRAMS.....	53
K.1	Diamond Crossing Configuration.....	53
K.2	Dual Gauge Diamond Configuration.....	54
K.3	K Crossing Configuration.....	54
K.4	Fabricated K Crossing	55
K.5	Solid Cast Manganese K Crossing Example	55

K.6	Rail Bound Manganese V Crossing Example.....	55
K.7	Compound Manganese Crossing Example	56
K.8	Fabricated Swing Nose Crossing Example	56
L	CROSSING TYPES	57
M	DIAMOND SPEED	58
N	SLIPS	59
N.1	Single Slip Configurations.....	59
N.2	Double Slip Configurations	59
O	TYPICAL CATCH POINT CONFIGURATION	60
P	CATCH POINT LOCATIONS	61
Q	EXPANSION SWITCH DIAGRAM	62
R	CONSTRUCTION TOLERANCES	63
S	BEARERS AND FASTENINGS.....	64
T	INSPECTION FREQUENCY	65
U	SWITCH AREA RESPONSE	68
V	GUIDE TO CROSSING AREA RESPONSE	79
W	TYPICAL DEFECTS.....	86
W.1	Measurement of Nose Breaks	86
W.2	Crossing Nose Measurements (a).....	86
W.3	Crossing Nose Measurements (b).....	87
W.4	Measurements in Switch Blade Breaks	87
W.5	Measurements in Switch Blade Breaks	88
W.6	Flangeway Depth and Clearance Diagram.....	88
W.7	Measurement of Switch Component Parameters	89
X	MAINTENANCE LIMITS.....	90

1 PREFACE

The aim 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 for a range of operational track gauges used in Australia.

For the purposes of this Standard, all clauses containing the term 'shall' are considered mandatory requirements, all clauses containing the term 'should' are considered recommendations, and all other clauses are explanatory statements. This Standard also highlights recommended and mandatory sections with (R) and (M) respectively alongside the paragraph number.

All RISSB standards provide controls for hazards contained in RISSB's hazard guideline. In this particular standard, the reference number of the hazard being addressed is identified in brackets at the end of each sentence (where appropriate). RISSB's hazard guideline can be found on the RISSB website at www.rissb.com.au.

1 INTRODUCTION

1.1 DISCLAIMER

- 1.1.1** This Rail Industry Safety and Standards Board (RISSB) Australian Standard on Turnouts and Other Special Trackwork has been drafted for use by rail organisations and the rail industry in Australia.
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- 1.1.10** Responsibility rests with the rail organisation to ensure that all aspects of the standard are safe.
- 1.1.11** ©Rail Industry Safety and Standards Board

1.2 DOCUMENT CONTROL

1.2.1 Identification

- 1.2.1.1** Document title: Railway Infrastructure – Turnouts and Other Special Trackwork
- 1.2.1.2** Number: AS 7642
- 1.2.1.3** Version: 1 for Publication
- 1.2.1.4** Publication date:

1.2.2 Preparation and Approval

- 1.2.2.1** Prepared by: CMT Solutions Pty Ltd and Evans & Peck Pty Ltd
- 1.2.2.2** RISSB Board approval date: 5 June 2013

1.2.3 Distribution and Change

1.2.3.1 The current version of this Standard is available from the RISSB website at www.rissb.com.au.

1.2.3.2 RISSB standards are subject to review at a period not exceeding five years from their date of publication.

1.2.4 Document History

1.2.4.1 Previous Published Versions

1. None.

1.3 CONTENT

1.3.1 Table of Contents

1. INTRODUCTION

1.1 DISCLAIMER

1.2 DOCUMENT CONTROL

1.3 CONTENT

1.4 PURPOSE

1.5 SCOPE

1.6 EXCLUSIONS

1.7 COMPLIANCE

1.8 REFERENCED DOCUMENTS

1.9 DEFINITIONS

2. GENERAL REQUIREMENTS FOR THE MANAGEMENT OF RAILWAY TURNOUTS AND OTHER SPECIAL TRACKWORK

2.1 GENERAL

2.2 COMPETENCY MANAGEMENT

2.3 INTERFACE COORDINATION

2.4 DOCUMENTATION AND RECORD MANAGEMENT

3. DESIGN AND RATING REQUIREMENTS

3.1 FUNCTION

3.2 COMPONENT DESCRIPTION AND ASSEMBLY

3.3 DESIGN SPECIFICATION

3.4 DESIGN AND RATING REQUIREMENTS

3.5 DESIRABLE CONFIGURATIONS

3.6 UNDESIRABLE CONFIGURATIONS

3.7 DOCUMENTATION REQUIREMENTS

4. MANUFACTURE AND SUPPLY REQUIREMENTS

- 4.1 GENERAL
- 4.2 USE OF SERVICEABLE RAIL IN TURNOUTS AND OTHER SPECIAL TRACKWORK
- 4.3 MARKING OF COMPONENTS
- 4.4 PRODUCT TESTING AND ACCEPTANCE
- 4.5 COMPONENT ASSEMBLY AND INSPECTION
- 4.6 PREPARATION FOR DISPATCH
- 4.7 DOCUMENTATION REQUIREMENTS
- 5. CONSTRUCTION AND COMMISSIONING REQUIREMENTS
 - 5.1 CONSTRUCTION
 - 5.2 COMMISSIONING
 - 5.3 DOCUMENTATION REQUIREMENTS
- 6. MONITORING AND MAINTENANCE REQUIREMENTS
 - 6.1 INSPECTION AND ASSESSMENT
 - 6.2 MAINTENANCE TOLERANCES
 - 6.3 DOCUMENTATION REQUIREMENTS
- 7. DECOMMISSIONING AND DISPOSAL REQUIREMENTS
 - 7.1 CATEGORISING RELEASED MATERIALS

