

Technical Specification for Manufacture of Components for Points & Crossing Structures

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1 Introduction

This Specification details the approved material components, manufacturing tolerances and procedures necessary for the manufacture of points and crossings structures and components for use in Australian Rail Track Corporation rail tracks.

This document covers the manufacture of turnouts, diamond crossings, slips and catchpoints, including dual gauge assemblies, and includes switches, crossings (fabricated, railbound, fully cast manganese (monoblock) and swingnose) and check rails.

This Specification is to be read in conjunction with drawings and other documents that form the complete specification for the particular work.

The definitions used in this document are shown in Appendix 1.

All components shall conform to the relevant drawings.

Referenced Australian Standards shall mean the current edition including any amendments.

2 Materials, Tests and Standards

All the materials and processes supplied by the manufacturer for this service shall unless otherwise specified and/or approved by ARTC, conform to the requirements and test standards of the relevant current Australian Standards as listed under or other applicable International standards:

AS 1085 Series	Steel rails, fishplates, sleeper plates, fishbolts, washers etc.
AS 1110	ISO metric hexagon precision bolts and screws
AS 1111	ISO metric hexagon commercial bolts and screws
AS 1112	ISO metric hexagon nuts
AS 1252	High Strength steel bolts with associated nuts, headlocks and washers for structural engineering
AS 1275	Metric screw threads for fasteners
AS 1442	Carbon steels and carbon-manganese steels – hot rolled bars & semi-finished products
AS 1444	Wrought alloy steels
AS 1448	Carbon steels & carbon manganese steels - forgings
AS 1554	Structural Steel Welding
AS 1816	Metallic Materials – Brinell hardness test
AS 1830	Grey Cast Iron
AS 1831	Ductile Cast Iron
AS 1832	Malleable Cast Iron
AS 2074	Cast Steels
AS 3678 or AS3679.1	Structural Steel - (Rolled Steel Sections, including bar for rivets)
AS 3834	Quality requirements for welding – Fusion welding of metallic materials
AS 4100	Steel Structures - (High strength bolting codes)

All the tests required by this Specification and/or the Australian Standard Specifications or other approved Specifications referred to herein shall be carried out by and at the expense of the manufacturer and such tests shall be subject to the supervision of ARTC.

Certificates of such physical tests and of the chemical analysis furnished by the manufacturers of the respective materials shall be supplied by the manufacturer free of charge to ARTC.

Use of Serviceable Rail

Serviceable rail may be used for the manufacture of points and crossing components where approved by ARTC.

Serviceable rail is that which meets the following requirements:

- The maximum wear limits for rails used in points and crossings manufacture shall be:
 - Points and Crossings Assemblies (excluding lead rails)
 - 3 mm maximum top wear
 - 2 mm maximum side wear
 - Lead Rails
 - 4 mm maximum top wear
 - 4 mm maximum side wear

The unworn or least worn running edge of transposed rail used for the manufacture of Points and Crossings assemblies shall be used as the running or gauge face.

All metal flow shall be removed by grinding or machining prior to commencement of manufacture.

Rail ends containing bolt holes shall be cropped to remove all bolt holes.

Oxy cut rail ends must be removed by saw or friction disc a minimum distance of 150 mm from the oxy cut prior to use.

All rails used for the manufacture of points and crossings and lead rails shall be ultrasonically inspected for defects in accordance with the requirements of AS 1085.1.

Welded serviceable rails are not permitted in the manufacture of Points and crossings assemblies.

3 Rails, Fishplates and Sleeper Plates

3.1 Rail

New rail shall comply with AS 1085.1.

Special rail sections shall comply with a recognised standard and be submitted to General Manager Technical Standards or nominated representative for review and acceptance.

Head hardened rail shall be provided for the manufacture of all switches and crossings where 50 and 60kg/m rail (both AS and to other approved standards) is specified.

It is the manufacturer's responsibility to ensure that rails both before and after manufacture are checked for straightness. The straightness tolerance shall conform to the rail straightness for un-machined surfaces in accordance with AS 1085.1 Appendix D. In addition, the straightness when measured with a two metres straightedge at any point shall not vary by more than 1mm over a length of 2m.

Flame cutting of or blowing of holes in rails and fishplates will not be permitted except that cutting of the discontinuous rails of diamond crossings to the correct profile where they abut the continuous rails will be allowed provided all oxidised material is ground off.

Flame cutting of rails may also be permitted for ease of handling purposes. After flame cutting, the rails must be sawn cut a minimum distance of 150mm from the flame cut end of the rails to remove any heat affected material.

Any reduction from the rolled section shall be by machining. The surface roughness value of machined or planed surfaces shall be better than 12.5 μm (N10).

3.2 Fishplates

Fishplates shall conform with AS 1085.2.

Flame cutting of holes in fishplates is not permitted

3.3 Sleeper plates

Reforged or fabricated steel plates may be used as an alternative to the standard rolled sleeper plate specified in AS 1085 Part 3.

Cast iron plates are to be made from Grade AS 1831 minimum grade 500-7 ductile iron or equivalent material.

Cast steel plates may only be used with the agreement of ARTC's nominated representative.

4 Castings

All castings shall be

- a. Clean and smooth on surface
- b. Free from surface defects
- c. Compatible with interfacing rail components
- d. Neatly dressed and cleaned
- e. Machined to accurately fit the rails
- f. Compliant with the relevant Australian standard.

Machined steel shall be smooth on the surface and sharp to the form and dimensions on the drawings.

All blocks shall be machined to accurately fit the rails.

5 Manganese Steel Castings

All manganese steel castings, including RBM crossing inserts, solid cast crossings and any special component part used for points and crossings (such as SNX cradles) shall conform to the provisions hereunder.

Manganese steel castings shall have the heat number clearly stamped or embossed on an upper surface.

Manufacturers are required to maintain quality records as described hereunder. All quality records shall be referenced to the ARTC turnout reference number.

5.1 Material

5.1.1 Composition

The chemical composition is given below.

C	Mn	Si	P
1.00 – 1.35	≥ 11.0	≤ 1.00	≤ 0.10

A spectrographic analysis is to be provided for each cast of metal which is to be taken from the ladle prior to pouring. These records shall be made available to ARTC's nominated representative upon request.

Note: The chemical composition of manganese steel castings may also comply with standard UIC 8660 where agreed by ARTC's nominated representative.

5.1.2 Heat Treatment

The heat treatment shall ensure that the final microstructure is austenitic and free of carbide aggregates, thick carbide films ($>0.2 \mu\text{m}$) and signs of incipient melting which are deleterious to toughness.

Castings shall be supplied in the water quenched condition. Quenching shall be performed from not less than 1040°C

5.1.3 Machining Allowance

A machining allowance may be specified on some drawings. This is designed to remove surface defects from the critical regions of the casting and to reduce the amount of weld repairs performed. The machining allowance shall be removed by a metal cutting process (not grinding) prior to explosive hardening.

5.1.4 Surface Hardness

Unless indicated otherwise in the schedule or on the order by ARTC, manganese steel crossings shall be explosively hardened to have hardness within the range 350 to 415 HBW, on all top surfaces and 20mm down the flangeways. Hardness testing shall be in accordance with AS 1816.

Machining of hardened surfaces shall not be undertaken unless approved by ARTC.

Castings which fail to meet the hardness specifications may be accepted only where agreed by ARTC.

Distortion resulting from the depth hardening process shall be rectified before the final assembly.

Hardness testing locations shall be taken as below:

1. On the running surface 500mm prior to the crossing nose (both sides)
2. On the running surface of the wing rails adjacent to crossing nose (both sides)
3. On the crossing nose surface at the point where the widens to 50mm
4. At the junction of any areas connective two components
5. At any other location specified by ARTC

Testing locations may be altered by agreement between the supplier and ARTC.

