Oberon Tarana Heritage Railway

Engineering Standard

Track

OTCS 250

TURNOUTS AND SPECIAL TRACKWORK

Version 1.0

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Approved by:

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Oberon Tarana Heritage Railway

Document control

Revision	Date of Approval	Summary of change
1.0	August, 2018	First Issue. Includes content from the following former RIC standards: TS 3103, TS 3104, TS 3105, TS 3202, TS 3501, TS 3502, TS 3504, TS 3509, TS 3645, RTS.3733, CTN 01/05 and CRN CS 250 Ver 1.1

Summary of changes from previous version

Section	Summary of change

Contents

1 Scope and application

This Standard establishes functional and design requirements, approved configurations, acceptance standards, damage limits and repair standards for the following elements of track infrastructure:

- turnouts,
- catchpoints,

It includes switch and crossing components.

It also includes manual points lever operation, but does not cover points operation where the points are connected to the signalling system.

It is applicable to all main line and siding tracks.

The standard also contains definitions of standard terminology relevant to turnouts and special trackwork (See Appendix 1).

2 References

2.1 Australian and International Standards

Nil

2.2 OTHR documents

OTCS 200 - Track System

OTCS 210 - Track Geometry & Stability

OTCS 215 - Transit Space

OTCS 220 - Rail and Rail Joints

OTCS 230 - Ties and track support

OTCS 240 – Ballast

2.3 Other references

CRN CP 204 – Product Approval

CRN CP 251 - Turnout Components

CRN RS 001 - Minimum Operating Standards for Rolling Stock

3 Engineering authority

Design and selection of infrastructure detailed in this standard may only be undertaken by persons who have been granted appropriate Engineering Authority by the Engineering Manager.

4 Description

Turnouts allow rail tracks to converge or diverge. They are an assembly of rail components comprising:

- Switch and stockrail assemblies
- V Crossings
- Checkrail units (not required for swing noise crossings)
- Closure rails
- Bearers
- Plates, fasteners and rail joints
- Point operating equipment

(See Appendix 2 for turnout component descriptions)

Catch points and derail devices provide a level of protection against train collisions at the junctions of sidings and main running lines. Catch points or derail devices are provided when required to conform with Signalling Design Standards.

Catch points and derail devices may be interlocked with a signalling system or operate via a manual lever.

Catchpoints are an assembly of:

- Switch and stockrail assemblies
- Closure rails
- Throw off rails
- Bearers
- Ramp (or derail) blocks
- Plates, fasteners and rail joints
- Point operating equipment

5 Design requirements

This standard has been developed in consideration of the following criteria:

- speed in each leg of the points and crossing structure (e.g. on the through and diverging tracks in a turnout structure) including consideration of maximum superelevation (cant) deficiency;
- service loads (and dynamic response) including effects of impact loading at the points and crossing wheel transfer locations, track alignment, maintenance standards, and traffic task;
- component material types and maintenance requirements (e.g. fabricated versus cast crossings, fixed nose versus swing nose and spring wing crossings, material hardness and hardening processes);
- servicing requirements (e.g. lubrication and adjustment);
- component, layout geometry and assembly details include the following:
  - ~ bearer dimensions, location and orientation;
  - ~ rail fastening baseplate and chair dimensions, location and orientation;
  - ~ track radius or alignment curvature;
  - ~ crossing angle and wheel transfer area cross-sectional geometry;

  - ~ switch geometry and cross-sectional geometry;
  - ~ detailed component geometry;
  - ~ flangeways and wheel opening dimensions;
  - ~ check rail length, location and effectiveness, profile and end flaring;
  - ~ wheelset geometry (i.e. wheel cross-sectional profile and wheelset back to back);

- requirements for movable components where applicable, including the geometric fit for construction and maintenance in all switch and crossing positions;
- need for trailable points in yard operations
- requirements for rails, bearers and fastenings.

5.1 Turnouts

Turnout general arrangements and components shall meet the requirements of Section 7.1 of this standard. Designs for turnouts comprising compatible individual components shall comply with standard configurations unless otherwise approved by the Engineering Manager.

The following criteria shall be used in the design of points and crossing configurations:

5.1.1 Turnout geometry

1. Nominal gauge shall be 1435 mm:
2. All turnout components shall be designed so that the rail is vertical (i.e. zero cant). The 1:20 cant in open track shall be transitioned to zero cant over a minimum of 3 sleepers clear of the turnout bearers.

5.1.2 Rolling stock interface

1. Turnout components shall meet the requirements of Engineering Standard OTCS 215 “Transit Space”. This shall include clearances between crossovers where such moves are permitted by signalling.

2. 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) shall be 1391 mm with a flangeway width of 42mm and a check rail gap of 43mm.
3. The design switch rail toe / stockrail open throw dimension shall be ≥ 100mm or otherwise to suit signalling equipment, if installed.
4. Switch rail throat opening shall be 60mm ± 5mm.
5. The check rail end opening shall be flared, and provide an opening ≥ 80mm (≥ 85mm if the checkrail is adjustable) to the gauge face of the running rail at the flared end. The flare angle shall be as shown in Figure 1.

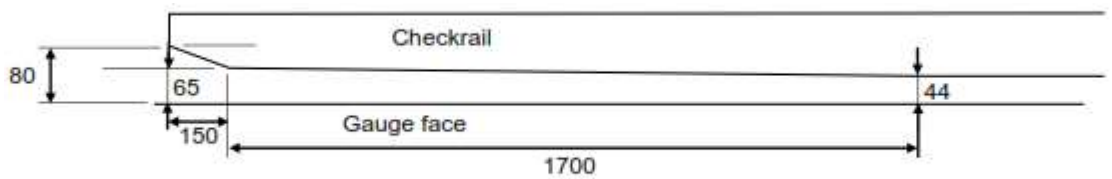


Figure 1 – Flare on checkrail end

6. Check rail height shall be between 0mm and 25mm above the running rail and shall take into consideration rolling stock clearances.
7. The design wheelset back to back dimension shall be 1357mm – 1360mm as documented in Engineering Standard CRN RS 001 “Minimum Operating Standards for Rolling Stock”.
8. Flangeways shall be designed to accommodate a wheel flange height of ≤ 45mm.
9. The turnout components shall be designed to suit the ANZR – 1 new and worn wheel profiles.

5.1.3 Track geometry

1. The maximum superelevation (cant) deficiency allowable through the diverging track of a turnout shall be as detailed in Engineering Standard OTCS 210 “Track Geometry and Stability”.
2. Design requirements for general track geometry including vertical/horizontal track alignment and superelevation are detailed in OTCS 210.
3. Maximum design superelevation in turnouts shall be 50mm

5.1.4 Components

The design shall be based on relevant Standards for the components used within the turnout.

5.1.5 Rail adjustment

Turnouts shall be designed as “fixed anchor points”. Designs shall include suitable rail anchoring arrangements as specified in Section 7.1.11.

5.1.6 Signalling interfaces

Turnouts shall be designed to meet the signalling requirements. This includes requirements for

- the placement of insulated joints
- limiting conditions for the placement and operation of switch motors on power operated points, crossings, switches and drives, including limitations on the drilling of switches (hole size and location).
- in-bearer signalling
- conductive rails for signalling
- positive security of points that will be installed and over which rail traffic will operate before the signal interlocking is connected, or where the signal interlocking equipment will be removed from a set of points pending removal.
- Where non-standard carbon steels are proposed for use in switches or crossings a review of electrical properties shall be undertaken and signalling implications determined

5.2 Diamond crossings

Not Applicable:

5.3 Slips

Not Applicable

5.4 Catchpoints

Catchpoint general arrangements and components shall meet the requirements of Section 7.4 of this standard. Designs for catchpoints comprising compatible individual components shall comply with standard configurations unless otherwise approved by the Engineering Manager.