1.3.2 Document Layout

- 1.3.2.1** The section and clause numbers provide a unique identifier for each sentence, recommendation or mandatory item in the document (e.g. this is sentence 1.3.2.1).
- 1.3.2.2** Mandatory items are identified with the symbol **(M)** at the left hand side of the text and highlighted with the colour used here.
- 1.3.2.3** Recommendations are identified with the symbol **(R)** at the left hand side of the text, but in this case no highlighting is used.
- 1.3.2.4** Supporting information given in this document is given in plain text (e.g. as this sentence) and is not identified by either an **(M)** or **(R)**.
- 1.3.2.5** The numbers in parentheses at the end of a particular clause show the hazard number, taken from Track and Civil Hazard Trees, for the hazard(s) being controlled by each requirement.

1.4 PURPOSE: AS7642 TURNOUTS AND SPECIAL TRACKWORK

- 1.4.1** The objective of this Standard is to provide the Australian rail industry with a set of mandatory and recommended requirements for the general management, design, supply, installation, maintenance, disposal and decommissioning of turnouts and other special trackwork, in order to promote a consistent treatment.
- 1.4.2** This Standard is intended to:
 - (a) provide a uniform basis for compliance with rail safety and occupational health and safety legislation in each state or territory

- (b) provide a uniform basis for the lifecycle management of turnouts and other special trackwork
- (c) be able to cover differing rail operations across Australia
- (d) identify the risk (hazards) being controlled.

1.5 SCOPE

- 1.5.1** This Standard covers rail networks classified in AS 7630, with the exception of high speed passenger (HSP) lines.
- 1.5.2** This Standard is not specifically intended to cover urban on-street tramway or light rail networks, cane railways, or heritage railways operating on private reservation, but items from this Standard may be applied to such systems as deemed appropriate by the relevant Railway Infrastructure Manager.
- 1.5.3** This Standard is not intended for use in the design and operation of HSP lines, monorail networks, or miniature or amusement park railways.
- 1.5.4** The document adopts a whole-of-life approach to the management of turnouts and other special trackwork, which includes design, supply, construction, maintenance, decommissioning and disposal, for a range of operational track gauges used in Australia.
- 1.5.5** This Standard addresses the following track gauges, as measured between the running faces of the rails at a point 16mm below the rail head:
 - (a) narrow gauge of 1067mm (3' 6")
 - (b) standard gauge of 1435mm (4' 8 1/2")
 - (c) broad gauge of 1600mm (5' 3")
 - (d) dual gauge assemblies which incorporate two gauges (i.e. 1067mm (3'6") with 1435mm (4' 8 1/2"), and 1435mm (4' 8 1/2") with 1600mm (5'3").
- 1.5.6** This Standard provides the minimum requirements for the life cycle management of turnouts and other special trackwork, but is not intended to supplant higher performance standards based on local experience and good engineering practice, which may be contained in relevant codes, guidelines and procedures of individual rail organisations.
- 1.5.7** The elements of turnouts and other special trackwork components addressed in this Standard include:
 - (a) turnouts
 - (b) crossings
 - (c) catch points
 - (d) switch and switch points
 - (e) stock rails
 - (f) check rails
 - (g) closure or lead rails
 - (h) turnout rails
 - (i) flange bearing ramps
 - (j) plates, fasteners and rail joints
 - (k) special or transition bearers/sleepers
 - (l) manually operated point lever equipment.

1.6 EXCLUSIONS

1.6.1 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.

1.6.2 These exclusions (1.6.1) are addressed through other Australian standards.

1.7 COMPLIANCE

1.7.1 There are two types of controls contained within the RISSB Australian Infrastructure Standards: 1. mandatory **(M)** requirements; and 2. recommended **(R)** requirements.

1.7.2 Both of these types of controls address hazards that are deemed to require controls on the basis of existing Australian and international infrastructure practices and standards.

1.7.3 A mandatory requirement is a requirement that the Standard recognises as the only way of treating the hazard.

1.7.4 A recommended requirement is one where the Standard recognises that there are limitations to the universal application of the requirement, and that there may be circumstances where the control cannot be applied or where other controls may be more appropriate or satisfactory, subject to agreement with the Railway Infrastructure Manager.

1.7.5 Recommended requirements in this Standard are considered when compliance to the standards is being assessed.

1.8 REFERENCED DOCUMENTS

1.8.1 Referenced Australian standards shall mean the current edition of the Standard, including any amendments.

1.8.2 The following are applicable to the design, supply, construction, maintenance and management of railway turnouts and other special trackwork:

- (a) AS 1085 series: Railway Track Materials, including Steel Rails, Fishplates, Sleeper Plates, Fishbolts, Washers, Turnouts, Switches and Crossings
- (b) AS 1110: ISO Metric Hexagon Precision Bolts and Screws
- (c) AS 1111: ISO Metric Hexagon Commercial Bolts and Screws
- (d) AS 1112: ISO Metric Hexagon Bolts
- (e) AS 1252: High-strength Steel Bolts with Associated Nuts, Headlocks and Washers for Structural Engineering
- (f) AS 1275: Metric Screw Threads for Fasteners
- (g) AS 1442: Carbon Steels and Carbon Manganese Steels – Forgings
- (h) AS 1554: Structural Steel Welding
- (i) AS 1816: Metallic Material – Brinell Hardness Test
- (j) AS 1830: Grey Cast Iron
- (k) AS 1831: Ductile Cast Iron
- (l) AS 1832: Malleable Cast Iron

- (m) AS 2074: Cast Steels
- (n) AS 3678 / AS 3679.1: Structural Steel (Rolled Steel Sections, including Bar for Rivets)
- (o) AS 3834: Quality Requirements for Welding – Fusion Welding of Metallic Materials
- (p) AS 7630: Railway Infrastructure – Track Classification
- (q) AS 7635: Railway Infrastructure – Track Geometry
- (r) AS 7639: Railway Infrastructure – Track Structures & Support
- (s) AS 7640: Railway Infrastructure – Rail Management (All Parts)
- (t) AS 7641: Railway Infrastructure – Guardrails and Check Rails
- (u) AS 7643: Railway Infrastructure – Track Stability
- (v) AS 7646: Railway Infrastructure – Trackside Equipment.

