



Railway track material

Part 21: Turnouts, switches and crossings



This Australian Standard® was prepared by Committee CE-002, Railway Track Materials. It was approved on behalf of the Council of Standards Australia on 13 June 2014. This Standard was published on 27 June 2014.

The following are represented on Committee CE-002:

- Australasian Railway Association
- Australian Chamber of Commerce and Industry
- Australian Industry Group
- Monash University
- Permanent Way Institute
- Rail Track Association Australia
- Railway Technical Society of Australasia

Additional Interests:

- Austrak
 - Australian Rail Track Corporation
 - Brookfield Rail
 - Department of Transport Victoria
 - John Holland
 - Martinus Rail
 - Pacific Rail Engineering
 - Pandrol Australia
 - Queensland Rail
 - Railcorp
 - Rail Industry Safety and Standards Board
 - Romberg Rail Australia
 - Voestalpine VAE Railway Systems
 - Vossloh Cogifer Australia
-

This Standard was issued in draft form for comment as DR AS 1085.21.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting www.standards.org.au

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.org.au, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

Australian Standard[®]

Railway track material

Part 21: Turnouts, switches and crossings

First published as AS 1085.21:2014.

COPYRIGHT

© Standards Australia Limited

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968.

Published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001, Australia

ISBN 978 1 74342 788 0

PREFACE

This Standard was prepared by the Standards Australia Committee CE-002, Railway Track Materials.

The objective of this Standard is to provide information and requirements for the design and manufacture of turnouts, switches and crossings and their components.

This Standard does not cover the use of existing or re-used materials. Users should satisfy themselves that such materials are satisfactory for the application intended.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

Notes to the text contain information and guidance and are not an integral part of the Standard.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	5
1.2 CONTEXT AND PURPOSE OF USE.....	5
1.3 REFERENCED DOCUMENTS.....	5
SECTION 2 TERMINOLOGY AND DRAWINGS	
2.1 GENERAL.....	7
2.2 GENERAL TERMS.....	7
SECTION 3 TURNOUT DESIGN	
3.1 GENERAL.....	27
3.2 DESIGN PARAMETERS.....	27
3.3 TANGENTIAL.....	32
3.4 SECANT.....	36
SECTION 4 MANUFACTURE	
4.1 MATERIALS, TESTS AND STANDARDS.....	39
4.2 RAILS, FISHPLATES AND SLEEPER PLATES.....	39
4.3 CASTINGS.....	40
4.4 MANGANESE STEEL CASTINGS.....	40
4.5 FASTENING.....	44
4.6 FLAME CUTTING.....	45
4.7 WELDING.....	45
4.8 HARDENING.....	45
4.9 RAIL DRILLING.....	46
4.10 SAWING AND MACHINING.....	46
4.11 RIVETING.....	46
4.12 FITTING.....	46
4.13 FORGINGS.....	46
4.14 CAST IRON BLOCKS.....	46
4.15 CAST STEEL BLOCKS.....	47
4.16 SPECIAL HEEL BOLT FERRULES.....	47
4.17 NYLON BUSHES.....	47
4.18 EPOXY GLUING OF CROSSINGS.....	47
4.19 SWITCH ASSEMBLY.....	47
4.20 CROSSING ASSEMBLY.....	48
4.21 TOLERANCES.....	48
4.22 STAMPING.....	48
4.23 MATCH MARKING.....	51
4.24 PAINTING AND COATING.....	51
4.25 FINAL ASSEMBLY AND INSPECTION.....	51
4.26 PREPARATION FOR DISPATCH.....	51
SECTION 5 INTERFACES	
5.1 GENERAL.....	52
5.2 OPERATING EQUIPMENT.....	52
5.3 INSULATION.....	52
5.4 INSTALLATION.....	53
5.5 TRACK AND STRUCTURE INTERFACES.....	53

SECTION 6 PRODUCT ACCEPTANCE

6.1	GENERAL.....	54
6.2	TYPE APPROVAL.....	54
6.3	CERTIFICATE OF COMPLIANCE.....	54
6.4	TRIAL ASSEMBLY.....	54
6.5	ASSEMBLY MAINTENANCE MANUALS AND DRAWINGS	54
APPENDIX A INFORMATION TO BE SUPPLIED BY THE PURCHASER.....		55

STANDARDS AUSTRALIA

Australian Standard Railway track material

Part 21: Turnouts, switches and crossings

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the design and manufacture of turnouts, switches and crossings and their components.

NOTE: Purchasing and usage guidelines are given in Appendix A, including information to be supplied by Purchasers and Suppliers.

1.2 CONTEXT AND PURPOSE OF USE

1.2.1 Function

Turnout switches and crossings are vital track components that allow and control the safe diversion of rail vehicles from one track to another or to cross other tracks.

1.2.2 Action

Turnouts, switches, crossings and their components are subject to effects resulting from the following actions:

- (a) Passage of rolling stock (including effects of vertical, lateral and longitudinal forces, vibration, acceleration and deceleration).
- (b) Maintenance operations.
- (c) Exposure to the elements.
- (d) Electrical potential, if present.