The following criteria shall be used in the design of catchpoint configurations:

5.4.1 Catchpoint geometry

1. Nominal gauge shall be 1435 mm:
2. All catchpoint components shall be designed so that the rail is vertical (ie zero cant). The 1:20 cant in open track shall be transitioned to zero cant over a minimum of 3 sleepers clear of the bearers.

5.4.2 Rolling stock interface

1. Catchpoint components shall meet the requirements of BCS 215
2. The design switch rail toe / stockrail open throw dimension shall be ≥ 100mm or otherwise to suit signalling equipment, if installed.
3. Switch rail throat opening shall be 60mm ± 5mm.
4. The design wheelset back to back dimension shall be 1357mm – 1360mm as documented in OTRS 001.
5. The turnout components shall be designed to suit the ANZR – 1 new and worn wheel profiles

5.4.3 Track geometry

Design requirements for general track geometry including vertical/horizontal track alignment and superelevation are detailed in OTCS 210.

5.4.4 Components

1. The design shall be based on relevant Standards for the components used within the catchpoint.
2. Catchpoints shall be of the same rail weight as the turnout they protect.

5.4.5 Rail adjustment

Catchpoints shall be designed as “fixed anchor points”. Designs shall include suitable rail anchoring arrangements as specified in Section 7.4.2.

5.4.6 Signalling interfaces

Catchpoints shall be designed to meet the signalling requirements. This includes requirements for

- the need for catchpoints at a particular location
- the functional requirements for the catchpoints
- the placement of catchpoints to suit placement of signals
- the placement of insulated joints
- limiting conditions for the placement and operation of switch motors on power operated switches and drives, including limitations on the drilling of switches (hole size and location)
- in-bearer signalling
- conductive rails for signalling
- positive security of points that will be installed and over which rail traffic will operate before the signal interlocking is connected, or where the signal interlocking equipment will be removed from a set of points pending removal.

5.4.7 Clearances

1. Catch points and derail devices shall be located to provide a minimum of 450mm clearance between the side of a vehicle on the running line and the derailed vehicle at the clearance point.
2. Throw-off rails shall be located so as to ensure the wheels of the derailing vehicle travel a path that ensures that the vehicle does not foul the running line.
3. The throw off rail shall be either parallel to the running line or at such an angle to it that a derailed vehicle will be deflected away from the main line.
4. Derail blocks shall be located so that the derailed wheel tracking in the “four-foot” will mount the derail block before striking the rail.
5. The location of catch points, derailers or other similar devices shall be selected to ensure that a vehicle derailed at such a device has a clear, even throw-off area to minimise subsequent damage. Derailed vehicles must not be directed into a building or onto any structure, particularly overbridges, transmission line poles, earthworks or over any embankment or directly into any cutting or retaining wall.

   The clear, even area required is dependent on the potential size and speed of any vehicle or train to be derailed and the nature of any retarding equipment or infrastructure (such as a sand drag) and will have to be determined for each site. .

   The normal minimum requirement at locations where the normal operating speed of vehicles is ≤ 25km/h shall be 2 vehicle lengths (40m) beyond the point of derailment (the end of the stockrail).

The establishment of a clear landing area MUST include consideration of the train desc down the ballast shoulder. A standard ballast shoulder creates a twist (tending to tip a tr over) as well as a severe dip. (See Figure 3).

A square even descent can be achieved using ballast (Figure 2 and Figure 4).

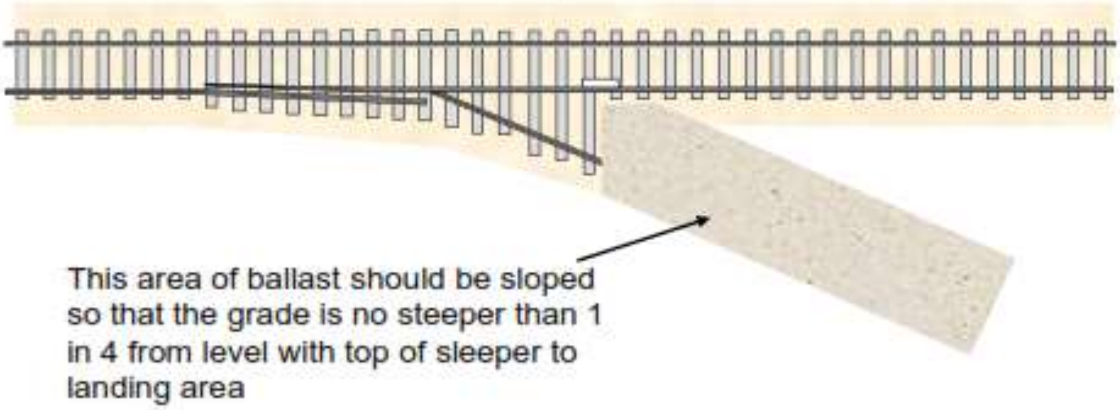


Figure 2 – Ramp to landing zone

Figure 3 – Example of catchpoint with poor landing zone

Figure 4 – Example of catchpoint with good landing zone

Special consideration must be given if there is any possibility of an occupied building being in the path of a derailed vehicle. This will include land outside the rail boundary where there is, or is the potential for, building development.

Bridge columns in the vicinity may need to be protected by deflection walls as specified in relevant Standards.

For locations where throw off and derail block configuration would not provide an adequate clear even run-off area, the following alternative arrangement is permitted.

– Retain the vehicle on the track from which it is derailed. In this case, the throw-off rail and derail block are not required.

– A detailed design is required on a case by case basis to provide an appropriate system to direct the derailed vehicle along the track. This can be achieved using a guard rail arrangement.

6. Catchpoints and derails at the ends of loops will normally be located in accordance with the guidelines specified in Table 1.

Track Centres	Catch point location
Main line straight with parallel loop	
4 - 5m	Catch point or de-rail located on the parallel loop road with throw-off located at the tangent point
6.4m	Catch point or de-rail located on the parallel loop road between the turnout and the loop road preferably on straight track
Main line curved with concentric loop	
4 - 5m	Catch point or de-rail located on the concentric loop road with throw-off located at the compound tangent point
6.4m	Catch point or de-rail located on the concentric loop road to provide specified minimum safety clearance as defined below.

Table 1 - Catchpoint location at loop ends

7. Minimum safety clearances shall be met. These shall be calculated on the basis of track geometry and traffic type as follows:

$$C_L = W + 0.450 + \frac{B_C{}^2}{4R}$$

Where C_L = Safety Clearance (metres)

W = Width of maximum vehicle operating in the track section (metres)

B_C = Bogie Centres (metres)

R = Radius of mainline or loop, whichever is less (metres).

The variables are defined in BCS 215

The distance from the throw off rail to the clearance point shall be $\frac{L - B_C}{2}$ metres i.e. equal to the distance from the end of the standard vehicle to the bogie centre (see Figure 5).