1.9 DEFINITIONS

- 1.9.1** General railway technical terms that are used in this Standard and defined in the RISSB National Guideline – Glossary of Railway Terminology can be found in Appendix A.
- 1.9.2** Technical terms that are used in this Standard and not defined in the RISSB National Guideline – Glossary of Railway Terminology are provided below.
- 1.9.3** **Fully cast manganese crossing:** A cast manganese crossing with legs welded onto the cast crossings (also known as 'monoblock crossing').
- 1.9.4** **Heavy-duty switch:** A switch with thickened switch points, which must be used with jogged stock rails to ensure the running face of the running rail is collinear.
- 1.9.5** **Heeled (or pivot heeled) switch:** A 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.
- 1.9.6** **Flexible (or fixed heeled) switch:** A flexible switch that is machined from longer rails, and fixed towards the end of this rail with blocks to the adjacent stock rail. In some cases, a section of the switch rail foot is removed towards the block and the switch is designed to flex over its length.
- 1.9.7** **Rail bound manganese crossing:** A crossing where the actual crossing area is made from manganese steel castings surrounded by specially machined and set rails.
- 1.9.8** **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.
- 1.9.9** **Spring wing crossing:** A switchable V crossing with both a fixed and 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 open when taking the siding road.
- 1.9.10** **Swing nose crossing:** Refers to 'switchable vee' in RISSB National Guidelines – Glossary of Railway Terminology.
- 1.9.11** **Throw-off rail (catch points):** Rail that may be provided in a catch point assembly to derail a train at a point clear of the mainline.

2 GENERAL REQUIREMENTS FOR THE MANAGEMENT OF RAILWAY TURNOUTS AND OTHER SPECIAL TRACKWORK

2.1 GENERAL (1.2,1.3,1.6,1,7,2.1,3.1,4.1,5.1,6.1)

- 2.1.1 (M) All rail organisations, transport operators, contractors, industry bodies and other parties working in the Australian rail industry shall establish business management systems suitable to the scale of their business activities and operations.
- 2.1.2 (M) Business management systems shall be compliant with the applicable legislative requirements of the individual States and/or Territories, and shall encompass quality, safety and environmental management.
- 2.1.3 (M) Rail infrastructure and operating requirements shall comply with the *Rail Safety Act* and, where appropriate, encompass specific safety management requirements for the safe application and use of turnouts and other special trackwork.
- 2.1.4 (M) Turnouts and other special trackwork shall be designed to meet the functional requirements applicable to the track classification as defined by AS 7630, and managed giving due consideration to the age and condition of that infrastructure, the operating environment, traffic task, and seasonal climatic conditions.
- 2.1.5 (M) 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

- 2.2.1 (M) Rail safety worker competency management procedures, which include particular works to turnouts and other special trackwork, shall be established by the Railway Infrastructure Manager.
- 2.2.2 (R) 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

- 2.3.1 (M) To ensure risks to safety are effectively managed, interface management and coordination requirements shall be established, implemented and maintained for the management of rail infrastructure.
- 2.3.2 (R) As appropriate, the interface management and coordination requirements should include due consideration for the special risks associated with the management of turnouts and other special trackwork.
- 2.3.3 (R) 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.
- 2.3.4 (R) The actual rated parameters for operation (permanent and temporary) over the track and infrastructure should be determined and documented.
- 2.3.5 (R) 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.

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

2.3.7 (R) The attention of train operators should be specifically drawn to infrastructure locations that do not meet the standards established for normal operating requirements documented for specific States and/or Territories.

2.4 DOCUMENTATION AND RECORD MANAGEMENT

2.4.1 (M) The Railway Infrastructure Manager 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 can be assured.

2.4.2 (M) The Railway Infrastructure Manager 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.

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

2.4.4 (M) Documentation shall be available for audit purposes as required by the Rail Safety Act.

2.4.5 (R) As a minimum, documentation on turnouts and other special trackwork should include:

- (a) (R) a database of turnouts and other special trackwork installed on the network, including their type and detailed description
- (b) (R) a system for defining their location on the network
- (c) (R) governing standards, procedures and work instructions applicable to their management through each life cycle stage
- (d) (R) design and rating records required to achieve the specified functional capability
- (e) (R) engineering drawings detailing design layout configurations, component manufacturing details and as-built construction
- (f) (R) hazard locations that have the potential to impact defined functional capacity
- (g) (R) inspection and assessment requirements, including records of the inspections and assessments carried out
- (h) (R) maintenance, modification, repair and renewal works conducted in relation to the structures.

3 DESIGN AND RATING REQUIREMENTS

3.1 FUNCTION

3.1.1 The function of turnouts and other special trackwork is to:

- (a) provide a means for rolling stock to:
 - i. diverge or converge from one track to another
 - ii. cross over one track while travelling on another
- (b) prevent unauthorised movements of trains or rolling stock.