These actions may result in fatigue, wear, corrosion and material degradation.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1085	Railway track material
1085.1	Part 1: Steel rails
1085.2	Part 2: Fishplates
1085.3	Part 3: Sleeper plates
1085.4	Part 4: Fishbolts and nuts
1085.12	Part 12: Insulated joint assemblies
1085.14	Part 14: Prestressed concrete sleepers
1085.17	Part 17: Steel sleepers
1085.19	Part 19: Resilient fastening assemblies
1442	Carbon steels and carbon-manganese steels—Hot rolled bars and semi-finished products
1816	Metallic materials

AS	
1830	Grey cast iron
1831	Ductile cast iron
1988	Welding of ferrous castings
2074	Cast steels
2205	Methods for destructive testing of welds in metal
2205.5.1	Part 1: Macro metallographic test for cross-section examination
AS/NZS	
1252	High strength steel bolts with associated nuts and washers for structural engineering
1554	Structural steel welding
1554.1	Part 1: Welding of steel structures
3679	Structural steel
3679.1	Part 1: Hot-rolled bars and sections
AWS	
5.13	Specification for Surfacing Electrodes for Shielded Metal Arc Welding
5.21	Specification for Bare Electrodes and Rods for Surfacing

SECTION 2 TERMINOLOGY AND DRAWINGS

2.1 GENERAL

This Section sets out terms and definitions used in relation to turnouts, switches and crossings.

2.2 GENERAL TERMS

2.2.1 Anti-creep device

Generally, a two part assembly used to minimize and monitor longitudinal creep between switchblade and stockrail. An anti-creep device may also be used in other applications where creep needs to be minimized and monitored, such as swing nose crossings.

2.2.2 Bearers

A type of sleeper used under turnouts and special trackwork. Bearers are generally larger in dimension than standard sleepers to provide support for both tracks as well as the increased loading experienced under such track structures. Generally manufactured from either steel, concrete or timber.

2.2.3 Blocks

A casting or fabricated steel component used mainly with checkrails and crossings to support rail components at a fixed distance apart. Lettering and numbers on the block are generally used to identify its application. Also known as 'chocks'.

2.2.4 Cant deficiency

The difference between the applied cant on the track and the equilibrium cant for the rolling stock at a particular speed.

2.2.5 Catchpoint (see Figure 2.1)

Provides a level of protection against train collision by derailing the train prior to the junction of rail lines. Generally catchpoints comprise the following:

- (a) One switch and stockrail assembly.
- (b) Closure rails.
- (c) Throw off rails (where required).
- (d) Ramp (where required).
- (e) Bearers.
- (f) Plates, fasteners and rail joints.
- (g) Point operating equipment.

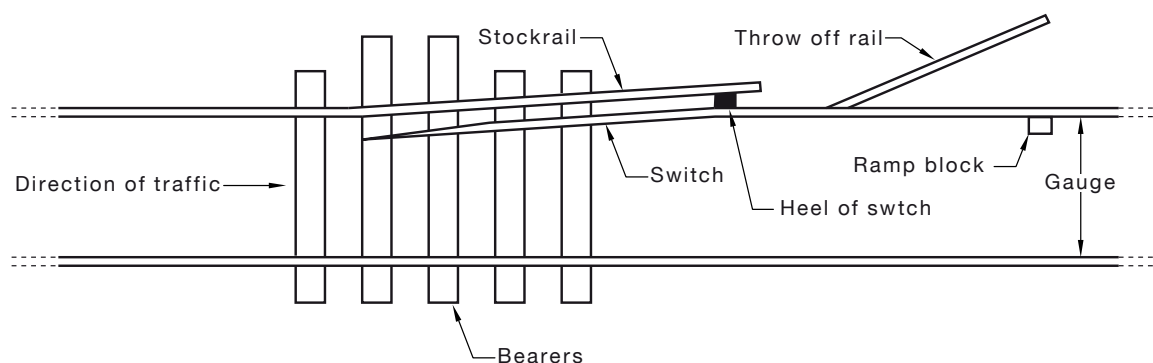


FIGURE 2.1 TYPICAL CATCHPOINT

2.2.6 Chair plate

A flat plate with a fixed raised section that is fastened to the web of either the stockrail, in the case of a switch assembly, or the checkrail carrier, in the case of a checkrail assembly. The types of chairs are identified by marking on the end of the plate by stamping.

2.2.7 Checkrail

A steel section (can be manufactured from rail) placed inside the running rail which comes into contact with the back of the wheel flange, along the checking face. It is used to provide steering of the wheel set, such that the crossing nose or switch point is not contacted and is protected by the opposite wheel.

A checkrail may be raised above the level of the running rail (i.e. the top of the checkrail is above the running rail).

Also known as 'guardrail'.

2.2.8 Checkrail effectiveness (see Figure 2.2)

Distance from the checking face of checkrail to the gauge face of the crossing nose. Measured square to the running rail at the nose of the crossing.

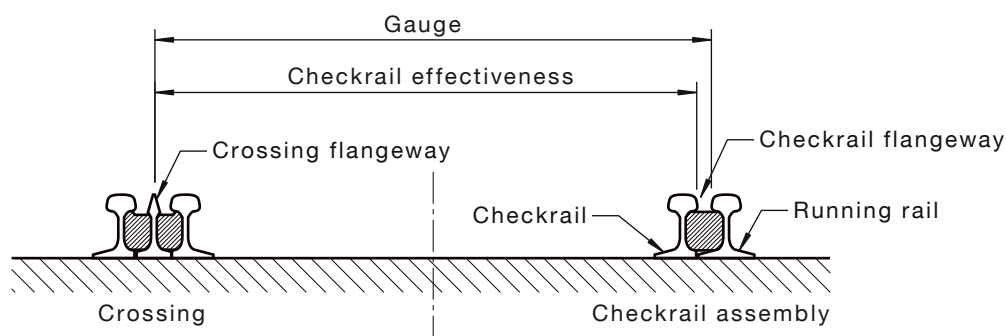


FIGURE 2.2 CHECKRAIL EFFECTIVENESS

2.2.9 Closure rails

Rails making up a turnout or special trackwork diamond configuration that are apart from those in the switch assemblies, crossings and checkrail units.

2.2.10 Common rail transfer

A track component used to transfer the common rail from one side to the other in dual gauge track.

2.2.11 Compound

See 'Slip' (Clause 2.2.55).