These locations are shown in example on an RBM crossing in Appendix B.

5.2 Casting Defects

Manufacturers shall ensure that sub-contractors are quality assured and shall negotiate with the sub-contractors the methods and responsibilities for testing and repair in accordance with the details specified hereunder.

5.2.1 Surface Defects

Castings shall be inspected visually for the presence of scale, lack of metal, cracks, sand holes, adherent sand, surface porosity, gas pockets, cold shots and cold shuts.

Imperfections	Maximum allowable dimension
Crack	Not permitted
Lack of fusion	Not permitted
Surface pore	Not more than 3mm diameter
Slag inclusion	Not permitted
Loss of cross-sectional area (including lack of porosity)	<5%

Surface imperfections shall be measured using dye penetrant testing.

Surface imperfections will not be classed as defects if dye penetrant testing verifies that they are less than 1 mm deep in critical areas and less than 3 mm deep in sub-critical areas.

All surface defects identified during visual inspections shall be prepared for weld repairs.

After weld preparation, the defect shall be re-measured for size using non-destructive testing.

The following definitions shall apply for manganese steel crossings:

g. Critical Area

The critical areas are defined as all top running surfaces and flangeways to a depth of 35mm, the junction of the tang and the casting on the top and bottom surface and within 120mm of interface for flashbutt welds.

h. Non-critical

The sub-critical areas are defined as all areas that are not critical such as other flangeway areas, the base of the casting, outside walls, webs, flanges and ribs.

5.2.2 Internal Defects

Radiographic testing shall be carried out to ensure the integrity of the casting:

1. If there are 8 or more defects within any one critical area, and/or,
2. If the size of the defect is greater than 5mm deep or 10mm wide, and/or,
3. When the clear distance between weld preparations is less than 15mm.
4. Periodically (samples from batches) as directed by ARTC.

5.2.3 Defect Repairs

5.2.3.1 Suitability for Repair

Near surface manufacturing defects may be repaired if the defect sizes are in accordance with the table below.

Maximum allowable dimensions	
Critical Area	<5mm deep and <10mm wide
	<7 defects of any size
Non critical area	<10mm deep and <15mm wide

Note: Adjacent weld preparations with less than 15 mm separation are considered as single defect for assessment purposes

Where defect sizes exceed the tolerances above repair may be undertaken when approved by ARTC

5.2.3.2 Repairing Defects

Defects shall not be repaired by peening, plugging or impregnating.

Weld repairs shall not be performed on a casting following the explosive hardening process. If any defect is found in a region that has been explosively hardened, the casting shall not be accepted.

Casting defects in new manganese steel inserts that have not been explosively hardened may be repaired by welding.

After explosive hardening the repaired area shall be hardness checked.

The complete removal of defects shall be verified by dye penetrant testing.

Welding repairs shall be performed in accordance AS 1988.

All weld repairs shall be performed in accordance with a qualified weld procedure endorsed by ARTC.

When weld repair is undertaken, all preparatory work, welding and non-destructive testing shall be undertaken by a competent person experienced in the qualified weld procedure.

5.2.3.3 Qualification of Welding Procedure

A procedure will be deemed qualified when a test sample is welded under similar conditions to that encountered in production and destructively tested by preparing two macro-specimens in accordance with AS 2205.1. The two macro-specimens should not be opposing surfaces of the same cut.

Both the weld and heat affected zone (HAZ) shall be examined. The qualified welding procedure must contain all of the information necessary for the welder to perform the repair and may take the form of a work instruction.

The test sample shall consist of manganese steel complying with this specification of final dimensions not less than 25 mm x 60 mm x 200 mm. Surface decarburization shall be removed from the surface to be welded. Four layers of weld metal shall be deposited to within 5 mm of all edges. The heat input shall not exceed 1.0 kJ/mm. The interpass temperature shall not exceed 260°C. The test piece can be tack welded to a backing plate to prevent distortion and shall be welded in the flat position. Unless otherwise approve by ARTC, electrodes shall be equivalent to AWS A5.13 EFeMn-A/B/C/D/E or AWS A5.21 ERFEMn-C/F/G/H.

Welders shall be qualified by welding the same test sample as detailed above using a qualified welding procedure and tested in accordance with the above.

5.2.4 Weld Maps

A weld map is to be prepared for all castings produced. If the casting has no defects the weld map is to be clearly marked with "NO DEFECTS".

Each report shall include the heat number, Manufacturer's name and crossing rate.

The points and crossings Manufacturer shall:

1. Maintain suitable quality records, including the weld maps, and referencing the heat number to the ARTC reference number.
2. Ensure copies of all weld maps are forwarded to the ARTC with comments on acceptability and request for the ARTC nominated representative to carry out inspections.

5.3 Explosive Hardening

Explosive hardening shall be carried out following weld repair and reheat treatment.

Following the explosive hardening, hardness testing in line with clause 5.1.4 shall be carried out at the locations shown on the drawing shown in Appendix 2, or as agreed by ARTC in the case of special castings.

Manufacturers shall maintain suitable quality records of the hardness test report.

5.4 Straightness of Casting

Following explosive hardening, the casting shall be straightened and machined in non-critical areas so as to conform to the tolerances listed in Clause 27 of this specification.

5.5 Epoxy Gluing of RBM Crossings

All blocks and the tang of RBM crossings shall be epoxy glued using Araldite 'Ciba Geigy' K105 air curing epoxy or equivalent. Surface preparation should be in accordance with the recommendations of the epoxy glue manufacturer, and shall at least include sand blasting or an equivalent surface preparation and degreasing. The fitting surfaces shall comply with Clause 16.1 and in no circumstances shall epoxy be used in lieu of a proper fit.

5.6 Theoretical Point

The theoretical point shall be indicated on the cast crossings by centre pop indent of 3mm diameter, after final machining and assembly as appropriate.

On fabricated crossings, the theoretical point shall be indicated by a low stress centre pop indent (rounded) of 2mm diameter on the outside of each wing rail.

6 Fastenings

6.1 Bolts

Fishbolt quality material shall comply with Australian Standard for fishbolts and nuts, AS 1085, Part 4 High strength (HS) steel bolts and associated nuts and washers shall comply with AS 1252.

All bolts shall be of the forms and sizes indicated and of a length to provide 3mm minimum to 12mm maximum projection of the end of the bolt beyond the nut when finally screwed into position.

The head of all bolts shall be formed by forging.

The following bolts and nuts used in assembling points and crossings shall have either square or hexagonal heads, hexagonal nuts and are to comply with the above specification unless detailed otherwise below:

TYPE OF BOLT	STANDARD
Switch Chair	AS1085 Part 4
Check Rail	AS1085 Part 4
Adjustable Switch Stop	AS1085 Part 4
Elevated Check Rails	AS 1110
Crossing	AS1252
Heel	AS1085 Part 4
Special Heel	To be manufactured from Grade X4150 or X4140 steel to AS1444 as supplied in the heat treated condition by the steel Manufacturer." Forged bolts are to be stress relieved in accordance with the steel Manufacturer's recommendation.
Counter Sunk Nib – Neck Bolts	To be fishbolt quality and fitted with nuts in accordance with AS 1112, unless insert type lock nuts are indicated on the drawings.

6.2 Swaged Fastenings

High tensile 25.4mm diameter swaged fastenings with flanged collars shall be used in crossing assemblies except at curved crossing bolt positions shown on the drawings where insufficient clearance in the holes precludes their use, unless otherwise specified.

Swaged fastenings shall be tightened commencing from the front of a crossing, alternately in each direction towards the openings. All sharp edges shall be ground off the ends of the swaged lock fastenings after installation.