3.2 COMPONENT DESCRIPTION AND ASSEMBLY

1. The technical terminology used in this Standard to describe and define components of turnouts and other special trackwork is provided in Section 1.9 and Appendix A.
2. The general layout of typical turnout structures (single and dual gauge), showing the points and crossing areas, is provided in Appendix B.
3. The following sections describe the main units of special trackwork structures and their component breakdown.

3.2.1 Turnout

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

- (a) switch and stock rail structures
- (b) V crossings
- (c) check rail units (except in swing nose/switchable vee crossings)
- (d) closure rails
- (e) bearers and special sleepers
- (f) plates and fasteners
- (g) rail joints
- (h) switch operating equipment.

3.2.1.2 Turnouts can be classed as either:

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

3.2.1.3 Both conventional and tangential turnouts may be either:

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

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

3.2.1.5 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 track, including the switches, continuously curved, with the tangent point located near the toe of the points.

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

3.2.1.7 Turnouts can be classed as 'facing' or 'trailing', depending on the direction of travel of the rolling stock.

3.2.1.8 The facing point of the switch is used to turn 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).

3.2.1.9 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.

3.2.1.10 An example of a left-hand turnout with labelled components is shown in Appendix D.

3.2.2 Diamond Crossing

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

3.2.2.2 Typical layouts for diamond crossings are provided for single and dual gauge configurations in Appendix K.

3.2.2.3 A diamond crossing is an assembly of rail components comprising:

- (a) V crossings
- (b) K crossings
- (c) check rail units (except in swing nose/switchable vee crossings)
- (d) closure rails
- (e) bearers and special sleepers
- (f) plates and fasteners
- (g) rail joints.

3.2.2.4 A diamond crossing can have:

- (a) fabricated V and K crossings
- (b) fully cast manganese V and K crossings
- (c) switchable K with two V and K crossings.

3.2.2.5 Layouts showing the different types of diamond crossings are illustrated in Appendix K.

3.2.2.6 The diamond crossing can be either:

- (a) flange bearing, where the depth of the flangeway is reduced so that the wheels of the rolling stock run on the surface of the component separating the running rail
- (b) rail running, where the rolling stock runs on the surface of the running rails.

3.2.3 Slip (or Compound)

3.2.3.1 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.

3.2.3.2 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 N.

3.2.3.3 A slip is an assembly of rail components comprising:

- (a) V crossings
- (b) K crossings
- (c) check rail units (except in swing nose/switchable vee crossings)
- (d) closure rails
- (e) bearers and special sleepers
- (f) plates and fasteners
- (g) rail joints.

3.2.4 Catch Point

3.2.4.1 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 standard.

3.2.4.2 A typical catch point configuration is illustrated in Appendix O.

3.2.4.3 A catch point may be interlocked with a signalling system, or may operate via a manual lever.

3.2.4.4 A catch point is an assembly of:

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

3.2.5 Expansion Switch

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

3.2.5.2 A typical expansion switch configuration is shown in Appendix Q.

3.2.5.3 An expansion switch is an assembly of:

- (a) switches and stock rails
- (b) closure rails
- (c) bearers
- (d) plates and fasteners
- (e) rail joints.

3.2.6 Manual Point Lever

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

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

3.3 DESIGN SPECIFICATION *(4.1, 11.1, 12.1)*

- 3.3.1 **(R)** Where practicable, turnouts and other special trackwork structures should be of a specified design with a standard footprint configuration.
- 3.3.2 **(R)** Individual components of these structures should be compatible with standard design configurations and assembled in accordance with prescribed design specifications.
- 3.3.3 **(R)** Standard designs should be selected to suit the track classification and environment in which they operate. *(2.34, 6.7)*
- 3.3.4 **(M)** Where standard designs cannot be adopted, the Railway Infrastructure Manager shall approve the design to ensure it is suitable for the track classification and operating environment. *(2.34)*
- 3.3.5 **(M)** Design specifications for turnouts and other special trackwork shall consider the following criteria: *(5.11)*

- (a) **(M)** speed over each leg of the structure (e.g. on through tracks, converging and diverging tracks in a turnout), including consideration of the maximum cant deficiencies applicable for the track classification, and the consequential Rate of Change of Deficiency (Jerk) based on the Virtual Transition calculation
- (b) **(M)** service loads (and dynamic response), including the effects of impact loading at the wheel transfer locations, in conjunction with track alignment, maintenance standards and traffic task
- (c) **(M)** component material types and maintenance requirements (e.g. fabricated versus cast crossing, fixed nose versus swing nose and spring wing crossings, material hardness and hardening processes)
- (d) **(M)** the component, layout geometry and assembly details, including:
 - i. **(M)** bearer dimension, location and orientation
 - ii. **(M)** rail fastening baseplate and chair dimensions, location and orientation
 - iii. **(M)** track radius or curve alignment
 - iv. **(M)** crossing angle and wheel transfer area cross-sectional geometry
 - v. **(M)** switch geometry and cross-sectional geometry
 - vi. **(M)** detailed component geometry
 - vii. **(M)** flangeways and wheel opening dimensions
 - viii. **(M)** check rail length, location and effectiveness, profile and end flaring
 - ix. **(M)** wheel set geometry (i.e. wheel cross-sectional profile and wheel set back-to-back) *(2.35, 2.43)*
 - x. **(M)** switch slide plates and roller plates
 - xi. **(M)** anti-creep devices
- (e) **(M)** requirements for movable components, where applicable, including the geometric fit for construction and maintenance across all turnouts and other special trackwork positions
- (f) **(M)** need for trailable points
- (g) **(M)** rodding and interlocking requirements for manual operations (in bearer actuation systems)
- (h) **(M)** requirements for rails, bearers and fastenings
- (i) **(M)** requirements for manual and motorised switch mechanisms, considerations associated with the clamping force between the switch and stock rail, and the operating conditions
- (j) **(M)** all motorised switches (e.g. motorised trailable switches)
- (k) **(M)** servicing requirements (e.g. lubrication and adjustment).