2.2.12 Crossing types and terms

2.2.12.1 *Crossing*

A track component that enables a wheel travelling along one rail to pass through the rail of a track which crosses its path. The most common types are 'V' and 'K'. Also known as a 'Frog'.

2.2.12.2 *Crossing/Opening—V/Wing end*

The opening between the gauge face of rails at each end of a crossing.

2.2.12.3 *Crossing—Housed (spliced) rail*

The rail in a fabricated 'V' or 'K' crossing that takes the minimum traffic or speed. This rail is machined and attached to the point rail to complete a 'V' assembly.

2.2.12.4 *Crossing—Point rail*

The rail in a fabricated 'V' crossing that takes the maximum traffic or speed. It is mechanically attached to the housed rail to complete the 'V' assembly. Refer to Figure 2.8.

2.2.12.5 *Crossing—Practical point*

A physical point in a crossing located at a distance from the theoretical point. Refer to Figure 2.7.

2.2.12.6 *Crossing—Rate (see Figure 2.3)*

A measure of the angle made by the rail gauge faces at the theoretical point. It is defined by one of three methods, they being either centre-line, right angle or isosceles. Refer Figure 2.3, in which a 1-in-8 crossing is shown as measured by each method. The preferred method is the right angle method.

Angle of crossing is 'A' in the equations in Figure 2.3.

Rate of crossing is 'B' in the equations in Figure 2.3, i.e. 1 in 8.

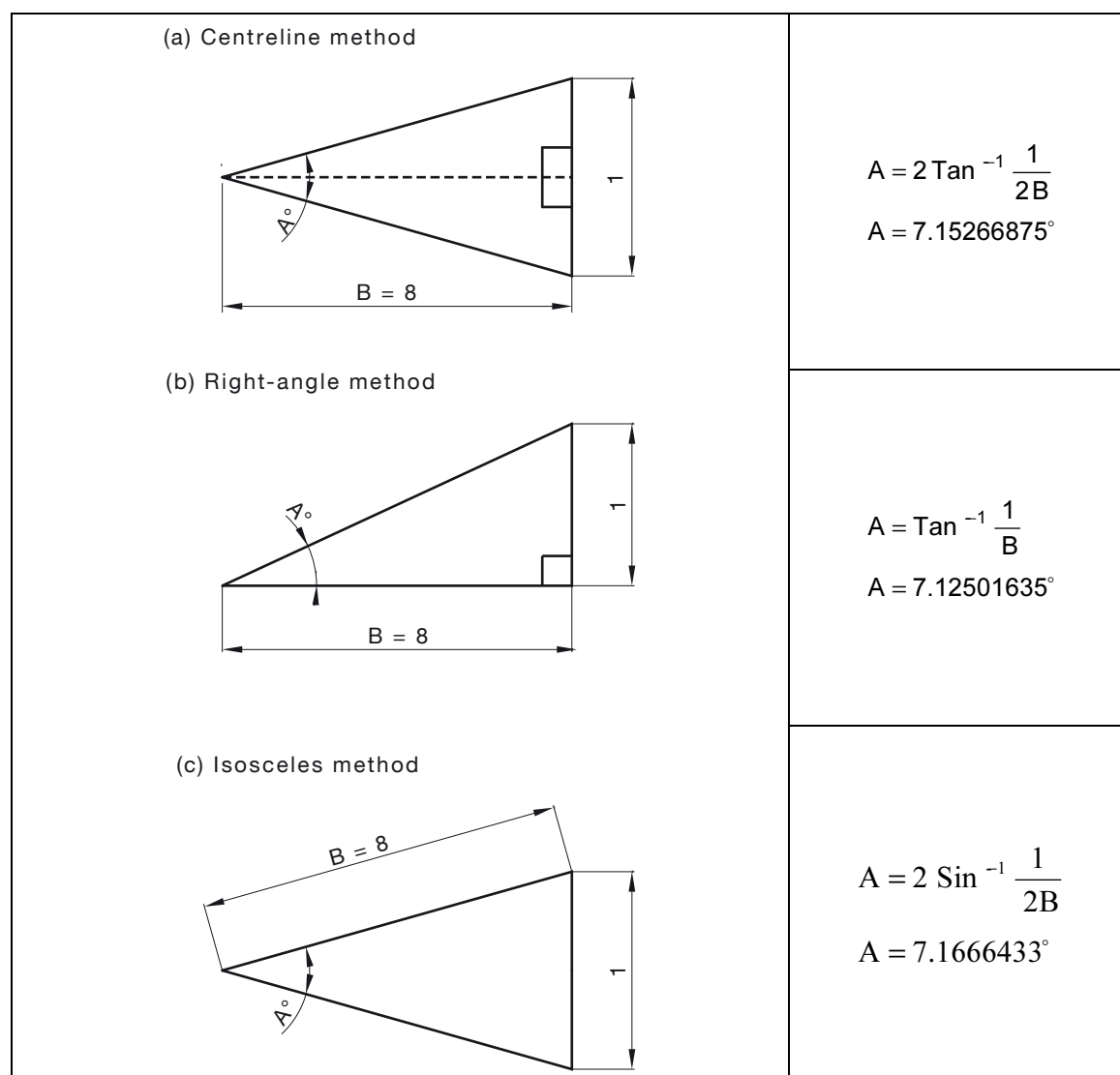


FIGURE 2.3 CROSSING—RATE

2.2.12.7 Crossing—Special

A non-standard crossing designed for a specific site. The crossing may be of an uncommon angle, and may have varying leg lengths or curved legs.

2.2.12.8 Crossing—Tang

The cast extension at the 'V' end of a rail bound manganese crossing to which the heel rails are fastened.

2.2.12.9 Crossing—Theoretical point

The intersection of the gauge lines of the two running rails forming the crossing.