Non-flanged collars are acceptable provided a hardened washer either flat or tapered is used.

The first washer under the head of any swaged fastener shall have clearance for the head to shank radius.

Tapered washers shall be used with bolts and swaged fasteners when angle between the head of the fastener and the rail exceeds 3 degrees. Tapered washers shall be manufactured from either cast steel, grade C6, in accordance with AS 2074 or machined S1040, S1042 or S1045 steel complying with AS 1442.

Flat hardened washers shall be used to pack the swaged fasteners to obtain the correct grip length, and shall be equally distributed under the head and collar.

Fastening pins shall comply with AS 1442 Grade 1137.

The maximum clearance between the inside diameter of the washer and pin shall be 3mm. Up to a maximum total of four washers shall be used to provide grip length. The total number of washer combinations shall consist of either four 4mm washers or two 4mm washers and two 10mm washers. Washers shall be equally distributed under the head and collar with the number of washers used kept to a minimum.

The pin shall not extend more than 10mm past the end of the collar or finish less than 3mm under the end of the collar after application. If longer fasteners are used, they shall be cut off 10mm outside the collar.

6.3 Retaining Compound

Where bolts are approved for use in crossings, during the final assembly a High Strength Anaerobic Retaining Compound shall be applied to the threads of the bolts and their nuts. The threads shall be clean and dry and any rust, grease, oil etc. shall be removed from the threads by a wire brush as far as possible. Solvents such as petrol and kerosene shall not be used to clean oil or grease. Locquic primer may be used as a cleaning solvent.

7 Welding and Cutting

Welding is not permitted other than where shown on the drawings, without the approval of the General Manager Technical Standards or nominated representative.

All mild steel switch chairs and switch lugs shall be true and free from defects when completed. The cutting shall be done in an approved manner. All the materials which are cut using an oxy-acetylene flame shall be ground smooth and all burnt metal shall be removed.

All the welding shall be done in strict accordance with the requirements of AS 1554 Part 1-SP.

Rails and Fishplates for modification are not to be flame cut.

8 Hardening

Certain wearing surfaces of components shall be hardened where shown on the Drawings supplied by ARTC.

The Contractor shall advise in writing all details of the method to be employed in the hardening process and approval in writing obtained from the General Manager Technical Standards or nominated representative before the process is commenced.

9 Drilling

All drilled holes shall be accurately drilled to jigs, templates and/or gauges conforming to the centres and dimensions shown on the Drawings. All drilling burrs must be removed. Holes to be 3mm larger than the bolt specified, unless otherwise shown on the Drawings.

Holes may not be drilled through debossed brands. Rolling brands must be removed from rails prior to jig drilling where such rolling brands will contact jig location or reference faces on chocks, etc. All castings required to be jig drilled shall be dressed to size before being jig drilled.

Incorrectly drilled holes are cause for rejection. Holes must not be plugged and re-drilled.

Punching of holes in rails and fishplate sections is not permitted.

10 Sawing and Machining

Rails shall only be cold sawn.

Flame cutting of rails is prohibited, except as described in clause 3.

All machining operations must be carried out by methods approved by the General Manager Technical Standards or nominated representative.

All machined components shall be machined accurately to the dimensions and sections shown on the relevant drawings.

All machining shall conform to approved templates and gauges and shall be finished to a roughness standard shown on the manufacturing drawings.

Any sharp edges and burrs shall be removed. All working surfaces are to be machined or ground to provide uniform bearing throughout.

11 Bending, Curving, Setting and Twisting of Rails

Rails shall be pressed straight and true before commencing fabrication.

When curved rails are specified, they shall conform to the uniform arcs of circles and be bent cold without injury to the material.

Rails shall only be curved, bent, set or twisted in machines approved by the General Manager Technical Standards or nominated representative. Curved or set rails must have no twist when sitting free on a level surface.

When twisted rails are specified to cater for changing rail cant from 1 in 20 to vertical, the rail surface tolerance over the area of the rail head affected shall be as specified for welds in ARTC Code of Practice: Section 1.

Rails shall not be heated above 175°C when bending.

12 Riveting

The quality of the material shall conform to AS 3679 Grade 250.

All rivets shall be hydraulically or pneumatically riveted and shall be heated uniformly from head to point before riveting.

No rivets shall be over heated. All loose rivets and rivets with mis-shaped heads shall be cut out and replaced by sound rivets.

13 Fitting

All parts of the components shall be to the correct form, dimensions and angles. They shall be fitted with accuracy to the dimensions and within the tolerances shown on the Drawings and in this Specification.

Cast iron chocks shall be finished to fit rail profile over 80% of their fitting faces, and where nominated on the drawings, chocks shall be machined to fit rail profile over 90% of their fitting faces.

All chocks except those nominated above shall be set in epoxy. See clause 21.

The manufacturer shall make due allowances for variations in rail sizes, for the machining and fitting of rail parts and blocks.

14 Forgings

All forgings shall conform to the relevant Australian Standard and the Drawings and shall be free from distortion, rags, pins, excessive scale and other imperfections.

Allowance must be made in the dies to prevent excessive drawing of the metal or distortion of the holes and rail slide surfaces.

Mild steel chairs, where required, shall be flat on the base and shall accurately fit the rails as required. Chairs are to be formed by a hot pressing process.

15 Cast Iron Blocks and Cast Iron Ferrules

The class and quality of the material shall conform to the requirements of Australian Standard for Iron Castings – Grey Cast Iron AS 1830 Grade 250. They shall be clean and smooth on the surface, free from blow holes, blisters, or flaws of any kind, run full and sharp to the form and dimensions shown on drawings and neatly dressed and cleaned. Blocks shall accurately fit the rails.

16 Cast Steel Blocks

16.1 General

All castings shall be clean and smooth on the surface, free from blow holes, blisters or flaws of any kind, run full and sharp to the form and dimensions shown on the drawings and neatly dressed and cleaned. Machined steel shall be smooth on the surface and sharp to the form and dimensions shown on the drawings. All blocks shall be machined to accurately fit the rails. Switch stop blocks shall be ground or machined to accurately fit the rails and tapped normal to the surface of the stop that bears against the web of the stock rail.

16.2 Steel Filler Blocks, Steel Distance Blocks and Steel Packing Blocks

Steel filler block, steel distance blocks and steel packing blocks shall be manufactured from either of (a) or (b) following:

- a. Cast steel, the class and quality of which shall comply with Australian Standard for Steel Castings AS 2074 Grade L1B
- b. Machined S1045, S1042, K1330, K1045 or K1042 steel complying with AS 1442

16.3 Adjustable Switch Stops

Adjustable switch stops shall be manufactured from either (a) or (b) above, or (c) following:

- a. Spheroidal graphite cast iron, the class and quality of which shall comply with Australian Standard for Spheroidal or Modular Graphite Iron Castings AS 1831 Grade 400-250-12.

16.4 Cast Steel Heel Blocks

Where cast steel heel blocks are required on the drawings, they shall comply with (a) above, additionally Grade C4 cast steel shall be acceptable.

16.5 Fabricated Steel Heel Blocks

Fabricated steel heel blocks shall be in accordance with the details shown on the drawings.

17 Mild Steel Tube

The dimensions and quality of this material where used for ferrules shall be equal to the best commercial steam piping of similar diameter.

The tubes shall be cut true to the lengths indicated on the drawings, free from burrs and other defects, with ends providing full contact on abutting surfaces.

18 Special Heel Bolt Ferrules

Special heel bolt ferrules, where required on the drawings, shall be machined S1040 or S1045 steel bar complying with AS1442, case hardened and tempered to Rockwell 54C.