The standard distance from heel block to throw off rail is 1.625m,

The maximum design rolling stock gauges for vehicles are detailed in BCS 215:

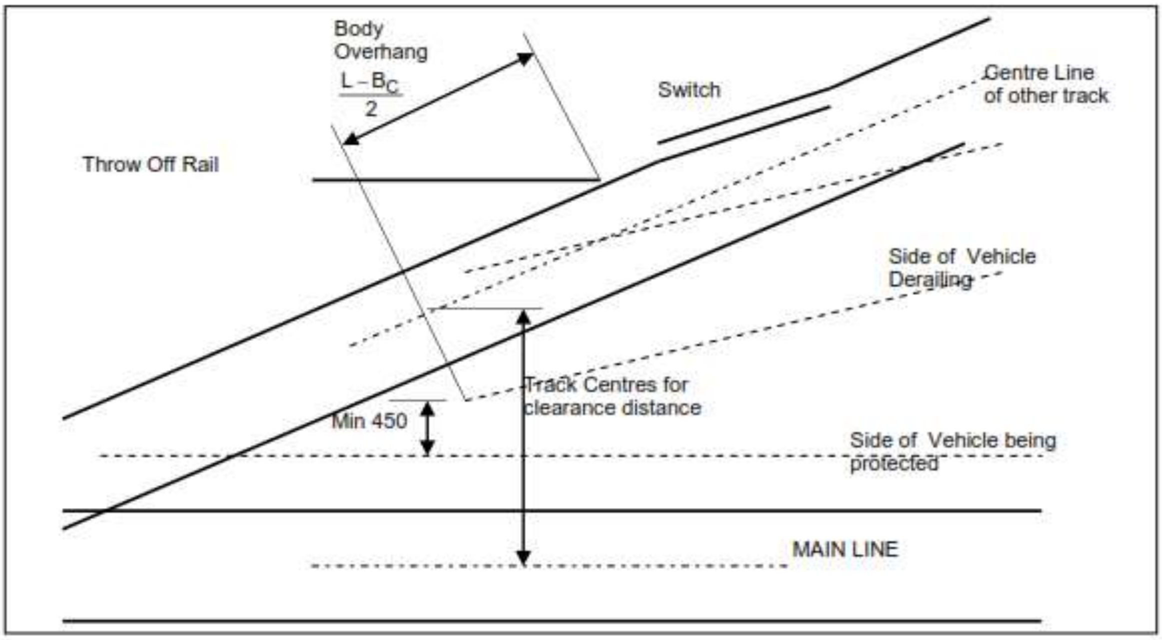


Figure 5 - Clearances at Catchpoints

5.5 Expansion switches

Not Applicable

5.6 Manual points levers

Point lever general arrangements and components shall meet the requirements of Section 7.6 of this standard. Designs for point levers shall comply with standard configurations .

The following criteria shall be used in the design of point lever configurations:

1. Manual point levers shall be designed to hold a closed switch against its matching stockrail with security, for safe vehicle movements.
2. Levers, or the points they control, may be locked or clipped to prevent unauthorised traffic movements.
3. Levers are operated manually and independently of an interlocked signalling system
4 Levers designed for trailable movements are permitted subject to operational requirements.
5 Manual point lever configurations shall be selected to meet the requirements of users.

6 Documentation requirements

6.1 Turnouts

Turnout designs shall include drawings detailing:

- turnout length
- switch length
- point arrangements including rail brace, slide chair and heel details and provisions for connecting rodding
- crossing and checkrail details
- rail weight
- bearer details
- plating details
- rail fastening and anchoring details
- setting out detail including curve radii

Detailed component manufacturing drawings shall be provided.

Designs relating to a specific layout shall include the following details:

- turnout framepoint co-ordinates
- location of points and crossing
- where there is no straight route in the turnout (i.e. the turnout is curved) offset dimensions shall be provided from a straight line
- crossing rate and catalogue No
- track centres
- track identification
- all proposed track alterations
- signalling requirements (supplied by signalling designer)
- location of insulated joints

6.2 Diamond crossings

Not Applicable

6.3 Slips

Not Applicable

6.4 Catchpoints

Catch point and derail designs shall include drawings detailing:

- point arrangements including rail brace, slide chair and heel details and provisions for connecting rodding
- throw-off rail details
- ramp (or derail) block details
- rail weight
- bearer details
- plating details
- rail fastening details
- setting out detail

Detailed component manufacturing drawings shall be provided.

Designs relating to a specific layout shall include the following details:

- framepoint co-ordinates
- location of points and throw-off rail
- location of clearance point
- where the catchpoint is designed for installation in a curve, offset dimensions shall to be provided from a straight line
- details of clear area required beyond the point of derailment including identification and assessment of any obstruction or other hazards in the area
- track centres
- track identification
- all proposed track alterations
- signalling requirements (supplied by signalling designer)
- location of insulated joints

6.5 Expansion switches

Not Applicable

7 Allowable configurations

7.1 Turnouts

Turnout configurations adopted for a specific site or application shall conform to the design requirements detailed in this standard unless otherwise approved by the Engineering Manager.

All new turnouts and replacement components shall be manufactured to meet the requirements of Engineering Specification CRN CP 251 “Turnout Components”.

There are two types of turnout used:

- Conventional
- Tangential turnouts

The distinction between the two types is based on geometry and component technology.

Both conventional and tangential turnouts may be either

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

Conventional turnouts

Standard conventional turnouts are defined by a combination of the switch length and heel angle, and the crossing rate. (See Appendix 4 for a description of conventional turnouts). Conventional turnouts may be left or right hand.

Standard conventional turnouts are designed with the main line track straight.

There are three standard design options for conventional turnouts:-

- A fully straight crossing – available for all turnouts with crossing angles ≥ 1 in 9. (See Appendix 4 - Figure 8)
- A partially curved crossing (short leg curved to turnout radius - long leg straight) available for turnouts with crossing angles ≤ 1 in 10.5 (See Appendix 4 - Figure 9)
- A fully curved crossing (short and long legs curved to turnout radius) available for turnouts with crossing angles ≤ 1 in 10.5.

The standard conventional turnout configurations adopted for new installations are detailed in Appendix 4 - Table 15.

Only approved designs shall be used. The approved designs are the standard conventional turnout configurations detailed in Appendix 4 - Table 15.

Tangential turnouts

Tangential turnouts are defined by the radius of the turnout. (See Appendix 5 for a description of a tangential turnout)

Tangential turnout designs have a standard configuration (footprint). The standard configurations adopted are detailed in Appendix 5 - Table 16.

All tangential turnout designs shall be based on an approved configuration. Each of these configurations has the through road straight and the turnout track, including the switches, continuously curved with a tangent point located near the toe of the points.

There are two standard configuration options for curvature through the crossing - either a straight crossing or fully curved crossing. (See Appendix 5 - Figure 10 and Figure 11).

Only approved designs shall be used. Suppliers shall submit designs for type approval in accordance with Engineering Specification CRN CP 204 - Product Approval.

7.1.1 Location of turnouts

7.1.1.1 Horizontal alignment

Installation of turnouts in curves is NOT desirable. Where a new or replacement turnout is proposed in a horizontally curved section of the main line the following requirements apply:-

1. Configuration approval is required if any turnout (new or replacement) is proposed to be located on a curved section of track.
2. Main lines shall be graded coplanar where track centres do not allow for turnouts forming the crossover to be treated separately.
3. Turnouts should NOT, normally, be placed in transitions. If this cannot be avoided, the twist created through the switch and crossing segments of the turnout shall meet the normal twist limits for plain track geometry detailed in OTCS 210.

7.1.1.2 Vertical alignment

Where a turnout is to be renewed or placed in a vertically curved section of the main line the following requirements apply:-

1. Track through turnouts and for 5m in front of switch tip shall be of constant gradient (no vertical curvature).

   Configuration approval is required if the turnout (new or replacement) is not located on a constantly graded section of track.

   Turnouts may only be constructed on vertical curves following a detailed assessment of maintenance impacts and risk.

2. If turnouts are approved on vertical curves, minimum radius (R_v) of the vertical curve for the length of the turnout plus 5 metres of track in front of the switch tip shall be as specified in OTCS 210.