2.2.12.10 Crossing—Throat

Where the minimum distance occurs between the inside edges of the wing rails at a position ahead of the nose(s) of a crossing.

2.2.12.11 Crossing—Wing rail

Wingrails form part of the construction of all crossings. They are either of the two outside rails of a permanent way crossing of which both are rigid in a fixed nose and swing nose crossing and one hinged in a spring wing crossing.

2.2.12.12 Crossing identification

Provided through a tag attached to the wing rail of a crossing and containing a set of data that identifies the crossing, manufacturer, etc. Also some of this data is stamped on the head of the checkrail ends.

2.2.12.13 Crossing 'K' types (see Figure 2.4)

A crossing comprising two opposing 'V's, a running wing rail and a wing checkrail. 'K' crossings are used in diamond and slip assemblies.

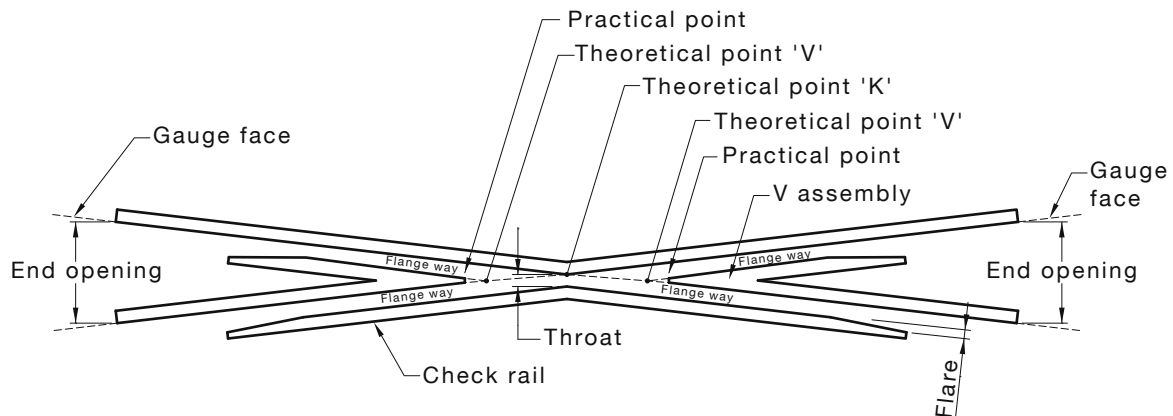


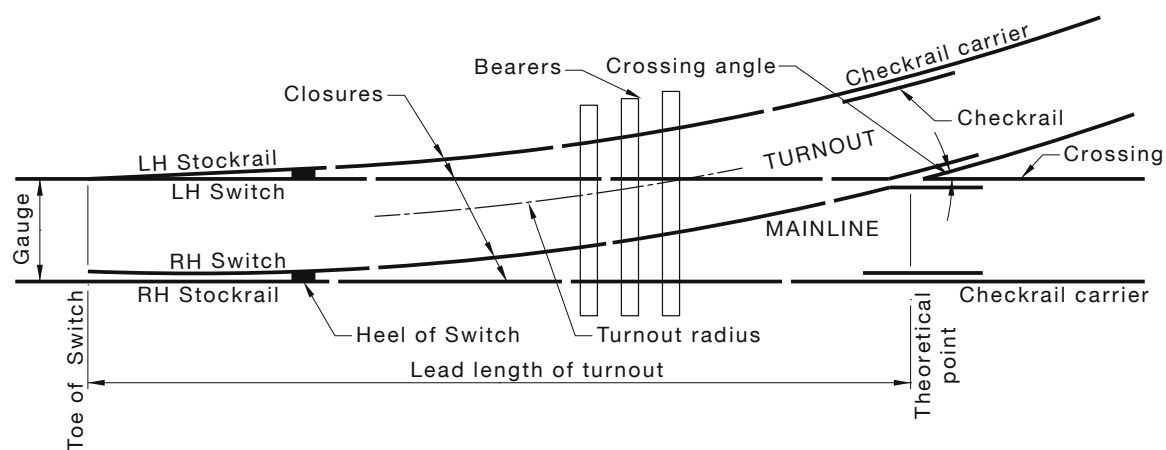
FIGURE 2.4 'K' CROSSING

2.2.12.14 Crossing 'K' types—Fabricated

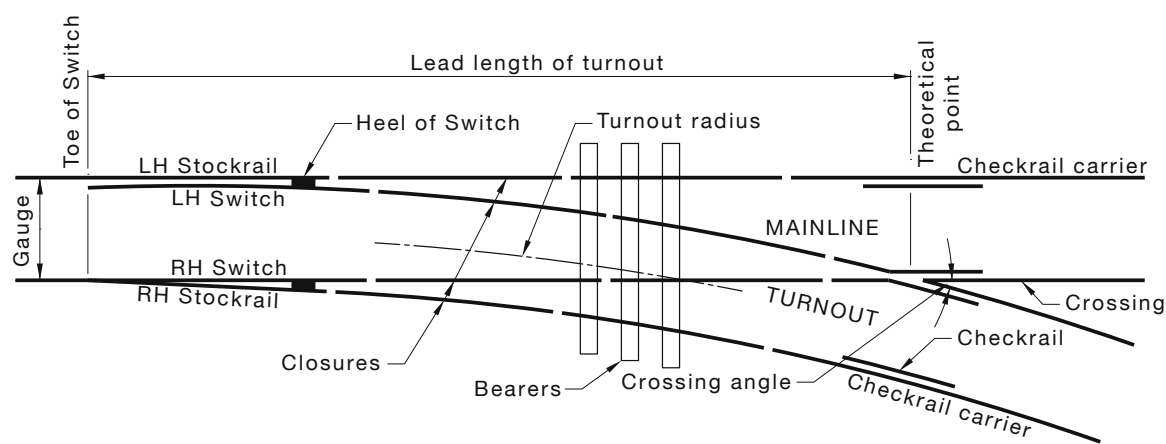
The noses, wing rails and checkrails are fabricated from sections of rail, set, machined and fitted together with blocks/chocks and bolts (refer to Figure 2.4).