3.4 DESIGN AND RATING REQUIREMENTS (4.1, 11.1, 12.1)

3.4.1 General

3.4.1.1 (R) In the design of turnouts and other special trackwork structures, the Railway Infrastructure Manager should take into account the general requirements for adjacent infrastructure, as well as the operational interfaces associated with rolling stock and signalling infrastructure on the network, to achieve the required compatibility for the local operating environment. Typical configurations are: (1.4, 1.5)

- (a) Appendix F – SG CTO Configuration Examples
- (b) Appendix G – SG TTO Configuration Examples.

3.4.1.2 (R) Due to the variety and complexity of turnouts and other special trackwork, a number of standard footprint designs should be adopted by the Railway Infrastructure Manager for new and replacement assemblies.

3.4.1.3 (R) The following sections prescribe the design and geometric criteria that should be applied in standard designs for narrow, standard and broad gauge assemblies.

3.4.1.4 A summary guide of the design criteria for each gauge is provided in:

- (a) Appendix C.

3.4.2 Narrow Gauge Assemblies

3.4.2.1 (R) The following design criteria should be applied, as far as practicable, in the design of turnouts and other special trackwork on 1067mm gauge lines:

- (a) **(R)** Within this document reference components should be designed for a wheel set back-to-back, as recommended in Table C.1 in Appendix C.
- (b) **(R)** The nominal dimension from the gauge face of the running rail of a crossing to the working face of the check rail (i.e. check rail effectiveness) should be 1022mm, with a flangeway width and check rail gap of 45mm and 40mm respectively.
- (c) **(R)** The maximum superelevation (cant) deficiency allowable through the diverging track of turnouts should be as recommended in AS 7635.
- (d) **(R)** The design switch rail toe/stock rail open-throw dimension should be at least 105mm.
- (e) **(R)** The throat of the switch, when open, should be not less than 50mm.
- (f) **(R)** The check rail end opening should be flared and have at least 80mm clearance to the gauge face of the running rail at the flared end.
- (g) **(R)** The check rail height should be designed such that it is an absolute maximum of 40mm above the running rail, with due consideration given to structure and rolling stock clearances.
- (h) **(R)** Components should be designed for a maximum wheel flange height of 45mm.
- (i) **(R)** The crossing nose profile should be designed to allow for the range of new and worn wheels operating over the crossing structure.

3.4.2.2 (M) These design criteria shall be reviewed by the Railway Infrastructure Manager for compatibility with the rail organisation's local network, and where any deviation from the criteria may be required, it shall be at the approval of the Railway Infrastructure Manager.

3.4.3 Standard Gauge Assemblies

3.4.3.1 (R) Within this Standard, the following design criteria should be applied, as far as practicable, in the design of turnouts and other special trackwork on 1435mm gauge lines:

- (a) **(R)** Components should be designed for a wheel set back-to-back between 1357mm and 1360mm.
- (b) **(R)** The nominal dimension from the gauge face of the running rail of a crossing to the working face of the check rail (i.e. check rail effectiveness) should be 1392mm, with a flangeway width and check rail gap of 45mm.
- (c) **(R)** The maximum superelevation (cant) deficiency allowable through the diverging track of turnouts should be as recommended in AS 7635.
- (d) **(R)** The design switch rail toe/stock rail open-throw dimension should be at least 105mm.
- (e) **(R)** The throat of the switch, when open, should be not less than 50mm.
- (f) **(R)** The check rail end opening should be flared and have at least 80mm clearance to the gauge face of the running rail at the flared end.
- (g) **(R)** The check rail height should be designed such that it is an absolute maximum of 40mm above the running rail, with due consideration given to structure and rolling stock clearances.
- (h) **(R)** Components should be designed for a maximum wheel flange height of 45mm.
- (i) **(R)** The crossing nose profile should be designed to allow for the range of new and worn wheels operating over the crossing structure.

3.4.3.2 (M) These design criteria shall be reviewed by the Railway Infrastructure Manager for compatibility with the rail organisation's local network, and where any deviation from the criteria may be required, it shall be at the approval of the Railway Infrastructure Manager.

3.4.4 Broad Gauge Assemblies

3.4.4.1 (R) The following design criteria should be applied, as far as practicable, in the design of turnouts and other special trackwork on 1600mm gauge lines:

- (a) **(R)** Within this Standard reference components should be designed for a wheel set back-to-back, as recommended in Table C.1 in Appendix C.
- (b) **(R)** The nominal dimension from the gauge face of the running rail of a crossing to the working face of the check rail (i.e. check rail effectiveness) should be 1555mm, with a flangeway width and check rail gap of 45mm.
- (c) **(R)** The maximum superelevation (cant) deficiency and rate of change of cant deficiency allowable through the diverging track of turnouts should be as recommended in AS 7635.
- (d) **(R)** The design switch rail toe/stock rail open-throw dimension should be at least 115mm.
- (e) **(R)** The throat of the switch, when open, should be not less than 50mm.
- (f) **(R)** The check rail end opening should be flared, and have at least 90mm clearance to the gauge face of the running rail at the flared end.
- (g) **(R)** The check rail height should be designed such that it is an absolute maximum of 40mm above the running rail, with due consideration given to structure and rolling stock clearances.
- (h) **(R)** Components should be designed for a maximum wheel flange height of 45mm.
- (i) **(R)** The crossing nose profile should be designed to allow for the range of new and worn wheels operating over the crossing structure.