7.1.1.3 Proximity to other special trackwork

Special trackwork geometry shall be designed using standard units that can each be replaced as single units, with the exception that standard crossover designs shall make provision for use of long bearers crossing both tracks.

7.1.2 Selection of turnout type

Turnout type shall be selected to, at least, meet the minimum requirements specified in Table 2.

Tangential turnouts are the preferable configuration and may be used where conventional turnouts are specified as the minimum.

Track Class		Turnout type	Rail size		Bearer type		Switch type	Crossing type
			Pref	Alt	Preferred	Alternative		
Main line								
1	Preferred	Tangential	60		Concrete	Steel, Timber	Tangential	Compound
	Alternative	Conventional	60	60HH, 53	Steel	Timber	Flexible	Fabricated
2	Alternative	Tangential	60		Concrete	Steel, Timber	Tangential	Compound
	Preferred	Conventional	50	47, 53	Steel	Timber	Flexible	Fabricated
3, 5	Preferred	Conventional	50	47, 53	Steel	Timber	Flexible	Fabricated
Siding (speed limited to 25km/h)								
1	Preferred	Conventional	60	53, 50	Steel	Timber	Flexible	Fabricated
2,3	Preferred	Conventional	50	47, 53	Steel	Timber	Flexible	Fabricated

Table 2 – Selection of Turnout type – Minimum requirements

1. Configuration approval is required if the turnout type detailed in Table 2 is not proposed for new or replacement turnouts.
2. Where a conventional turnout design is selected for a main line application, only standard conventional turnout designs shall be used. (See Appendix 4 - Table 15).
3. Where the through track in main lines is installed on a curve <800m radius, and the turnout track is also curved some degree of curvature is required. "Special" designs, which are non standard, are required for conventional turnouts. In such cases tangential turnout designs shall be used. (See Appendix 5 Table 16)

4. The design requirements for non standard tangential turnouts are detailed in Section 7.1.8
5. Configuration approval is required if non standard special designs are proposed for siding applications.
6. Where an increase in turnout speed is desirable the use of tangential turnouts is recommended. A tangential turnout replacing a conventional turnout will normally allow a higher speed.
7. Where there is more than 2 MGT traffic on the turnout road the use of tangential turnouts is recommended
8. Conventional turnouts should generally be restricted to sidings and slow speed, low traffic, turnouts on the main line.

7.1.3 Use of recycled turnout material

Recovered material (either components or complete configurations may be installed on all main lines (except Class 1) and in all sidings.

Components shall be assessed for compliance with the following requirements

1. Rail wear shall meet the classification limits given in Table 4 of OTCS 220 for Category 1 (White Rail) or Category 2 (Blue Rail).
2. Rails shall be ultrasonically tested and visually inspected and have
   - No reportable defects (see Table 14 of OTCS 220)
   - No visible web fillet cracks
   - No head or foot cracks
   - No crush or laminated head
3. Wheel burns more than 3mm deep shall be removed or corrected
4. Visible end batter shall be removed or corrected if rail is to be classified for reuse in mainlines
5. Rail shall not have excessive rust
6. The gauge face shall be re-profiled to the correct rail profile by removing any lip that has developed
7. Gauge face angle shall not exceed 26° to the vertical when the worn face is within 15mm of the lower edge of the rail head

When replacing turnout components (switches, stockrails, crossings and checkrails) recycled components shall be of the same rail weight as the component they replace.

When replacing complete turnouts, recycled components shall, as a minimum, be the same rail weight as the turnout they replace.

7.1.4 Rail

Rail used in the manufacture of turnouts shall meet the requirements of OTCS 220

Rail size shall be selected for a turnout in accordance with the requirements of Table 2.

7.1.5 Bearers

7.1.5.1 Selection of bearer type

Concrete, steel and timber bearers shall meet the requirements of BCS 230.

Ecotrax composite bearers are also approved for use.

Concrete or timber bearers will, normally, be selected for a turnout in accordance with the requirements of Table 2.

Timber bearers shall only be used as an alternative to concrete or steel bearers (where specified in Table 2) at locations where it is impractical to design for concrete or steel. The alternative use shall be verified by the designer.

Notwithstanding the requirements detailed in Table 2, where concrete sleepers exist on the adjoining track, concrete bearers will, normally, be used.

Similarly, where steel sleepers are installed, steel or composite bearers should be used

7.1.5.2 Bearer layout

The layout for turnout bearers or ties, as well as interface requirements for fixing components (crossings, checkrails, switch/stockrails and closure rails), shall be included in the design.

Turnout bearers in **conventional turnouts** are set out square to the main line alignment. This includes crossovers and any infill between turnouts

The turnout bearers in **tangential turnouts** are set out in a fan shape, with each bearer forming a half angle with both the main line and turnout road. This allows a single set of turnout bearers and plates for both a right hand and left hand turnout of similar radius.

The first sleeper installed beyond the bearers behind the crossing (mainline and turnout roads) shall be angled to return the sleeper skew to square to the track (angle ½ difference between bearer skew and normal to the track).

For crossovers designed with tangential turnouts, the bearers are set out normal to the main lines. Long bearers shall be installed where clearance is not available for standard sleepers on adjoining tracks.

The bearer design for a nominated tangential turnout configuration is standard and can be used independently of the manufacturer of the steel componentry.

7.1.5.3 Use of In-bearers

The use of approved in-bearers (where the signalling equipment is contained within the bearer) is encouraged.

The layouts are only for use in tangential turnouts with concrete bearers. Standard concrete beams are used except for the bearers that are replaced by in-bearer units.

In the points area there is some respacing of bearers to suit the in-bearer A and B ties and the back-drive. The A and B in-bearer units are the same for all turnouts.

The back-drive units are of two types: Type 1 which suits 250m and 300m radius designs and Type 2 which suits 500m.

7.1.6 Crossings

7.1.6.1 Selection of crossing rate

The selection of the crossing rate shall be based on the geometric design of the turnout and the associated limiting speed of the turnout road.

Turnout speeds shall be determined by applying design standards for track geometry detailed in OTCS 210.

Allowable published speeds for turnouts are as shown in Table 3. The speeds indicated are for normal passenger and freight trains.

Turnout Rate	Straight/ Curved	Switch length	Recommended Turnout Speed (km/h)
Standard Conventional			
1 in 8.25	Curved	6100 switch	15
1 in 9	Straight	6100 switch	20
1 in 10.5	Straight	6100 switch	25
		9150 switch	40
1 in 15	Straight	9150 switch	50
Standard Tangential			
Turnout radius: Crossing rate			
190:7	Curved		35
190:9	Straight		35
250:8.25	Curved		40
250:10.5	Straight		40
300:9	Curved		45
300:12	Straight		45
500:12	Curved		60
500:15	Straight		60
800:15	Curved		75
800:18.5	Straight		75
1200:18.5	Curved		85
1200:24	Straight		85

Table 3 – Turnout Speeds

1. Where there is a straight of 13m or longer between turnouts of a crossover, the speeds applicable to the individual turnouts shall be applied.
2. The allowable speed through a crossover or reversing movement where the intervening straight section of track is < 13m shall be calculated on an individual site specific basis in accordance with the requirements of OTCS 210.
3. Speeds for non-standard turnout designs shall be calculated from geometries in OTCS 210 using Virtual transitions where required.

Crossings in main lines (other than swingnose crossings) introduce a design dip in the track. This is an impact point that leads to accelerated deterioration of components. The impact can be reduced by limiting the speed over the crossing. Whilst this is achieved for traffic travelling on the turnout road because of the crossing alignment geometry in Table 3 above, the speed of mainline (through road) traffic should be limited by the dip angle. As a guide the crossing angle should be selected to meet the design speed requirements in accordance with Table 4.