2.2.12.15 Crossing 'K' types—Solid cast manganese (see Figure 2.5)

A one piece solid cast manganese steel crossing with the four legs joined to standard rail sections through a welding process or by bolts and plates.



(a) Left hand turnout



(b) Right hand turnout

FIGURE 2.5 'K' CROSSING TYPES—SOLID CAST MANGANESE

2.2.12.16 Crossing 'K' types—Switchable (see Figure 2.6)

The two opposing switches of the 'K' crossing that move to allow a continuous surface for the wheel to run through the crossing.

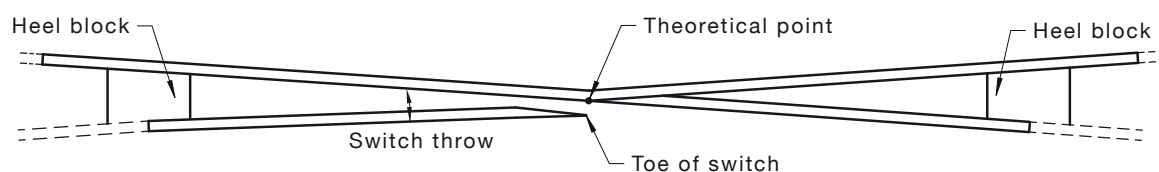


FIGURE 2.6 'K' CROSSING TYPES—SWITCHABLE

2.2.12.17 Crossing 'V' types (see Figure 2.7)

A crossing comprising a 'V' and two wing rails fixed by blocks/chocks and bolting to a specified geometric configuration.

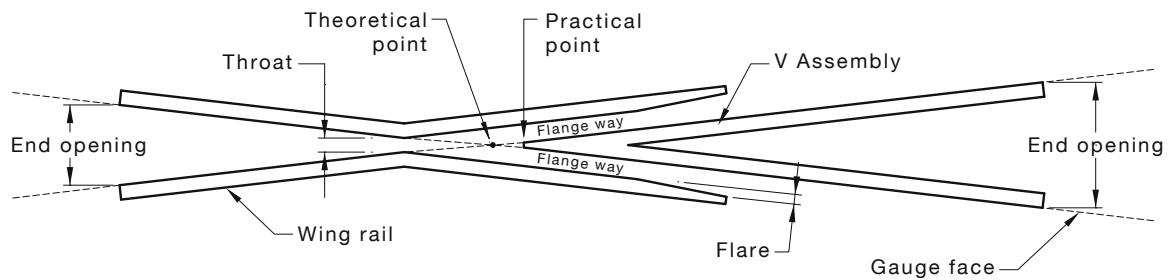


FIGURE 2.7 'V' CROSSING

2.2.12.18 *Crossing 'V' types—Fabricated (see Figure 2.8)*

A fabricated 'V' crossing comprises a 'V' which is manufactured from a point rail and a housed rail which are machined to match, assembled with two wingrails, fitted with spacer blocks and bolted or swage fastened together at the required angle.

The point rail may be right hand or left hand, and is generally laid along the rail carrying the predominant traffic.

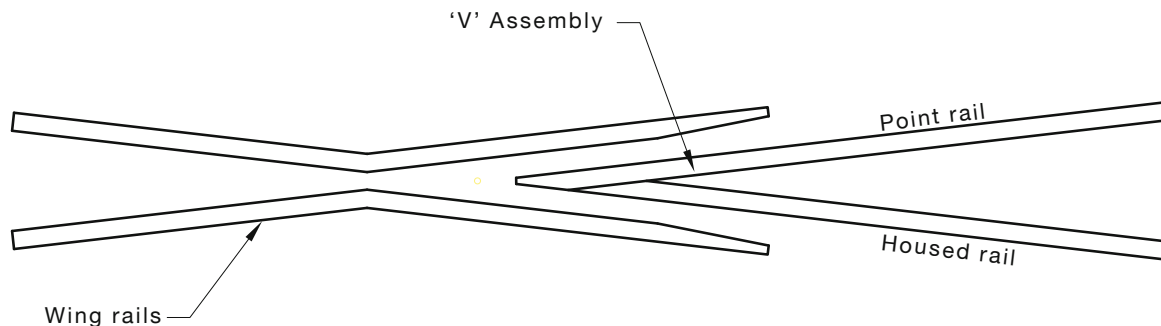


FIGURE 2.8 'V' CROSSING TYPES—FABRICATED

2.2.12.19 *Crossing 'V' types—Compound (see Figure 2.9)*

A compound crossing comprises a single-piece 'V' and two wing rails which form the front legs of the crossing. The 'V' point is manufactured from a special material (e.g. cast manganese, billet steel or forged material) which is welded to rails to complete the 'V'. This assembly in the wheel transfer area replaces the point/housed rails in a fabricated crossing. Spacer blocks may be epoxy-glued or welded to the 'V', and are fastened together using high-tensile bolts or high tensile swage fasteners.