3.4.4.2 (M) These design criteria shall be reviewed by the Railway Infrastructure Manager for compatibility with the rail organisation's local network, and where any deviation from the criteria may be required, it shall be at the approval of the Railway Infrastructure Manager.

3.4.5 Dual Gauge Assemblies

3.4.5.1 A dual gauge (or mixed gauge) railway track allows rolling stock of different gauges to use the same track, and usually consists of three rails, with the two outer rails forming the wider gauge, and the outer and inner rail forming the narrower gauge.

(a) On some occasions it is necessary to use four rails particularly when the rolling stock of both gauges are required to operate on a common centreline. This four rail dual gauge track is commonly known as gauntlet track.

3.4.5.2 Dual gauge turnouts and other special trackwork are an integral element in linking rail across various states/territories across Australia, and usually require some special dual gauge componentry in the design to meet the requirements of their particular location and operating environment.

3.4.5.3 Like single gauge assemblies, dual gauge assemblies incorporate fabricated, fully cast manganese or switchable crossing types.

3.4.5.4 (M) In dual gauge assemblies, the Railway Infrastructure Manager shall consider the unique design considerations that need to be applied to each type of structure.

3.4.5.5 (M) In particular, the Railway Infrastructure Manager shall give due consideration for the design, and for the subsequent manufacture, to any special requirements arising from the difference in the distance between the gauge lines of dual gauge rails (368mm for narrow and standard gauge, and 165mm for standard and broad gauge), and the implications of this in the following components:

- (a) **(M)** K crossing
- (b) **(M)** V crossing
- (c) **(M)** switch and stock rail movement, including compatibility with common switch gear
- (d) **(M)** special guarding, including requirements for the flangeway clearances and any additional machining
- (e) **(M)** special plates and bearers
- (f) **(M)** special fixings and fastenings.

3.4.5.6 (R) Where practicable, the application of standard componentry should be considered for use in dual gauge assemblies.

3.4.5.7 (R) The Railway Infrastructure Manager should limit the number of different types of dual gauge configurations in use on the network and, where possible, develop standard design footprints for the rail organisation that meet the requirements of its local operating environment.

3.4.6 Capacity Rating

3.4.6.1 (M) The following elements in turnouts and other special trackwork assemblies shall be used to assess their capacity rating:

- (a) **(M)** weight of rail
- (b) **(M)** length of switch and type (heeled or flexible)
- (c) **(M)** type of fastenings, whether resilient or dog spikes
- (d) **(M)** type of bearers (typically timber or concrete)

- (e) (M) crossing angle and type
- (f) (M) radii
- (g) (M) turnout type
- (h) (M) turnout length.

3.5 DESIRABLE CONFIGURATIONS

- 3.5.1** (R) The selection of turnouts and other special trackwork components should be based on meeting the desired capacity requirements for the specified track classification, as defined in AS 7630.
- 3.5.2** (R) The component selection for new and replacement structures should consider future planned operating requirements.
- 3.5.3** (R) Guidelines on desirable footprint configurations with supporting design criteria for mainlines and yards are provided for the following components, and should be used as part of the selection and capacity rating assessment for new and replacement structures:
- (a) (R) turnouts (provided in Appendix D)
 - i. (R) Appendix E TO Design Rating
 - ii. (R) Appendix F SG CTO Configuration Examples
 - iii. (R) Appendix G SG TTO Configuration Examples
 - (b) (R) crossings (provided in Appendix K)
 - i. (R) Appendix L Crossing Types
 - ii. (R) Appendix M Diamond Speeds
 - (c) (R) catch points, provided in:
 - i. (R) Appendix O Catch Point Configurations
 - ii. (R) Appendix P Catch Point Locations
 - (d) (R) expansion switches, provided in:
 - i. (R) Appendix Q Expansion Switch Diagram
 - ii. (R) Appendix Q Expansion Switches.
- 3.5.4** The guidelines on standard desirable configurations provided in these appendices should be considered as good practice, and not an exhaustive list of suitable configurations for use in mainlines and yards.
- 3.5.5** (M) The Railway Infrastructure Manager shall determine the standard configurations that shall be used on the network, ensuring their suitability for the operating environment.

3.6 UNDESIRABLE CONFIGURATIONS

1. (R) The following configurations should be considered undesirable for installation in mainlines and yards.
 - (a) (R) heeled switches
 - (b) (R) short switches (<6100mm)
 - (c) (R) turnouts on sharp curves, especially if they are similar flexure
 - (d) (R) diamonds on sharp curves
 - (e) (R) single or compound slips
 - (f) (R) 'entangled' trackwork, where different special trackwork units overlap
2. (R) Where the following configurations exist, they should be considered for strategic upgrading:

- (g) **(R)** catch points without a clear landing area (and in such cases, a risk analysis should be undertaken to establish potential corrective or protective actions)
- (h) **(R)** assemblies on transition curves
- (i) **(R)** combinations of assemblies which create reverse curvature where connecting straights are less than the nominal bogie centres.

3.6.1 Assessment

- 3.6.1.1 **(R)** Undesirable configurations should only be designed and installed after first assessing the implications on the rail network.

3.7 DOCUMENTATION REQUIREMENTS

- 3.7.1 The minimum recommended requirements for documentation are set out in Section 2.4 of this Standard.