19 Welding of Fishplates for Diamond Crossings

Where required the fishplates shall be jointed in the manner indicated on the Drawings and all workmanship shall be in accordance with Australian Standard AS 1554.1-SP. Electrodes are to be of approved low hydrogen type. The welding procedure must be approved by the General Manager Standards, Systems & Performance or nominated representative prior to the commencement of production welding. The fabricated fishplates are to be stress relieved after welding by heating to 450 degrees Celsius and held for two hours at this temperature after which they are to be cooled in still air.

20 Nylon Bushes

Bushes shall be injection moulded from type 11 nylon impregnated with graphite or molybdenum disulphide.

21 Epoxy Gluing of Crossing Blocks

All blocks and rail mating surfaces of diamond, fabricated crossings and swing nose crossings manufactured from AS60kg/m, AS53kg/m, AS50kg/m and 47kg/m rail shall be epoxy glued using Araldite "Ciba Geigy" K105 air curing epoxy or equivalent. Filler blocks for diamond crossings may not be glued when disassembly is necessary for transport. Surface preparation should be in accordance with the recommendations of the epoxy glue manufacturer, but shall at least include sand blasting or an equivalent surface preparation and degreasing. The fitting surfaces shall comply with Clause 16 and in no circumstance shall epoxy be used in lieu of a proper fit.

22 Assembly of Points

The method of assembly shall be specified by the Manufacturer and approved by ARTC.

Notching for run-out of machining of heads and flanges of stock rails shall conform to the relevant drawings, shall be finished smoothly and shall be no deeper than required.

Rail stops shall touch the webs of the switch rails over 80% of the face of the stop when the switches are fitting against the stockrails. The switches must give the required amount of throw.

Rails shall be straight where required without pressure being applied to the parts.

Distortion of parts caused by machining or other operations shall be corrected before the points are assembled.

Switch/Stockrail assemblies for the turnout shall have the appropriate set in the stockrails for that turnout. The stockrail is to have all plates attached, the heel block fitted and the switch attached.

All sliding surfaces of switch chairs shall be coated with an approved dry lubricant.

23 Assembly of Crossings

The method of assembly shall be specified by the Manufacturer and approved by ARTC.

The running edges shall be to true alignment at a depth below the top surface of the rails as specified on the relevant drawings.

An epoxy resin filler (Araldite K105 or approved equivalent) shall be applied to the fitting faces of the manganese inserts and blocks.

Rails and blocks shall be free of scale, rust and contaminants prior to application of the epoxy resin filler. Excess filler shall be removed from the rail and blocks.

Fastenings shall be inserted with all heads on the one side of crossings wherever practical. The correct side is indicated on the relevant drawings.

24 Swing Nose Crossings

24.1 General

A swing nose crossing comprises a flexible vee between two specially bent wing rails fitted together with blocks and fastenings as shown on the drawings.

Lifting beams for swing nose crossings are required for the transshipment of the crossings and shall be designed to ensure that distortion of the crossing does not occur during transportation and handling.

Swing nose crossings and lifting beams shall be manufactured in accordance with the drawings.

Reinforcing bars may be riveted or swaged fastened to switch rails. Where swaged fasteners are used, the holes in reinforcing bars and the switch shall be 1.0mm maximum larger than the pin.

24.2 Packaging, Handling and Transport

The Manufacturer shall take care to avoid bending and/or distortion of the rail or plates by ensuring that the swing nose crossing assembly is adequately supported and braced at all stages of manufacture, loading and transportation.

When not required to be supplied by the Manufacturer as part of the contract or order, a suitable lifting beam shall be used by the Manufacturer for the loading of swing nose crossings.

For transportation either by road or rail, the Manufacturer shall ensure that all crossings are fully supported and restrained to prevent any movement or damage in transit. Bracing timber blocks shall also be provided between leg rails at both ends of swing nose crossings.

The Manufacturer shall be responsible for providing and meeting all costs for packaging, supporting and restraining crossings for transportation.

25 Dual Gauge Assemblies

Each completely assembled turnout must satisfy the following requirements, unless otherwise specified on the drawings:

- a. Track gauge as measured between the running faces of the rails at a point 16mm below the top of the rail head shall be:

Broad gauge	1600mm \pm 2mm
Standard gauge	1435mm \pm 2mm
Narrow gauge	1067mm \pm 2mm
- b. The end of the switch blades of the left and right switch assemblies, are to be square in relation to each other within \pm 2mm.
- c. The ends of the check rails of the check rail assemblies are to be in line with the wing rails of the 'V' crossing assembly. The maximum allowable out of square tolerance is \pm 5mm.
- d. The force required to operate the switch mechanism non-lubricated, must not exceed 1500 N.
- e. The distance between the running faces of the broad and standard gauge rails shall be 165mm \pm 2mm.
- f. The manufacture tolerances for the individual switch, crossing and check rail assemblies shall be as specified on the drawings.
- g. For dual gauge assemblies laid on flat steel plates secured to timber bearers where the plates support more than 2 rails, the hole positions are to be marked from the steel work to allow for accumulation of variations in rail dimensions and the fitting together of the rails and blocks.
- h. The lengths of closure rails as detailed on the drawings are for guidance only. Each closure rail is to be measured from assembly of each mixed gauge turnout to meet overall dimensional criteria and tolerances.

26 Fixed Points

Fixed points are used in standard and broad gauge separation assemblies in Victoria.

For all fixed point assemblies the toe thickness of the point rail shall be +0.5mm, -0mm of the thickness specified on the drawings, the alignment of the running edges of the top shall be \pm 3mm in any 5 metre length.

27 Tolerances

Tolerances are permitted in the rolling of rails and the manufacturer must make due allowances for variations in rail sizes.

Except where otherwise shown on drawings and in this Specification the following tolerances shall apply.

27.1 Manufactured Rails

Where rails are to be cut to length the maximum out of square tolerance for the ends is 0.5mm.

Rails required to be curved to a specified radius shall be formed to an even radius. The maximum deviation from the specified radius is $\pm 10\%$ of the correct version for that radius, measured over a 3 metre chord length at any point. Where offset dimensions are given, the rail position shall be within $\pm 2\text{mm}$ of that position in addition to meeting the above radius specification.

Where curved crossings are used, check rails must be curved to the radius of the check rail carrier before assembly.

The position of holes in rails shall be $\pm 1\text{mm}$ longitudinally and $\pm 1\text{mm}$ vertically of that specified on the drawings. The size of all holes shall be $\pm 1\text{mm}$ of that specified.

The surface roughness value of machined or planed surfaces shall be better than $12.5 \mu\text{m}$ (N10).