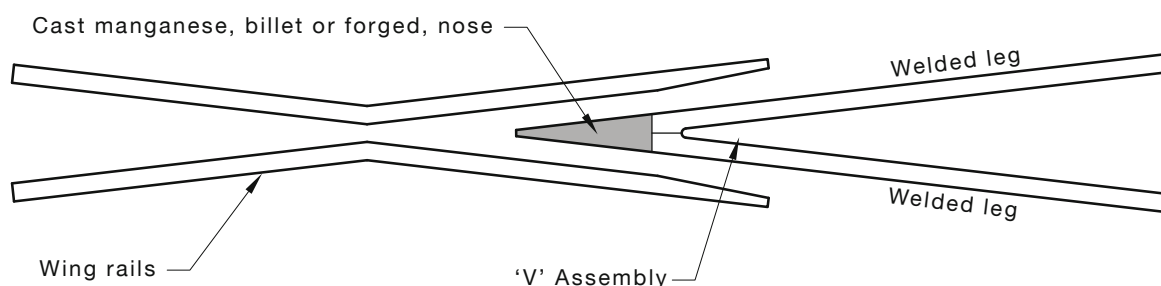


FIGURE 2.9 'V' CROSSING TYPES—COMPOUND

2.2.12.20 Crossing 'V' types—Rail bound manganese (see Figure 2.10)

Rail-bound manganese (RBM) crossings are crossings which include two specially machined and set wing rails which form the front legs of the crossing and which then enclose the insert casting and provide guarding of the transfer from the casting to the heel rails.

Additional spacer blocks are provided between the rails and insert to provide flangeway clearance and strength to the crossing assembly.

The insert, wing rails, heel rails and spacer blocks are usually set with an epoxy glue, and secured with high tensile swage fasteners.

The manganese steel insert casting is usually machined and explosively hardened prior to its assembly into the crossing.

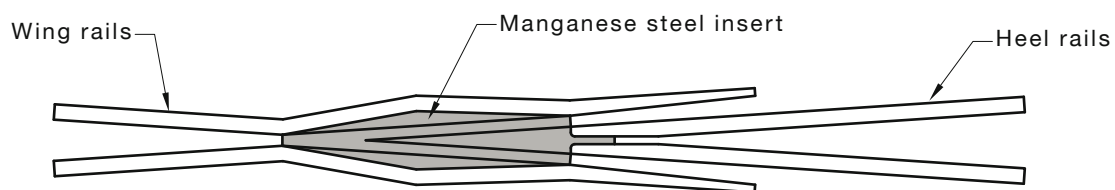


FIGURE 2.10 'V' CROSSING TYPES—RAIL BOUND MANGANESE INSERT

2.2.12.21 Crossing 'V' types—Solid cast manganese (see Figure 2.11)

Cast manganese steel monoblock crossings, or cast solid frogs are manufactured from a single austenitic manganese steel casting. The running surfaces may be machined and explosively pre-hardened prior to installation into track. Short closure rails may be welded to each leg of the casting to facilitate welding into track or by bolts and fishplates.

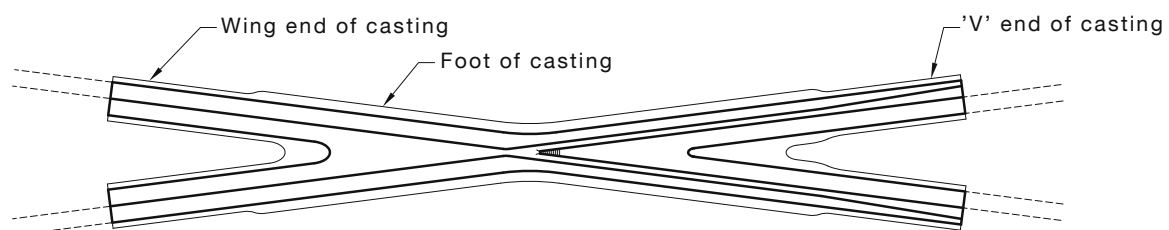


FIGURE 2.11 'V' CROSSING TYPES—SOLID CAST MANGANESE

2.2.12.22 Crossing 'V' types—Spring wing (see Figure 2.12)

A modified 'V' crossing with both a fixed and spring wing leg. The spring wing effectively eliminates the flange way gap when using the main line thus reducing the wheel generated impact in the crossing. The wheel flange forces the spring wing open when taking the siding track.

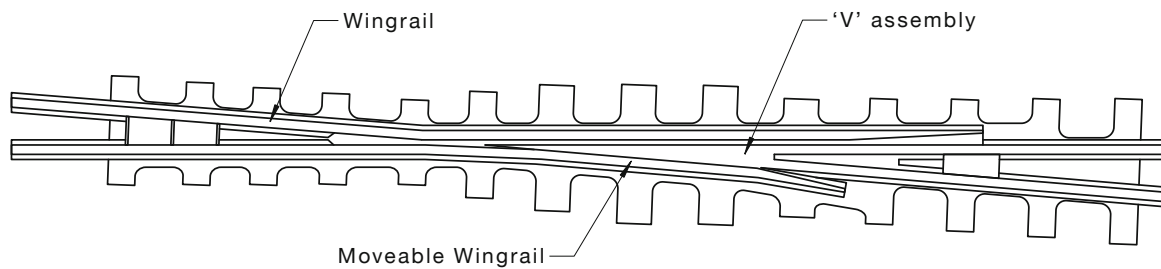


FIGURE 2.12 'V' CROSSING TYPES—SPRING WING

2.2.12.23 Crossing 'V' types—Swing nose (see Figure 2.13)

The 'V' which forms a moveable point, a moveable 'V' or a swing-nose crossing may be moved horizontally so that it may fit flush against one wing-rail or the other. The operation of the swing-nose is controlled by a motor or operating equipment which is interlocked with the motor or equipment used to operate the switches of the same turnout. Because the swing-nose is fitted against the relevant wing-rail, there is no gap when wheels transfer between the running rails and the 'V'. No checkrails are required with this crossing type.