4 MANUFACTURE AND SUPPLY REQUIREMENTS

4.1 GENERAL (1.5, 4.1, 11.1, 12.1)

- 4.1.1 **(M)** The Railway Infrastructure Manager 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. (5.9)
- 4.1.2 **(M)** 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 Railway Track Materials – Turnouts, Switches and Crossings; other relevant Australian standards listed under Section 1.8; or other equivalent approved standards.
- 4.1.3 **(M)** All component materials shall be manufactured and supplied in accordance with relevant engineering drawings and specifications, making due allowances for variations in rail size and the maximum tolerance limits, as specified by the Railway Infrastructure Manager for the particular track classification, geometry and rail operating environment. (12.1, 5.9)

4.2 USE OF SERVICEABLE RAIL IN TURNOUTS AND OTHER SPECIAL TRACKWORK

- 4.2.1 **(R)** Serviceable rail should only be used for the manufacture of turnouts and other special trackwork components where permitted and approved by the Railway Infrastructure Manager.
- 4.2.2 **(M)** Where serviceable rail is to be used, it shall comply with the requirements defined in AS 7640.
- 4.2.3 **(M)** The Railway Infrastructure Manager shall be responsible for determining the allowable top and side wear limits for serviceable rail used in turnouts, other special trackwork and lead rail.
 - (a) Guidelines are provided in Appendix X
 - (b) For additional information, refer to AS 7640.
- 4.2.4 **(M)** The unworn or least worn running edge of transposed rail used for the manufacture of turnouts and other special trackwork shall be used as the running or gauge face.

- 4.2.5** (M) All metal flow shall be removed by grinding or machining prior to commencement of manufacture of rail.
- 4.2.6** (M) Rail ends containing bolt holes shall be cropped to remove all bolt holes.
- 4.2.7** (M) Oxy cut rail ends shall be removed by saw or friction disc to a minimum specified distance from the oxy cut prior to use (typically 150mm).
- 4.2.8** (R) All serviceable rails used for the manufacture of turnouts, other special trackwork and lead rails should be ultrasonically inspected for defects, in accordance with the requirements of AS 1085.21.
- 4.2.9** (M) Serviceable rails that contain welds shall not be permitted in the manufacture of turnouts and other special trackwork assemblies.

4.3 MARKING OF COMPONENTS

- 4.3.1** (R) Turnouts and other special trackwork components should be clearly and legibly stamped for identification, in accordance with the requirements specified in AS 1085
- 4.3.2** (R) 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 and heat treatment number (where appropriate).

4.4 PRODUCT TESTING AND ACCEPTANCE

- 4.4.1** (M) Product testing and acceptance shall be in accordance with AS 1085, and any other relevant procedures defined by the Railway Infrastructure Manager.
- 4.4.2** (M) 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.

4.5 COMPONENT ASSEMBLY AND INSPECTION

- 4.5.1** (R) The method of assembly of components should be specified by the manufacturer and approved by the Railway Infrastructure Manager.
- 4.5.2** (R) The Railway Infrastructure Manager should direct that a whole item, or any portion thereof, be completely assembled prior to delivery.
- 4.5.3** (R) The complete assembly should be inspected by the Railway Infrastructure Manager or other nominated representative.
- 4.5.4** (R) Prior to constructing assemblies on site, a baseline should be marked out to ensure all components are easily installed to the correct sequence and in the correct position, with due consideration given to critical structure requirements such as:
 - (a) (R) track gauge detailed in the design at the specified location
 - (b) (R) distance to the Theoretical Point
 - (c) (R) square across the switch and heel blocks
 - (d) (R) radius and length of the lead and closure rails
 - (e) (R) position and alignment of the guardrails with particular reference to the check rail effectiveness and check rail gap requirements
 - (f) (R) flangeway clearances
 - (g) (R) gauge tolerance at the V nose
 - (h) (R) tangent and position of the curved rail into the straight rail
 - (i) (R) alignment of the straight rail section

(j) **(R)** installation and tolerance of the fastenings.

4.5.5 (R) At all stages of factory manufacture, building the final product to perform the required function should be the primary focus.

4.5.6 (M) All trial and final assemblies shall conform to the dimensions and tolerance limits shown on the relevant engineering drawings.

4.6 PREPARATION FOR DISPATCH

4.6.1 (R) After inspection, where the items are being dispatched in sub-units rather than whole assemblies, they should be prepared for dispatch in the following units:

- (a) **(R)** individual closures
- (b) **(R)** crossings
- (c) **(R)** check rails bolted to matching check rail carrier
- (d) **(R)** each switch combined with switch, stock rail, studs, chairs and heel blocks, with the switch securely fastened to the stock rail to prevent damage.

4.6.2 (R) Baseplates, bolts and other items which form part of the contract should be packaged into bags or boxes with appropriate maximum defined masses.

4.6.3 (R) All other items should be clearly distinguishable as identifiable components to enable correct assembly.

4.7 DOCUMENTATION REQUIREMENTS

4.7.1 (R) The minimum recommended requirements for documentation are set out in Section 2.4 of this Standard.

5 CONSTRUCTION AND COMMISSIONING REQUIREMENTS

5.1 CONSTRUCTION *(1.4, 1.5, 1.6, 4.1, 5.1, 11.1, 12.1)*

5.1.1 General

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

5.1.1.2 (M) The Railway Infrastructure Manager shall ensure that the finished geometry of all turnouts and special trackwork installations comply with AS 7635.

5.1.1.3 (R) 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 +2mm, -4mm.

5.1.1.4 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 may be considered.

5.1.1.5 (R) 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.

5.1.1.6 (R) When installed on the network, the check rail effectiveness through turnouts and other special trackwork should be in accordance with:

- (a) **(R)** narrow gauge
- (b) **(R)** standard gauge
- (c) **(R)** broad gauge.