27.2 Other Tolerances

	COMPONENT	TOLERANCE
a	Rails	
	Length of check rails	+5mm, -5mm
	Length of wing rails	+5mm, -5mm
	Length of closure rails	+5mm, -5mm
b	Switch Assemblies	
	Length of switches	+5mm, -5mm
	Length of point rails	+5mm, -5mm
	Toe of switches to end stock rail	+5mm, -5mm
	Heel spread	+2mm, -2mm
	Toe thickness	+1mm, -0mm
	Set stockrail heel end offset (where provided)	+2mm, -2mm
	Point stop fit against stock rail	0.5mm max clearance
	Spreader bracket location	+2mm, -2mm
	Gauge of points	+2mm, -1mm
	Switch toe opening (at locking position)	+10mm, -10mm
c	Crossing Lengths	
	Fabricated and RBM crossing leg lengths to theoretical point	+3mm, -3mm
	Fabricated and RBM crossing overall length	+6mm, -6mm

d	Width of Flangeways	
	Fabricated crossings	+2mm, -2mm
	Solid cast crossings	+1mm, -2mm
e	Check Rail Gap	
	Width of gap	+0mm, -1mm
f	Gauge for Diamond Crossings	
	Track gauge	+2mm, -2mm
g	Manganese Steel Castings (including castings for RBM crossings)	
	Overall length	+6mm, -6mm
	Theoretical point to end of casting	+3mm, -3mm
	Toe and heel spread	+2mm, -2mm
	Running surface flatness from theoretical top	+1mm, -1mm
	Machined surfaces	+0.5mm, -0.5mm
	Flangeway width	+1mm, -2mm
	Flangeway depth and vertical dimensions (except as specified otherwise)	+2mm, -2mm
	Gauge face alignment from theoretical line	+2mm, -2mm
	Fishing surfaces to test fishplate	+2mm, -0mm
	Maximum twist of casting from end to end	5mm
	Hole vertical position and diameter	+1mm, -1mm
	All running surfaces, both top & flangeway edge and fishing surfaces are to be machined or ground smooth and true prior to hardening to achieve tolerances	
h	Rail Bound Manganese Crossings	
	Relative height of casting to running rails at throat area and tang	
	For non-machined surfaces	1mm
	For machined surfaces	0.5mm
	Gauge face alignment, casting to abutting tang rails	1mm
i	Crossings (all crossings)	
	Relative height of crossing nose to wing rails	+1mm, -1mm
	Nose width	+1mm, -1mm
	Rail flange clearances	+2mm, -2mm
	Theoretical point to end of crossing	+3mm, -3mm
	Overall length	+6mm, -6mm
	Alignment of running edges and surfaces, from theoretical line	+2mm, -2mm
j	Solid Cast Manganese Crossings	
	Relative height of casting to top running surface of abutting rails	+1mm, -1mm
k	Dual Gauge Turnouts	

Theoretical point to theoretical point	+5mm, -5mm
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28 Lubrication

Where specified on the drawings, the slide surfaces of AS47, AS50, AS53 and AS60kg chairs and baseplates, which are located between the toe and the first fixed heel blocks of points shall be lubricated with an approved graphite lubricant by a process specified by the manufacturer and approved by ARTC.

The slide surfaces to be lubricated shall be thoroughly cleaned to remove all scale rust, grease, moisture and other contaminants. Redisal N5 or similar non-flammable solvent may be used for degreasing if necessary.

Two liberal, even layers of graphite lubricant shall be applied onto the slide surfaces. Dust and contaminants shall not be permitted to come into contact with the wet lubricant. The first layer shall be completely dry before the second is applied. The point blade shall not be assembled onto the slide surfaces until the lubricant has completely dried. Drying of the lubricant under normal conditions will require 30 minutes and may be assisted by using dry compressed air.

29 Stamping

All crossings and fixed gauge components shall be clearly and legibly stamped for identification as below.

- a. For points and crossing assemblies the name or symbol identifying the Manufacturer, the year of manufacture, the manufacturer's job number, the ARTC catalogue number and on crossings, its angle. These shall be branded in 12mm minimum characters on the top of the head at the splayed end of one wing rail and on the heel block of switch assemblies.

When a fabricated crossing or wing rail is manufactured with materials other than standard carbon steels, the materials in the crossing and/or wing rail is to be identified on the other wing rail. Branding shall be as follows:

- "HH" for head hardened rail
 - "MN" for manganese steel
 - "CV" for chrome-vanadium steel
- b. All crossing blocks and heel blocks shall be branded with 16mm minimum raised letters and numerals indicating the type of block, size of rail, and angle of crossing (if crossing blocks) eg C.60AS.12. Heel blocks for fixed heel switches shall also be branded with a triangle pointing towards the toe of the switch to indicate the orientation of the block.
 - c. The word "TOP" shall be branded in small letters on the topside of blocks for all classes of rail which are not symmetrical. If there is insufficient room for the word "TOP", the letter "T" is to be substituted.
 - d. All plates shall be branded with 12mm minimum letters and numerals stamped into the plate indicating the type of plate and weight of rail, or as indicated on the drawings. The plate type shall also be indicated with 25mm letters and numerals painted in white on the top of the plate. Plates under the crossing and under the guardrail on the turnout side only shall be further branded with the angle of the crossing. The plate must be attached in a permanent manner to the body of component and not a leg which may be shorted during installation.
 - e. The name or symbol identifying the Manufacturer shall be shown on each track assembly.

- f. On diamond crossings only, the wing rail of one obtuse crossing shall be branded in 12mm minimum letters and numerals with the drawing number to which the diamond has been manufactured.
- g. RBM castings shall be branded with 12mm minimum raised letters and numerals on the tang, identifying name or symbol of the Manufacturer, year of manufacture, angle of crossing, size of rail and heat number. The intersection of gauge line shall be indicated by a suitable raised point.

Crossings shall be stamped on the head and within 300mm of the end of the wing rail as shown on the drawings with the weight of rail and angle of crossing i.e. "47Kg", 1 in 10, also the initials of the manufacturer shall be stamped in this same location.

Switch assemblies shall be stamped on the heel block with the initials of the manufacturer.

30 Match Marking

Each turnout, including mixed gauge turnouts, compound and diamond assemblies shall be match marked to facilitate re-assembly in the field.

The method of match marking shall be with letters 50mm high using a white durable paint.

31 Coating and Painting

All components except bolts, pins and sliding surfaces of plates shall be coated with one coat of an approved "environmentally friendly" protective coating such as 'Aqualock 8125'. The use of alternative protective coatings will only be approved after a certified "Material Data Sheet" has been accepted by the General Manager Technical Standards or nominated representative.

Prior to dispatch the sliding surfaces of plates are to be coated with an approved dry plate lubricant. The coating may be applied by brushing, spraying or dipping.

All bolts and pins shall be dipped in an approved protective coating. On no account shall any painting or oiling be carried out before final inspection.

Surfaces may be painted with grey paint. All loose rust and mill scale shall be removed before painting.

Internal machined or ground surfaces which cannot be oiled after assembly and all fastenings for permanent assembly shall be rust proofed by coating with an approved rust proofing compound.

Spreader bracket bolt holes shall be rust proofed.

32 Final Assembly and Inspection

The General Manager Technical Standards or nominated representative may direct that a whole item, or any portion thereof, be completely assembled prior to delivery. The trial assembly is to comply with all specified dimensions of the assembly Drawings.

The assembly may be inspected by the General Manager Technical Standards or nominated representative and must conform to the dimensions shown on the Drawings.

33 Preparation for Dispatch

After inspection, the items are to be prepared for dispatch in the following sub-units.

- Individual closures.

- Crossing.
- Checkrails bolted to matching checkrail carrier.
- Each switch combined with switch, stockrail, studs, chairs and heel blocks. The switch must be securely fastened to the stockrail to prevent damage.

Baseplates, bolts and other items which form part of the contract shall be packaged into bags or boxes with maximum mass of 40Kg.

All other items are to be identified in an approved manner for identification for correct assembly to distinguish them from similar components as required.

34 Appendix A

34.1 Definition & Description of Major Components of Points & Crossing Structures

Turnout

A Turnout is a complete track unit consisting of switches, crossings, associated closure rails, check rails, running rails, plates, filler blocks, spacer block, chairs and rail braces, bearers (timber or concrete), lockspikes, dogspikes and/or resilient track fastenings, swaged fastenings fishplates, bolts and insulated joints when specified. See Figure 1 for component configuration.

Some turnouts in line with ARTC NSW Standards are designated as standard, medium speed, special or semi-standard as described below.

A "Standard" turnout is a turnout designed to allow a passenger train to travel through the turnout curve at speeds up to normal 55km/h, XPT 70km/h. It is used when the main through track in which the turnout is installed is straight.