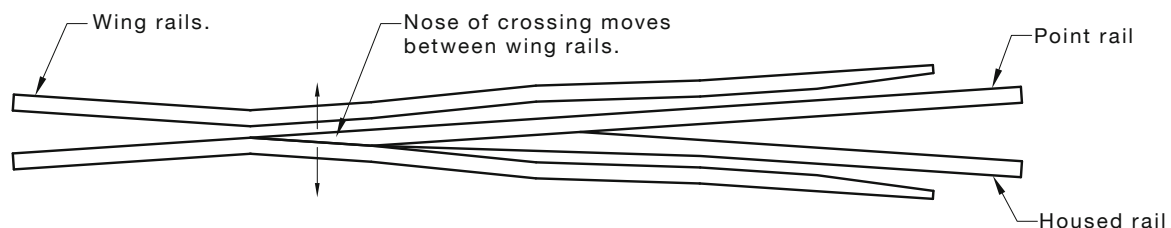


FIGURE 2.13 'V' CROSSING TYPES—SWING NOSE

2.2.13 Crossover

2.2.13.1 Crossover types (see Figure 2.14)

A means by which trains pass from one track to an adjacent track. A crossover is constructed from two turnouts, one on each track facing opposite directions.

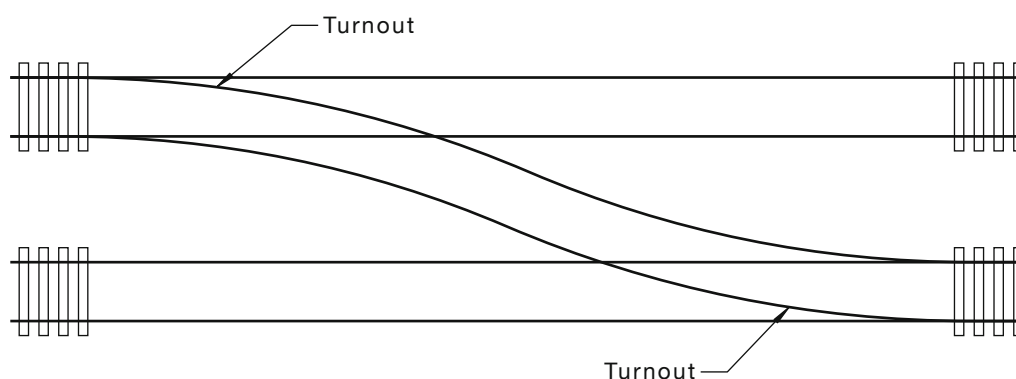


FIGURE 2.14 CROSSOVER

2.2.13.2 Crossover—Scissors type (see Figure 2.15)

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

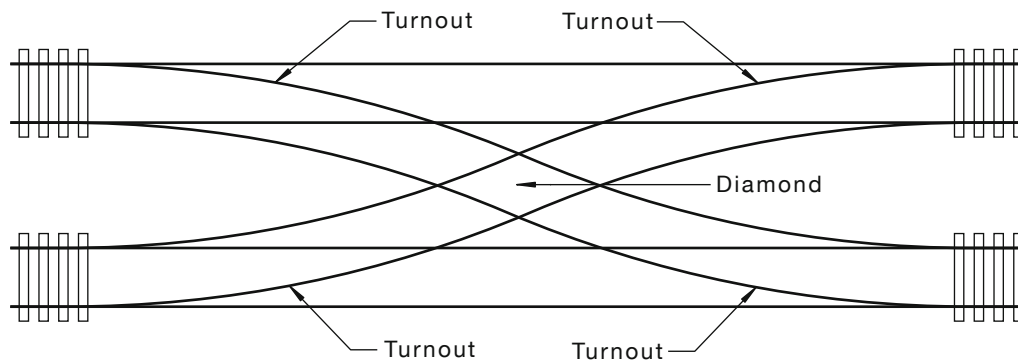


FIGURE 2.15 CROSSOVER—SCISSORS TYPE

2.2.14 Diamond (see Figure 2.16)

Diamonds provide for one track to cross another whilst maintaining continuous support and direction. They are an assembly of rail or cast components comprising the following:

- (a) 'V' crossings.
- (b) 'K' crossings.
- (c) Checkrails closure rails.
- (d) Bearers.
- (e) Plates, fasteners and rail joints.

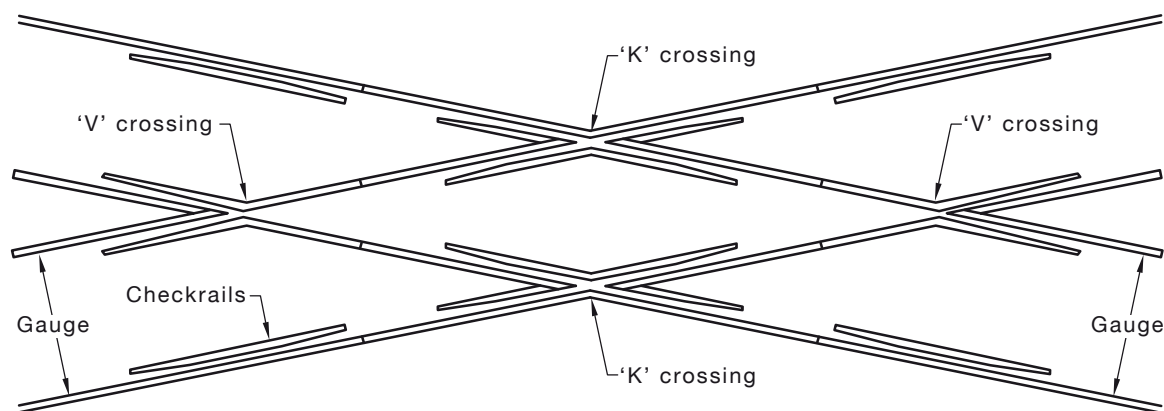


FIGURE 2.16 DIAMOND

2.2.14.2 Diamond crossing types—Fabricated

A diamond comprising fabricated 'V' and 'K' crossings.