Crossing Rate (1 in)	Crossing Angle (mrad)	Mainline Speed over Turnout(kph)		
		Normal	Maximum	Exceptional
2	140	16	25	29
4.5	62	37	55	65
7.5	37	62	92	108
8.25	34	68	102	115
9	31	74	111	
10.5	27	86	115	
12	23	99		
15	19	115		
18.5	15			
21	13			

Table 4 – Maximum mainline speeds for crossings based on dip angle

7.1.6.2 Selection of crossing type

The selection of crossing type shall be based on the requirements of Table 5.

Crossing type	Rail size		For use in turnout type
	New	Replacement	
Fabricated	50, 60	47, 50, 53, 60	Conventional
Rail Bound Manganese	60	53, 60	Conventional & Tangential
Compound	60	53, 60	Conventional & Tangential
Fully cast	60	60	Conventional & Tangential
Swing Nose	60	60	Tangential
Swing Wing	60	60	Tangential

Table 5 – Crossing types

1. Standard conventional turnouts can be provided with Fabricated or Compound “V” assemblies. See Appendix 2 for diagrams of each.
2. Standard tangential turnout designs are approved for both straight and curved crossings. Where there are no site constraints or adverse impacts on other rail infrastructure the straight crossing type shall be used.
3. Standard tangential turnouts shall be provided with fixed nose compound crossings unless specified otherwise.
4. Swing nose crossings are available for the standard tangential turnouts detailed in Table 6.

General Description	Crossing	General Layout Design Drawing Reference No.
300:12	Straight	775-136
800:18.5	Straight	775-139
1200:24	Straight	775-141

Table 6- Swing nose crossings

5. The following criteria influences the selection of a turnout with a swing nose crossing:-
   ~ Turnout must have a straight crossing and be installed on concrete bearers.
   ~ Any requirement for noise and vibration reduction with continuous wheel/rail contact through the crossing throat
   ~ Requirement for additional point operating motor and associated signalling componentry.

7.1.7 Switches

7.1.7.1 Selection of switch type

The selection of switch type shall be based on the requirements of Table 7.

Switch Type	Rail size		For use in turnout type
	New	Replacement of existing	
Heeled	50, 60	47, 50, 53, 60	Conventional
Flexible	50, 60	47, 50, 53, 60	Conventional
Tangential	60	60	Tangential

Table 7 – Switch types

See Appendix 2 for diagrams of standard switch types

1. Switches for use with 47kg and 53kg rail have no machining on the stockrail and the switch rail is machined and vertically set to override the foot of the stockrail.
2. Switches for use with 50kg and 60kg 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.

   The undercut switch design eliminates the requirements for Heavy Duty and Housed Switches.
3. Switches for tangential turnouts are manufactured from a shallow depth asymmetric rail.
4. Where conventional turnouts are approved for use in main line applications, all new switches shall be the flexible type. There are however, limitations on the capacity of points operating equipment to operate flexible switches at remote distances. Where required by the Principal Signal Engineer, heeled switches may be used.
5. Switches used with Manual Levers (Thornley or Throwover) shall be, preferably, the flexible type
6. Switch protection pads shall be installed to protect conventional switches in siding turnouts where the crossing rate is ≤ 1 in 8.25. Apply the switch pad protector on one rail only 50mm in front of the appropriate switch (See Figure 6). Only approved bolt-on switch pad protectors may be used. Approved pad protectors are detailed in Appendix 6.

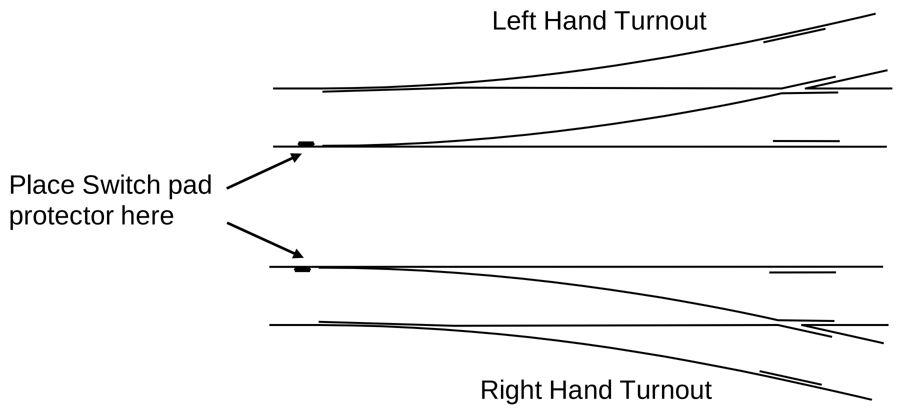


Figure 6 – Location of switch pad protectors

7. The operation of all new or renewed switches shall be determined by the Signal Engineer. The switch operation shall be included in the turnout design.

8. The distance from the point of the switch to the nearest end of the stockrail is called the "front" of a turnout. The "front" is a standard length as shown in Table 8 and Appendix 2.

   The front length shall normally be retained for all new turnouts and only altered in restricted location situations.

Switch Type		Rail size	Front length (mm)	For use in turnout type
Heeled		53	4877	Conventional
Flexible		53	4877	Conventional
Flexible		50, 60	2000	Conventional
Asymmetric	160 - 500	50, 60	2890	Tangential
	800		3490	
	1200		2290	

Table 8 – Front lengths of turnouts

9. Where switches require renewal in an existing 53kg turnout, and there is no 53kg material available, the points may be renewed in 60kg material. Junction rails or welds shall be fitted between the switches and the crossing and associated check rails and appropriate plating shall be adopted.

   Similarly, 47kg switch and stockrail units may be replaced by 50kg material.

7.1.8 Design requirements for non-standard tangential turnouts

For turnouts in which both roads will be curved, the basic design shall be reconfigured to achieve the required geometry. In this case:

- the bearer design will be the same as for the standard turnout design but will need re-spacing to suit the altered track geometry
- the closure rails will be slightly shorter or longer depending on the extent of curvature applied in the design
- switch and stockrail design will be the same as for the standard turnout design but with altered curvature to suit the main line radius
- checkrail design will be the same as for the standard turnout design but with altered curvature to suit the main line radius
- crossings will need to be specially curved to suit the applicable geometry.
- Turnouts may be left or right handed.

7.1.9 Other special track components

In addition to the major components specified in this standard, all other special track components completing a standard turnout configuration such as fastenings, plating and closure rails shall be as specified on the General Arrangement drawings for each turnout type. Approval of a turnout design shall include approval of all special components included in the design.

7.1.10 Standard track components

Where standard plain track components are used in turnouts then the rail, rail joining methods, fastenings, sleepers/bearers, ballast, and track geometry used shall be designed in accordance with the relevant CRN standards detailed in Table 9.

Standard No	Component
OTCS 210	Track Geometry & Stability
OTCS 220	Rail and Rail Joints
OTCS 230	Ties and track support
OTCS 240	Ballast

Table 9 - Standards for components

7.1.11 Rail adjustment

The following rail anchoring requirements apply to turnouts constructed with timber sleepers and non-resilient fastenings. Bearers (timber, steel, composite or concrete) with resilient fastenings do not require anchoring.

Double anchor every second sleeper for 32 sleepers (i.e. a total of 16 anchored sleepers) in front of the switch, commencing from the first sleeper from the switch.

Double anchor every second sleeper/timber for 32 sleepers/timbers (i.e. a total of 16 anchored sleepers/timbers) behind the crossing, commencing from the first timber after the crossing that has plain track fastenings.