A "Medium Speed" turnout is a turnout designed to allow a passenger train to travel through the turnout curve at speeds up to Normal 80km/h, XPT 100km/h.

A "Special" or Semi-Standard" turnout is one that is installed in a main track which has an amount of curvature occurring in that length between the end of the stockrail front and the end of the crossing long leg.

Diamond Crossing

A diamond crossing comprises two V crossings and two K crossings, check rails and filler blocks, bolts or swaged fastenings, spring washers, fishplates and metal bearing plates.

A diamond crossing enables one track to cross another at any angle flatter than 1 in 8.

Catchpoints

A catch point comprises one switch (left hand or right hand as required) complete with one switch lug or switch rod bracket as required and attached by bolts, one heel fishplate (heel plate) one washer plate with heel block and bolts, one set of switch chair plates and one set of heel plates complete with bolts, switch stops and studs, one switch stop bracket and one catch point lock staple and attachment bolts. Spring washers are to be included with all bolts.

Catchpoints are generally manufactured for use with timber sleepers. When they are to be used with concrete bearers, the materials to be supplied shall be in accordance with the material lists shown on the relevant drawings.

Unless indicated otherwise, catch points shall be supplied for manual operation.

For mechanical or electrical operation, the catch point is to include two rail brace chair plates and chairs as appropriate in lieu of the first two switch chair plates, and any additional plates indicated on the drawings. Switch rod brackets are to be provided in lieu of switch lugs.

Catch points are described as left or right hand when standing at the point of the switch looking towards the heel, a left hand catch point is one in which the switch closes against the left hand rail and right hand catch point is one in which the switch closes against the right hand rail.

Switches

A switch is a machined tapered rail that allows the direction of a train to be altered to another line when required.

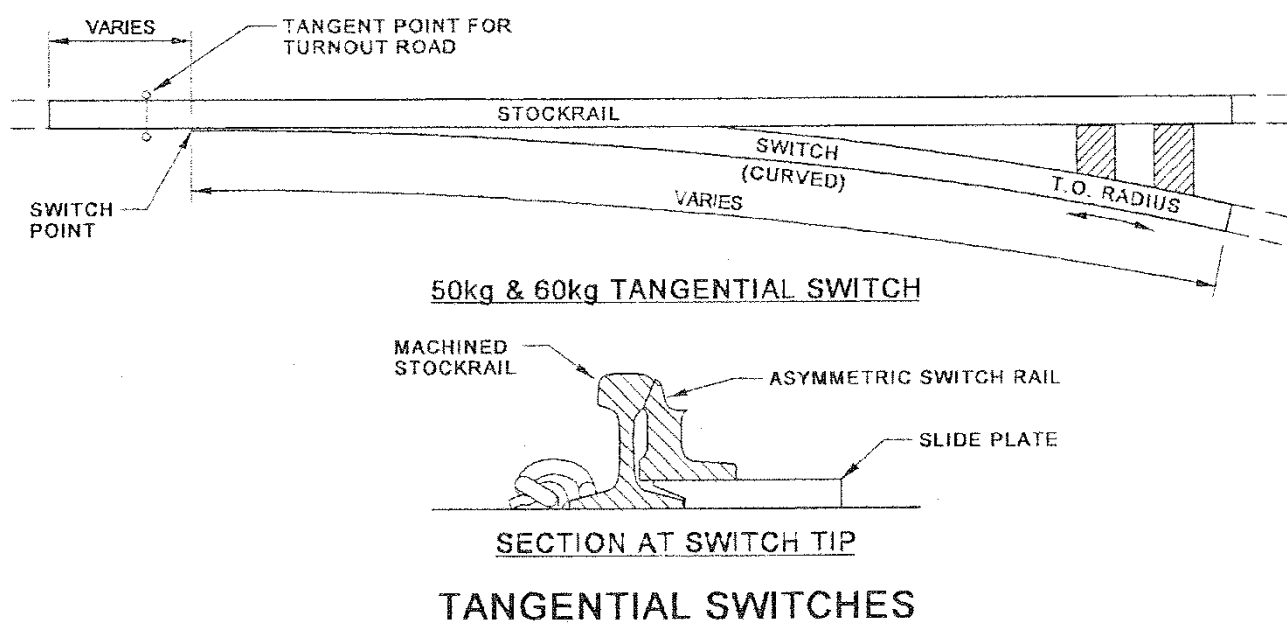
A switch consists of a section of rail set and machined to a design shape, drilled to detail and to accommodate gauge rod brackets and heel blocks. Switches are left and right hand with the basic machining differences being:

- Switches for use with AS47kg and AS53kg rail have no machining on the stockrail and the switch rail is machined and vertically set to override the foot of the stockrail.
- Switches for use with AS50kg and AS60kg rail have the stockrail undercut by machining to allow the switch to move partially under the head of the stockrail. The foot of both the switch and stockrail sit at the one level where the switch rails are manufactured from AS50 and AS60kg rail.

Switch rails are also manufactured from sections such as AS60kg asymmetrical switch rail and 60E1A4 (60D) asymmetrical switch rail and in such case the feet of the stock and switch rails are set at different levels.

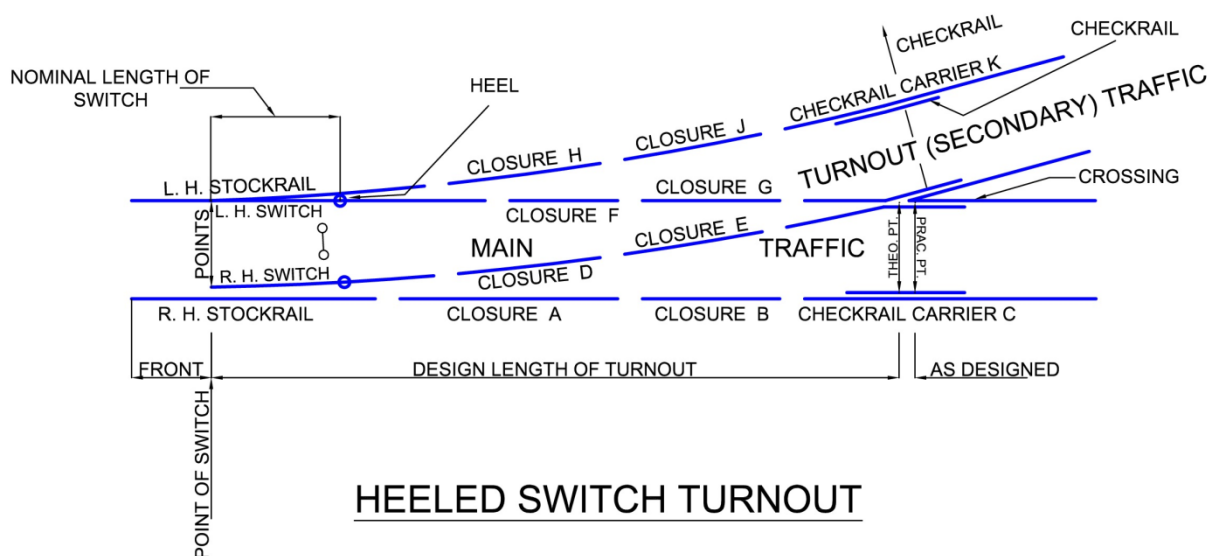
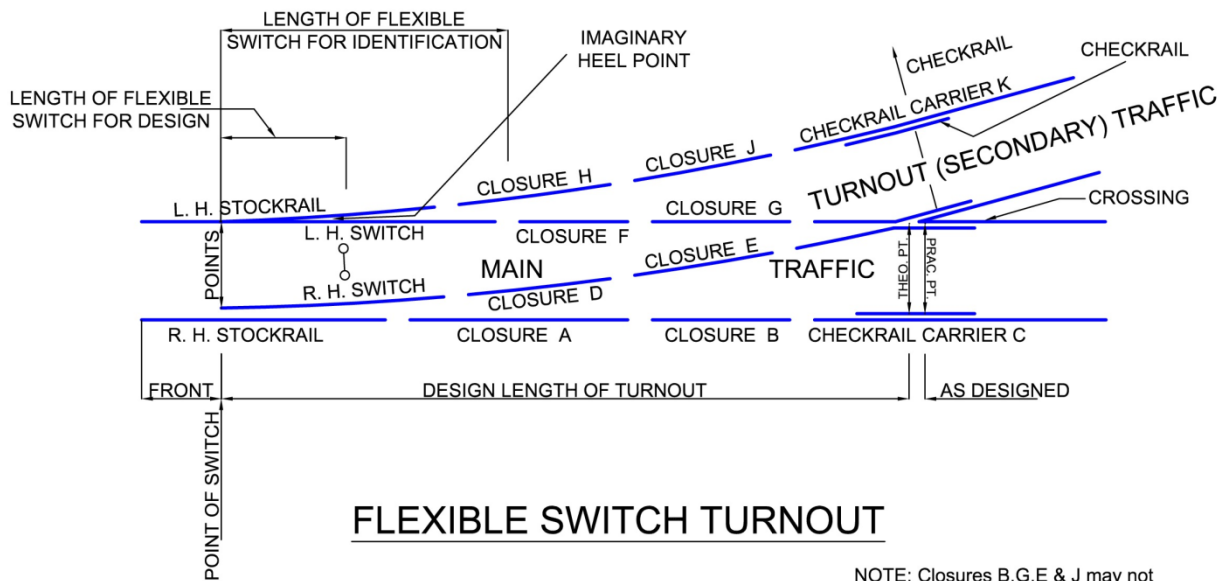
The stock rails in such switches are manufactured from AS60kg rail or UIC60 rail.