5.1.1.7 (R) When constructing turnouts and other special trackwork, the check rails should be installed towards the maximum value of the guardrail gauge tolerance (e.g. 1024mm for narrow 1067mm gauge), to allow maximum guardrail wear before readjustment is required.

5.1.1.8 (R) A guideline on recommended construction acceptance tolerances for turnouts and other special trackwork assemblies is provided in:

- (a) **(R)** Appendix R Construction Tolerances.

5.1.2 Turnout

5.1.2.1 General

1. **(R)** Tangential turnouts offer higher turnout speed and reduced wear over conventional turnouts, and should be used for mainline renewals and new construction works.
2. **(R)** Where tangential turnouts are used, the turnouts, and the track for 50 metres either side, should be fully welded.
3. **(R)** Renewal and new construction of conventional turnouts should generally be restricted to yards and sidings where there are low speeds and light traffic.
4. **(M)** When constructing turnouts which incorporate swing nose crossings, the Railway Infrastructure Manager shall ensure that the switch and the swing nose are aligned prior to the passage of rail traffic, to prevent derailment.
5. **(R)** 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.
6. **(R)** The implications for rail expansion from long span bridges should be considered in the configuration used for turnouts for example:
 - (a) **(R)** when turnouts are placed within 30m of a bridge end (where spans are <18m)
 - (b) **(R)** when turnouts are placed within 60m of a bridge end (where one or more spans are ≥18m but <80m), the turnout should be aluminothermic welded throughout and a flexible switch used if possible.
7. **(R)** The use of non welded joints (excluding IRJs) should only be permitted for a short period during the initial construction and installation of turnouts.
8. The installation of crossing units with fixed, swage fastened joints may, however, be approved at the discretion of the Railway Infrastructure Manager.
9. **(M)** For turnouts fitted with dry slide chairs, no oil or grease shall be applied to these chairs during installation.

5.1.2.2 Acceptable Tolerances

1. **(M)** The finished geometry of the track shall be in accordance with the requirements of AS 7635.
2. **(M)** 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 Railway Infrastructure Manager. (2.34, 2.35, 2.42, 2.43)

(a) **(R)** Recommended tolerance limits are provided in Appendix R

5.1.2.3 Installation of Switches and Switch Stops

1. **(R)** Switches should be laid up against the stock rail within the following limits, without any applied force: (4.14)
(a) **(R)** Recommended tolerance limits are provided in Appendix R
2. **(R)** The minimum flangeway gap at the end of the switch head planing from the back of the switch to the stock rail should be 50mm.
3. **(R)** Switch operating forces should be checked, with all stretcher bars connected but all operating rods disconnected.
4. An exception to this may be made where a mechanical back-drive is to be used.
5. **(R)** The force required to operate the switch to reverse should not vary from the force required to operate to normal by more than 10%.
6. **(R)** 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.
7. **(R)** The adjustment should be such that the switch conforms to the true design geometry.
8. **(R)** Where a non-adjustable switch stop is used, the stud should have a minimal gap between the switch and the stock rail web.

5.1.2.4 Installation of Reversible Spring Levers

1. **(M)** When securing a reversible spring lever to a switch bearer, the rods shall be connected and the lever located, so that when the switch is at mid-throw the lever handle is vertical.
2. **(R)** This should be done correctly so that when the lever is in either closed position, the spring will have the same degree of compression.
3. **(M)** When the lever has been secured to the timbers, the switch shall be set in one of the fully closed positions.
4. **(R)** The spring set screw should be tightened so that all slack is taken up and the compression of the spring is about to commence.
5. **(R)** The spring set screw should be tightened securely, after which the lock nut should be tightened securely against the frame.

5.1.2.5 Installation of Bearers

1. **(R)** Bearers should be placed in accordance with the spacing plan nominated in the design, with a tolerance of $\pm 2\text{mm}$ for spacing between adjacent bearers, and $\pm 10\text{mm}$ of cumulative design position.
2. **(M)** The bearer type (typically concrete or timber) shall be appropriate to the operating environment and track classification.

5.1.3 Diamond Crossing

- 5.1.3.1 **(R)** A finished diamond crossing should meet the requirements as recommended in Appendix R.
- 5.1.3.2 **(R)** Other installation tolerances should be in accordance with the design specification or manufacturer's instructions.
- 5.1.3.3 **(R)** The bearer type (typically concrete or timber) should be appropriate to the operating environment and track classification.

5.1.4 Catch Point

- 5.1.4.1 **(R)** Where a catch point is required at the junction of a siding and main running line to prevent unauthorised access to the main running line, the finished catch point should be installed to the requirements recommended in Appendix R.
- 5.1.4.2 **(M)** The Railway Infrastructure Manager 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.
- 5.1.4.3 **(M)** The risks associated with where a derailed vehicle is to be directed shall be considered by the Railway Infrastructure Manager when determining the location of the catch point and the need for a throw-off rail and any other special provisions.
- 5.1.4.4 **(R)** 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.
- 5.1.4.5 **(M)** 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 catch point blade heel.
 - (a) Alternatively, a closure rail and V crossing could be provided.
- 5.1.4.6 **(R)** The provision of crash barriers should also be considered, to ensure a derailed vehicle does not foul the running line's structure gauge.

5.1.5 Expansion Switch

- 5.1.5.1 **(M)** 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).
- 5.1.5.2 **(R)** The switch and gauge should not exceed the design requirements at the limits of expansion and contraction of both the rail and the structure.
- 5.1.5.3 **(R)** The gap between the switch and the stock rail at installation should not exceed 0.5mm.
- 5.1.5.4 The switch heel and stock rail may be welded to adjoining rails.