2.2.14.3 Fully cast manganese

A diamond comprising of fully cast 'V' and 'K' crossings.

2.2.14.3.1 Switchable 'K's

A diamond comprising two 'V' crossings and two switchable 'K' crossings.

2.2.14.4 Diamond types**2.2.14.4.1 Flange bearing**

Where the depth of flangeway is reduced so that the wheels of the rolling stock run on the surface of the component separating the running rails. This operation occurs through the flangeway gap of the crossings.

2.2.14.4.2 Rail running

Where the rolling stock run on the surface of the running rails.

2.2.15 Dual gauge turnouts

Turnouts that are constructed with a mixture of both Standard Gauge (1435 mm) and Broad Gauge (1600 mm) widths, or Standard and Narrow Gauge (1067 mm) widths utilizing a common rail.

2.2.16 Expansion switch (see Figure 2.17)

An assembly comprising two rails appropriately matched and fastened at the longitudinal interface to provide virtual continuity of the running rail and gauge faces while allowing controlled longitudinal slip.

Expansion switches provide a level of control for rail stresses when tracks are attached to sub-structures (e.g. steel underbridges) which are also subject to temperature related expansion and contraction.

Expansion switches comprise:

- (a) Switch and stockrail assemblies.
- (b) Bearers.
- (c) Plates, fasteners and rail joints.

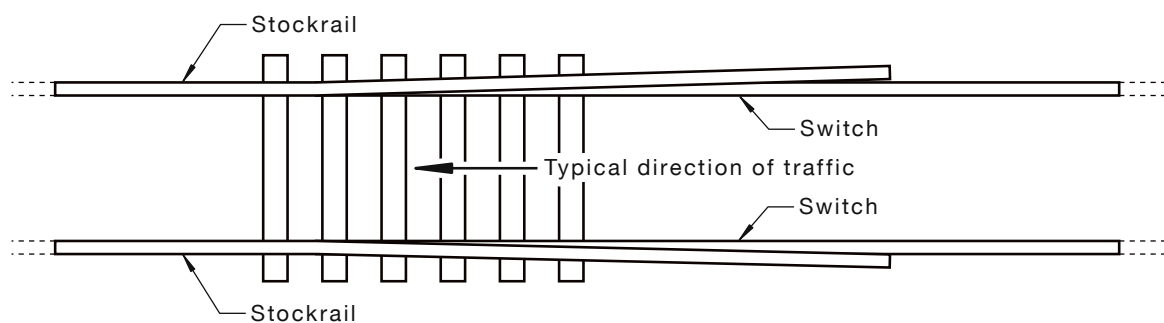


FIGURE 2.17 TYPICAL EXPANSION SWITCH

2.2.17 Fastening system

A combination of base plates, and fasteners used to attach the rail to the bearer. The system may include spikes, pads, clips, insulators and anchors.

2.2.18 Fishplate

A metal joint bar used to connect adjacent rails. Refer to AS 1085.2.

2.2.19 Flangeway (see Figure 2.18)

The space adjacent to the running rail to allow for the passage of wheel flanges.

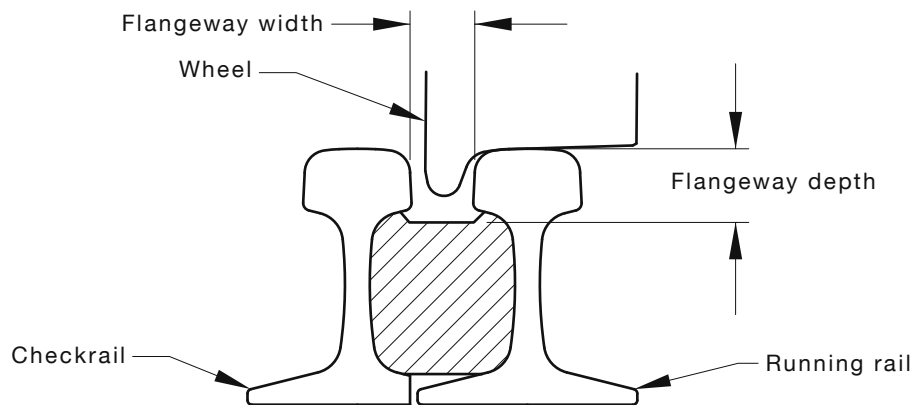


FIGURE 2.18 FLANGEWAY

2.2.20 Flangeway depth

The vertical distance between the top running surface and the top of the blocks/chocks separating the running and guarding surfaces to ensure wheel flange clearance.

2.2.21 Flangeway width

The distance between the running and checking surfaces to ensure wheel flange clearance or guidance.

2.2.22 Flare

The tapered opening at the ends of flangeways to gradually engage wheel flanges and position them to pass through flangeways.

2.2.23 Frog

See 'Crossing' (see Clause 2.2.12).

2.2.24 Gauge

The distance between the inside running (or gauge) faces of the two rails, measured at the gauge point.

2.2.25 Gauge corner

Transition surface separating the running surface (top of rail) from the gauge face of the rail.

2.2.26 Gauge face/Gauge line

The running side of a running rail.

2.2.27 Gauge point

The point on the side of the rail head (nominally 16 mm) beneath the top surface of the rail at which track gauge is measured.

2.2.28 Gauge side

The side of the rail within the track gauge.

2.2.29 Guardrail

A rail (inside or outside of the running rail) used to restrain lateral movement of a derailed wheel-set. Used to protect structures or control the lateral movement of the wheel-set on bridges or in other high risk situations.

'Checkrail' may have been referred to as 'guardrail' previously.