Figure 1 shows diagrammatically a tangential switch with an asymmetrical switch rail.



NOTE: RIGHT HAND TURNOUT AND LEFT HAND SWITCH ONLY DRAWN.

Figure 1



IDENTIFICATION OF STANDARD COMPONENTS

Figure 2

The types of switches are described below.

Heeled or Pivot Heeled Switches

Heeled Switches are switches that pivot about a gapped joint between the switch rail and adjoining closure rail.

The heel block and fishplate at this joint to which the switch is bolted are so designed to allow this movement. The switch length is the total length of the switch rail.

Available in AS47kg, AS50kg and AS60kg only. AS47kg and AS53kg (NSW designs) as replacements only.

Flexible or Fixed Heel Switches

Flexible switches are switches machined from longer rails and fixed towards the end of this rail with blocks to the adjacent stockrail. A section of the switch rail foot in some cases is removed towards these blocks and the switch is designed to flex over its length.

For AS47kg and AS53kg rail (NSW designs) the flexible switch is defined as the total length of switch rail from which the switch is made. AS53kg as replacements only.

In AN design turnouts in AS47kg and AS53kg rail, the flexible switch length is defined as the length from the point to the nominal flexing point.

For AS50kg and AS60kg rail the flexible switch is defined as the length from the point to the theoretical head point (for design purposes only), and can be identified by the machining on the stockrail.

For the ARTC Vossloh Cogifer turnouts manufactured from UIC60 rail and 60E1A4 (60D) asymmetrical switch rail, the switch length is defined as the total length of the asymmetrical switch rail.

Heavy Duty Switches (NSW Only)

Heavy duty switches have thickened switch points and must be used with joggled stockrails to ensure the running face of the running rail is colinear.

Available in AS53kg rail as replacements only. Not used with AS50kg or AS60kg rail.

Housed Switches (NSW Only)

A housed switch is a heavy duty switch and joggled stockrail equipped with a "Housing". It is used only with AS53kg material. The housing is a specially machined component with a hardened checking face fitting above the switch to act as a checkrail for the opposite switch and joggle. Where both switches are required to be heavy duty, a housing is required on one of the switches.

The housing is attached to housing chairs and is dispatched from the Manufacturer correctly lined and packed to suit the application. It must not be taken apart prior to installation in the track under any circumstances.

The housing is provided to permit a smooth passage of a main line train tracking across the points by restraining wheels from entering the stockrail joggle of the open switch which is a potential derailment situation.

Crossing

A V crossing is the unit that allows the turning out rail to cross the mainline rail in a turnout.

The crossing rate is a measure of the angle made by the rail gauge faces at the theoretical point. It is the cotangent of the angle made.

The identifying catalogue number of the crossing is stamped on the top surface of the wing rail end along with the crossing rate and manufacturer's identification.

There are 4 types of crossings in use and these are described below. (See Figure 4)

Fabricated Crossings

A fabricated "V" crossing comprises a Vee and two (2) wing rails fabricated from sections of rail set, machined and fitted together with chocks and high tensile bolts or swaged fastenings to the

specified angle. The point rail may be either left or right hand, depending on the general movement of traffic.

The hand of the crossing is determined by the location of the point rail. The point rail is always the rail carrying the maximum tonnages, or high speed. A right hand crossing has the point rail in the rail that connects to the right hand switch.

The spot where the running faces theoretically cross is known as the theoretical point and is marked on the wing rails of the crossing.

The components and hand of a crossing are illustrated in Figure 3, showing the number identification system used in NSW.

Rail Bound Manganese Crossings

Rail Bound Manganese Crossings are crossings with the actual crossing area made from manganese steel casting and surrounded by specially machined and set rail wings.

Fully Cast Manganese Crossings (Monoblock)

Fully cast manganese crossings are now available and consist of a cast manganese crossing with legs (normally AS 60kg rail) welded onto the cast crossings.

Swing Nose Crossings

Swing Nose Crossings are fabricated crossings, used in medium and high speed turnouts, where the point of the crossing can be moved horizontally.

Stockrails

These provide support for the closed switch and become the running rail when the switch is open. They are curved, set and /or jogged and drilled associated with chairs and switches as a unit before dispatch. The distance from the point of the switch to the nearest end of the stockrail is called the "front" of a turnout. This "front" is a standard length of 4877mm for AS47kg and AS53kg rail and 2000mm for AS50kg and AS60kg rail for ARTC NSW designs.

For the ARTC Vossloh Cogifer turnouts manufactured from UIC60 rail the "front" is a standard length of 1320mm.

This front length should be retained for all new turnouts and only altered in restricted location situations.

Stockrails can either be standard full rail sections or machine undercut depending on the type of switch used and can be set left or right handed as required.

Points

A set of points is a fully assembled pair of switches and stockrail units with chairs, switch stops, rail brace plates and the required rodding attached to correctly operate the switches.

Points may be interlocked or non-interlocked.

Checkrail Unit

The unit consists of a length of rail (called the checkrail) with a flared bevel machined on each end, hardened on the checking face, bolted through chocks to a closure rail (called the carrier) to attain the standard flangeway clearance of 44mm for AS47kg and AS53kg rail and 43mm for AS50kg and AS60kg rail.

The checkrail is required to protect the crossing point from being struck by the wheels.

Where appropriate, the unit is curved prior to dispatch from the workshops.