Double anchor every second timber on the through rails and turnout rails between the heel of the switch and the front legs of the crossing.

7.2 Diamond crossings

Not Applicable

7.3 Slips

Not Applicable

7.4 Catchpoints

7.4.1 General

Catch point or derail configurations adopted for a specific site or application shall conform to the design requirements detailed in Section 5.4

All new catchpoints and replacement components shall be manufactured to meet the requirements of CRN CP 251

Table 11 details approved configurations for catchpoints used in main lines/crossing loops and in siding class tracks.

Track components comprising standard catchpoint configurations such as fastenings, plating and closure rails shall be as specified on the General Arrangement drawings for each catchpoint type.

Track Class	New or replacement catchpoints	
	Rail size (kg/m)	Drawing Reference
All	60	580 - 715
	53	153- 891
	47	300 - 696

Table 11 - Approved catchpoint configurations

7.4.2 Rail adjustment

The following rail anchoring requirements apply to catchpoints constructed with timber sleepers and non-resilient fastenings. Catchpoints constructed with resilient fastenings do not require anchors.

Only approved configurations shall be installed.

Double anchor the catchpoint rail every second sleeper for 32 sleepers (i.e. a total of 16 anchored sleepers) in front of the switch, commencing from the first sleeper from the switch.

Double anchor the catchpoint rail every second sleeper/timber for 32 sleepers/timbers (i.e. a total of 16 anchored sleepers/timbers) behind the heel commencing from the first timber after the heel that has plain track fastenings.

Anchor the plain track rail as for plain track (see OTCS 220).

7.5 Expansion switches

Not Applicable.

7.6 Manual points levers

Manual point lever configurations include:

- throw over levers
- sprung levers

Approved manual point levers, including proprietary designs, are detailed in Appendix 6.

8 Configuration requirements for existing special trackwork

Existing configurations of turnouts or catchpoints may not meet the requirements for new and replacement configurations (see Table 2 to Table 12). Speeds in Table 3 may not be achieved for these configurations.

All replacement components for existing turnouts shall be manufactured to meet the requirements of CRN CP 251

9 Undesirable configurations

The following configurations are considered undesirable for installation in main lines. They should be considered for strategic upgrading.

1. Heeled switches
2. Short switches (< 5030m)
3. Turnouts on sharp curves, especially if they are similar flexure.
4. Catchpoints without a clear landing area. Where such cases exist a risk analysis shall be undertaken to establish potential corrective or protective actions.

10 Acceptance standards for new installations

10.1 Turnouts

1. Turnout geometry for new installations shall meet the requirements of Standard OTCS 210 “Track Geometry & Stability”. In addition:
   - gauge dimensions at the switch tip shall conform to the design ± 2mm.
   - gauge at crossings shall conform to the design ± 2 mm
   - flangeways at crossings shall conform to the design ± 1 mm
   - checkrail effectiveness shall conform to the design +3 −1mm
   - switches shall bear on all plates + 1 − 0 mm in closed position
2. Other fabrication and installation tolerances shall be in accordance with the manufacturer's instructions.
3. When turnouts are placed within 30m of a bridge end (where spans are < 18m) OR when turnouts are placed within 60m of a bridge end (where one or more spans are ≥ 18m but <

80m), the turnout shall be aluminothermic welded throughout and a flexible switch used if possible.

4. Where tangential turnouts are used, the turnouts, and the track for 50 metres either side, shall be fully welded. The use of joints is only permitted for a short period during the initial construction and installation phase.
5. For turnouts fitted with dry slide chairs, no oil or grease shall be applied to these chairs.
6. Plain track components shall meet the acceptance standards detailed in the component standards in Table 9.

10.2 Diamond crossings

Not Applicable

10.3 Slips

Not Applicable

10.4 Catchpoints

1. Catchpoint geometry shall meet the requirements of OTCS 210. In addition gauge generally in catchpoints shall conform to the design ± 3 mm
2. Other fabrication and installation tolerances shall be in accordance with the manufacturer's instructions.
3. Plain track components shall meet the acceptance standards for component standards in Table 9.

10.5 Expansion switches

Not Applicable

10.6 Manual point levers

Manual point levers shall be installed to meet the tolerances established by the manufacturer.

11 Repair standards

11.1 Geometry

11.1.1 Turnouts

The following maintenance limits shall be applied to manual regauging of turnouts or component renewal.

1. Turnouts shall meet the requirements of OTCS 210
2. For non-interlocked points the clearance between the back of an open switch point and the gauge of the running stock rail shall conform to the design ± 2mm.
3. Housed switches shall conform to the design ± 1mm of the specified parameters.
4. If the maintenance activity includes longitudinal movement of any crossing, the resulting position of the crossing intersection point (Theoretical Point) must be within 15mm of the position defined by reference pegs or survey monuments.
5. After maintenance, crossing and check rail measurements on all tracks shall be within the limits in Table 13.

	Flangeway Depth (min) (mm)	Crossing Flangeway Width (mm)	Checkrail Flangeway Width (mm)	Gauge (mm)	Checkrail Effectiveness (mm)
V Crossing	38 min	44 ± 2	44 ± 2	1435 ±2	1389 - <1396
K Crossing	38 min	44 ± 2	NA	1435 ±2	1389 - <1395

Table 13 - Turnout geometry maintenance limits

11.1.2 Diamond Crossings

Not Applicable

11.1.3 Slips

Not Applicable

11.1.4 Catchpoints

The following maintenance limits shall be applied to manual regauging or component renewal in catchpoints.

1. Geometry shall meet the requirements of OTCS 210.
2. For non-interlocked points the clearance between the back of an open switch point and the gauge of the running stock rail shall conform to the design ± 2mm.

11.2 Component repair

11.2.1 Switches

1. Repair of switches by wirefeed welding is prohibited. Switch profile and condition may only be repaired by grinding.
2. After maintenance switch tip measurements shall be within the limits in Table 14.

<table>
<tr><th>Parameter</th><th>Standard</th><th>Heavy duty</th><th>Undercut</th><th>Asymmetric</th></tr>
<tr><td>Switch tip radius</td><td>≥ 13mm</td><td>≥ 13mm</td><td>NA</td><td>NA</td></tr>
<tr><td>Switch angle (to vertical)</td><td>≤ 18^{0} (3:1)</td><td>≤ 18^{0} (3:1)</td><td colspan="2" rowspan="3">The top of the switch tip must sit within the face of the stockrail</td></tr>
<tr><td>Switch tip height (below top of rail)</td><td>≥ 13mm</td><td>≥ 13mm</td></tr>
<tr><td>Switch tip width (at top of switch)</td><td>≤ 4mm</td><td>The whole of the switch tip must sit within the gauge line of the joggled stockrail</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">No part of the running surface of the switch blade, between 17mm and 30mm from the head of the rail, shall form a plane at an angle of less than 40^{0} to the horizontal (see Figure 7)</td></tr>
</table>

Table 14 – Switch tip maintenance limits

3. There shall be no damage in the first 2m from the tip of the switch blade, deeper than 17mm from the running surface and which extends more than 100mm along the blade, or consecutive areas of damage less than 100mm apart forming a length more than 100mm.”
4. There shall be no damage in the first 2m from the tip of the switch blade, deeper than 19mm from the running surface”

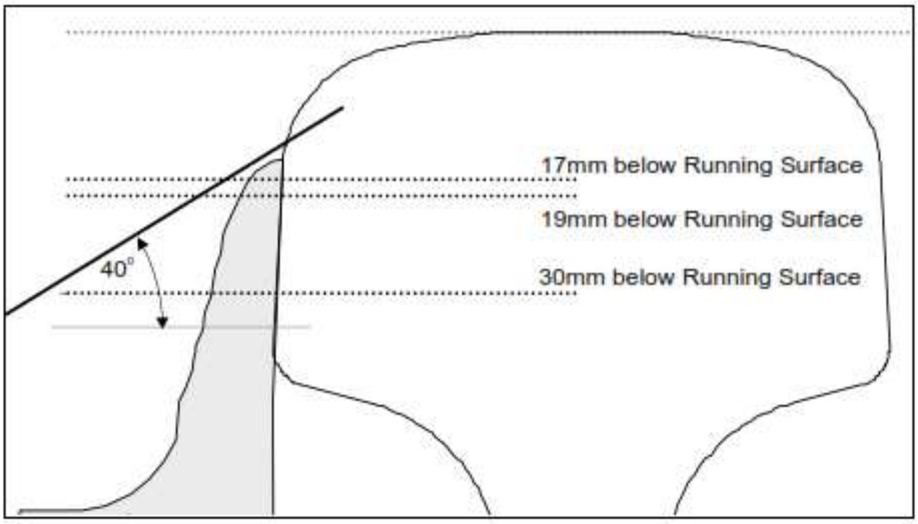


Figure 7 – Switch tip acceptance limits

11.2.2 Crossings and wingrails

1. Repair of crossings and wingrails by wirefeed welding is an approved repair method.
2. Repaired components shall meet the design profile and tolerances of the component being repaired.
3. All repairs shall be ultrasonically tested. ALL ultrasonic indicators must be below reportable limits as detailed in CRN CS 220.

Appendix 1 Definitions

Term	Description
A	
Asymmetric Switch	Switches used with tangential turnouts. They are not machined from rail. They have a thick web and are shallower than conventional and undercut switches.
B	*No Entries*
C	
Catch points:	A single switch assembly and a throw-off rail. The catch point switch is normally set in the open position, thus breaking the continuity of the siding track causing unauthorised train movements to derail at a point clear of the main line.
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.
Check Rail	A rail placed inside the running rail which comes into contact with the back of the wheel flange and is used in points and crossing work to provide steering of the wheelset such that the crossing nose is not contacted by the opposite wheel
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 a flangeway clearance. The centre of the checkrail is usually opposite the theoretical point of the crossing
Chocks	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
Clearance Point	A point on converging or diverging tracks where the track centres or separation between the tracks allows clear passage for passing trains and beyond which vehicles must not stand.
Closure Rails	Rails making up a turnout apart from those in the points, crossings and checkrail units
Compound Crossing	Comprises a crossing V point that is manufactured from a single cast nose which is welded to head hardened rails to complete the V which replaces the point/housed rails in a fabricated crossing. They may be manufactured from manganese steel, chrome vanadium alloys or other materials
Compound Manganese Crossing	Is a Compound crossing V point that is manufactured from a cast manganese nose which is explosively hardened and flashbutt welded to head hardened rails to complete the V which replaces the point/housed rails in a fabricated crossing.
Conventional Switch	Conventional switches are machined from rails and tapered down from a full rail at the heel, to a thin point that fits closely against the stock rail. They are only in use with 53kg and lighter rail and are not used when turnouts are renewed.
Crossing Assembly	The component of a track system where lines branch out or intersect. Crossings assist in the passage of track wheels where two track rails intersect. Crossings may be fixed or switchable. In diamond crossings there are K and V crossings and in turnouts V crossings.
Crossover	The means by which trains pass from one track to an adjacent parallel track. A Crossover is constructed from two turnouts (one on each track facing opposite directions) and connecting plain trackwork
D	
Derail	A vehicle derailing device that, when operating to protect the main running line, causes wheels to climb the siding rail and derail clear of the protected line.
Diamond Crossing	The component of a track system where lines intersect. Diamond Crossings comprise V and K crossings.

Term	Description
E	
Expansion switch	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 (eg steel underbridges) which are also subject to temperature related expansion and contraction.
F	
Fabricated Crossing	Comprises a Vee and two (2) wing rails fabricated from sections of rail, set, machined and fitted together with chocks. The hand of the crossing is determined by the location of the point rail and may be right or left. The point rail is always the rail carrying the maximum tonnages, or higher speed. A right hand crossing has the point rail in the rail that connects to the right hand switch.
Fixed crossings.	These crossings have a wheel flange gap in both rails. Wheel transfer of fixed crossings depend on matching wheel and rail profiles. Fixed crossings are used in conjunction with check (guide) rails to provide lateral guidance in the crossing area.
Flangeway	The space adjacent to the gauge face of a running rail to allow for the passage of wheel flanges.
Flangeway Clearance	The distance between the gauge side of a running rail and the guard face of a check rail or the guard face of a wing rail
Flangeway Depth	Flange way depth is the height of the running surface of the rail above the top of the blocks at check rails and in ‘V’ and ‘K’ crossings
Flare	The tapered widening at the ends of flangeways to gradually engage wheel flanges and position them to pass through flangeways.
Flexible Switch	A switch machined from longer rails and fixed towards the end of this rail with blocks or other device to the adjacent stockrail. The switch movement is provided by the flexibility of the longer switch rail and a section machined from the rail foot (foot relief) towards the fixed end.
Fully cast crossing	A one piece solid cast steel crossing with the four legs joined to standard rail sections through a welding process or by bolts and plates.
G	*No Entries*
H	
Heavy duty switch	Switch with thickened switch points used in conventional turnouts with heavy traffic to limit wear. Used with joggled stockrails to ensure the running face of the running rail is colinear
Heel	The end of a switch at which the switch pivots
Heel Block	Single or multiple blocks, depending on switch type, that rigidly fix the switch rail to the adjacent rail in the correct geometric configuration. The adjacent rail is the stockrail and can include a closure rail for some switch types.
Heeled Switch	A switch that pivots about a gapped joint between the switch rail and adjoining closure rail. The switch is bolted to the stockrail and closure rail using a heel block and fishplate designed to allow this movement.
Housed Switch	A housed switch is a heavy duty switch and joggled stockrail equipped with a “Housing”. 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.

Term	Description
I	
In - Bearer	A bearer fabricated into a hollow channel shape that is used at a set of points to house the switch operating rodding. This eliminates the rodding being located in a bay between bearers.
Interlocking	Interaction of equipment controlling switches and/or signals to prevent conflicting movements, and to make sure that routes are set correctly.
J	*No Entries*
K	
K Crossing	The principal special component of a diamond crossing. It is the intersecting component between two rails. The intersection creates an unchecked area in the centre of the K, thus limiting the angles that can be designed for K crossings
L	*No Entries*
M	
Manual Point Lever	An apparatus consisting of a manually actuated lever and connecting rodding to operate points in turnouts and catchpoints or to operate a derail device. Manual point levers do not include ground frame or signal box levers that are generally connected to an interlocked signalling system.
N, O	*No Entries*
P	
Points and crossings	A combination of rail and track components that provide for one track to join or cross another whilst maintaining continuous support and direction to the rolling stock wheels. The points are the location where one track separates into two tracks (or vice-versa) and generally includes moving rail components called switches or switch blades. The crossing allows rolling stock wheels to cross over a rail. Combinations of points and crossings may be used to construct various track structures including slips, diamond crossings, turnouts and Catchpoints.
Points Assembly	The location where one track separates into two tracks (or vice-versa) and generally includes moving rail components called switches or switch blades that are attached to stockrails.
Q	*No Entries*
R	
Rail Brace	Component used in points assemblies to fasten the stockrail in position where fastenings on the gauge side of the rail cannot be used. The Rail Brace is bolted through the web of the stockrail.
Rail Brace Plates	Attach the Rail Brace to the bearer.
Rail Bound Manganese Crossings	Crossings with the actual crossing area made from manganese steel casting and surrounded by specially machined and set rail wings.
S	
Single/Double Slip	A special track layout that combines turnouts and diamond crossings. They allow train movements both across and onto and out of a track.
Spring Wing crossing	A switchable 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 road
Stockrails	These provide support for the closed switch and become the running rail when the switch is open. They are curved, set and /or joggled.