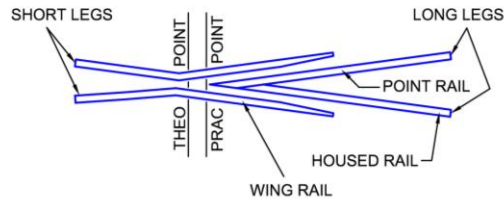
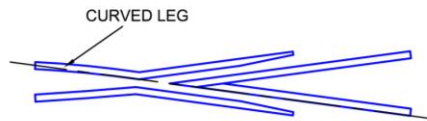
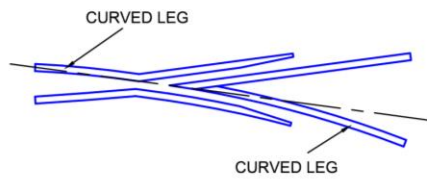
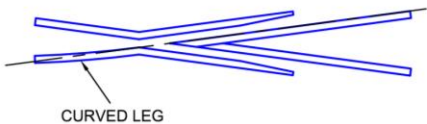
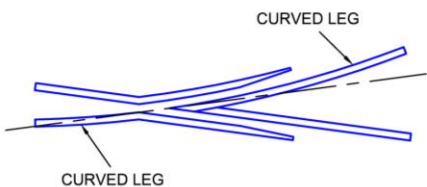
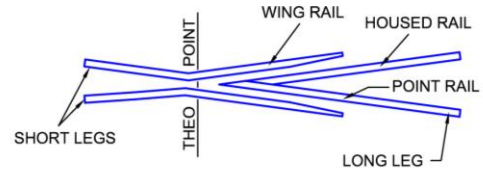
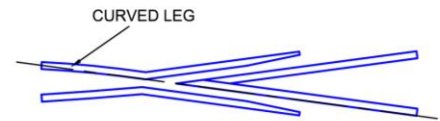
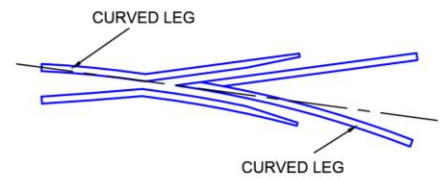
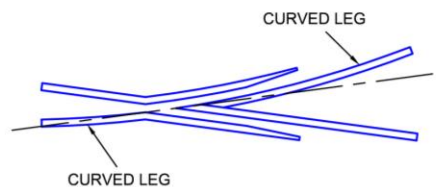
The centre of the checkrail is usually opposite the theoretical point of the crossing.

Checkrails may also be manufactured from UIC33 rail and are supplied separately from the closure rail.

Closure or Lead Rails

Closure Rails are all other rails making up a turnout apart from those in the points, crossings and checkrail units.

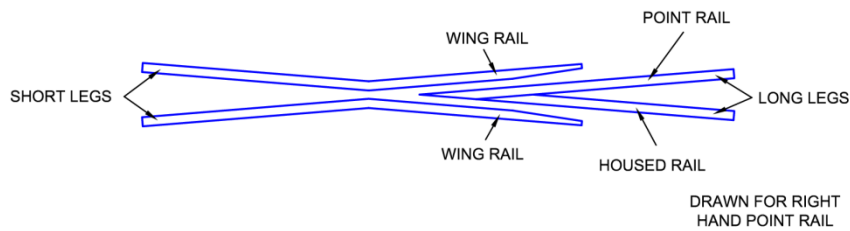
Closure rails can be a full length rail or a section of rail either straight or curved as required, drilled at ends for a standard fishplate assembly. Rail gaps will be indicated, if necessary, in schedule or annexure to accommodate welded joints or insulated joints for the signalling system.

RIGHT-HAND POINT RAILSCROSSING XL...0CROSSING XL...2CROSSING XL...4CROSSING XL...6CROSSING XL...8LEFT-HAND POINT RAILSCROSSING XL...1CROSSING XL...3CROSSING XL...5CROSSING XL...7CROSSING XL...9

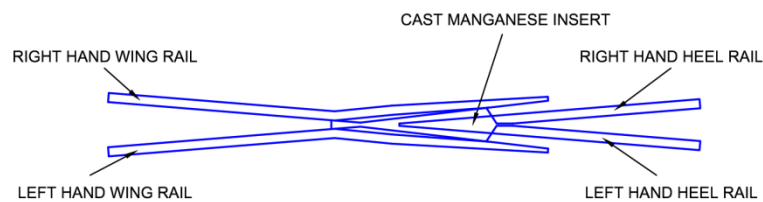
'V' CROSSINGS
NUMBER IDENTIFICATION SYSTEM

Figure 3

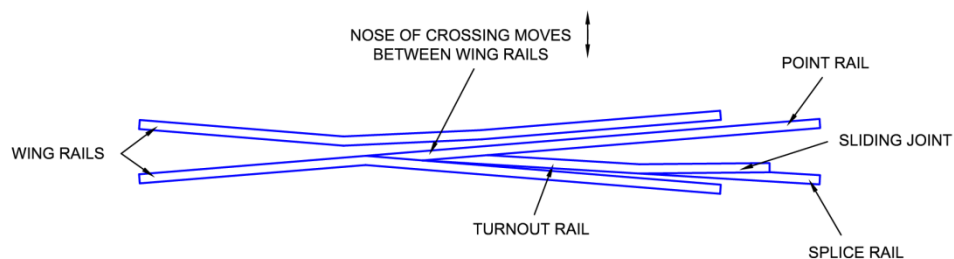
STANDARD CROSSING TYPES



1. FABRICATED CROSSING



2. RAIL BOUND MANGANESE CROSSING (R.B.M)



3. FABRICATED SWING NOSE CROSSING

NOTE: Only rail head and cast manganese insert shown in diagrams

Figure 4

Turnout Rail

This is the closure rail that joins the turnout switch to the crossing, as part of the secondary track. It may consist of more than one rail length. The rails are to be curved to provide the correct radius.

34.2 Definition and Description of Minor Components

Check Blocks

A checkblock is an iron casting used mainly with check rails and crossings to support rail components at a fixed distance apart. Raised lettering and numbers on the chock identify its application.

Chair Plates

A chair is a flat plate with a pressed up section that is attached with a bolt through the web of either 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 a mark on the end of the plate e.g. CR, SR, A, B, C, D. With the AS60kg and AS50kg rails the plates are flat under the switch-stockrail and with the AS47kg and AS53kg the plates under the first 3 bearers from the point of the switch have a raised table to support the switch.

Rail Brace Plates

Rail Brace plates are used under the switch assembly to which a cast Rail Brace is attached and this in turn is bolted to the stockrail. The Rail Base contacts the underside of the head and the top of the foot of the stockrail and is used for stockrail support to maintain the gauge. The plates are distinguishable by a number at the end.

Switch Stops

Switch Stops can be manufactured from castings, rolled angle section or extended bolts. They are currently all made by casting and are bolted to the web of the stockrail. When the switch is in the closed position, they make contact with its web providing support. The switch-stockrail are supplied with the stops attached.

Heel Blocks

For flexible switches there are normally 2 heel blocks attached to the end of the switch and the adjacent stockrail and closure rail. They are fabricated blocks that rigidly fix the switch rail to the adjacent rail in the correct geometric location.

For heeled (or pivot heeled) switches, the heel block and associated fishplates and bolts are so designed to allow a movement of the switch blade at this point similar to a hinge.

34.3 General Definitions

Hand of a Turnout

It is usual to describe the components of a turnout by standing between the switches and facing the crossing. For example, a right hand turnout is one where the turning out, or secondary line turns out to the right of the stockrail. Can be right hand or left hand.

Length of Turnouts

The length of a Turnout is the distance along the mainline rail in which the crossing is located, from the point of the switch to the theoretical point of the crossing.

Turnout Radius

The Turnout Radius used in this standard is the radius of the centreline of the curved turnout track and not the turnout rail radius.

This radius is tangential to the switch at the heel (real or imaginary) and to the appropriate leg of a straight crossing. The radius is carried through a curved crossing.

35 Appendix B