Term	Description
Swing Nose Crossing	A switchable V crossing with a nose assembly that moves from the main line rail to the turnout rail, depending on the train movement, allowing a continuous surface for the wheel to run through the crossing. They are provided with straight crossings only. No check rails are required with this crossing type.
Switch	Is a machined tapered rail that allows the direction of a train to be altered to another line. A switch consists of a section of rail set and machined to a design shape, drilled to detail to accommodate switch operating rodding and heel blocks or chocks to allow attachment to a stockrail.
Switch Rollers	Rollers that support the switch during the opening and closing operation. The can be located in the bay between bearers, usually bolted to the stockrail, or be fabricated as a part of the plate assembly under the switch. They eliminate the need to lubricate the switch plate/switch interface.
Switch Stops	Switch Stops are bolted to the web of the stockrail and make contact with the web of the switch when the switch is in the closed position, providing lateral support. They can be manufactured from castings, rolled angle section or extended bolts.
Switchable crossings.	These crossings close the gap in one track that is being made active for traffic allowing a continuous surface for the wheel to run through the crossing. Wheel transfer in switchable crossings is without any impact for any wheel profile. Switchable crossings have no flange gap in the active track and thus do not require check rails. They can have either Swing Nose or Spring Wing
T	
Tangential Switch	A switch with a continuous curve through the full length of the switch. The curved gauge line of the switch is tangent to the gauge line of the attached stockrail at a distance in front of the switch tip
Theoretical Point	Located on the crossing nose at the intersection of the gauge lines of the two running rails forming the crossing
Trailable Point Lever	A manual point lever that is designed to allow for vehicle wheels trailing through points set the wrong way to re-set the points for the trailing movement without the need to operate the lever.
Turnout	Special trackwork that allows trains to pass from one track on a diverging path. It consists of switch and stockrail assemblies, a 'V' crossing and checkrails, linked together by straight and curved infill rails (closure rails).
Turnout Radius	The radius of the centreline of the curved turnout track and not the turnout rail radius. It 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
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.
Turnout Length	The distance from the toe of the switch to the theoretical point measured along the main line running rail containing the crossing.
U	
Undercut Switch	Switches for use with 50kg and 60kg rail have the stockrail undercut by machining to allow the switch to move partially under the head of the stockrail.

Term	Description
V	
V crossing	A unit that allows a train travelling on the turnout direction rail to cross the mainline rail. The crossing rate is a measure of the angle made by the main line and turnout rail gauge faces that intersect at the theoretical point. The crossing rate is the cotangent of the angle made. All crossings are identified by markings on the wing rail which are provided during manufacture. See Appendix 2 Crossing Identification The catalogue number allows the geometry of the particular crossing to be identified. Each catalogue number defines a crossing with a unique geometry. See Appendix 2 for diagrams of standard crossing types
W	
Wing Rail	The rails of a crossing (on the end closest to the switch in a turnout) that are flared to allow the passage of the wheel to transfer to or from the crossing nose. Named for their resemblance to a wing in shape.
X, Y, Z	No entries

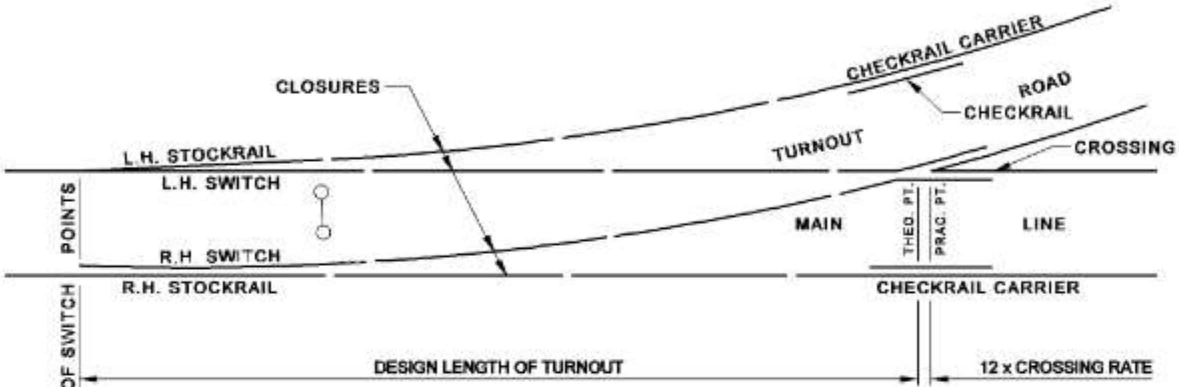
Grouped by component	
Term	**Description**
General	
Points and crossings	A combination of rail and track components that provide for one track to join or cross another whilst maintaining continuous support and direction to the rolling stock wheels. The points are the location where one track separates into two tracks (or vice-versa) and generally includes moving rail components called switches or switch blades. The crossing allows rolling stock wheels to cross over a rail. Combinations of points and crossings may be used to construct various track structures including slips, diamond crossings, turnouts and Catchpoints.
Turnout	Special trackwork that allows trains to pass from one track on a diverging path. It consists of switch and stockrail assemblies, a 'V' crossing and checkrails, linked together by straight and curved infill rails (closure rails).
Turnout Length	The distance from the toe of the switch to the theoretical point measured along the main line running rail containing the crossing.
Turnout Radius	The radius of the centreline of the curved turnout track and not the turnout rail radius. It 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
Turnout Rail	This is a 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.
Stockrails	Provide support for the closed switch and become the running rail when the switch is open. They are curved, set and /or joggled.
Crossover	The means by which trains pass from one track to an adjacent parallel track. A Crossover is constructed from two turnouts (one on each track facing opposite directions) and connecting plain trackwork.
Diamond Crossing	The component of a track system where lines intersect. Diamond Crossings comprise V and K crossings.
Catchpoints:	A single switch assembly and a throw-off rail. The Catchpoint switch is normally set in the open position, thus breaking the continuity of the siding track causing unauthorised train movements to derail at a point clear of the main line.

Term	Description
Clearance Point	A point on converging or diverging tracks where the track centres or separation between the tracks allows clear passage for passing trains and beyond which vehicles must not stand.
Derail	A vehicle derailing device that, when operating to protect the main running line, causes wheels to climb the siding rail and derail clear of the protected line.
Expansion switch	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 (eg steel underbridges) which are also subject to temperature related expansion and contraction.
Single/Double Slip	A special track layout that combines turnouts and diamond crossings. They allow train movements both across and onto and out of a track.
Points	
Points Assembly	The location where one track separates into two tracks (or vice-versa) and generally includes moving rail components called switches or switch blades that are attached to stockrails.
Switch	A machined tapered rail that allows the direction of a train to be altered to another line. A switch consists of a section of rail set and machined to a design shape, drilled to detail to accommodate switch operating rodding and heel blocks or chocks to allow attachment to a stockrail.
Heeled Switch	A switch that pivots about a gapped joint between the switch rail and adjoining closure rail. The switch is bolted to the stockrail and closure rail using a heel block and fishplate designed to allow this movement.
Heel	The end of a switch at which the switch pivots
Heel Block	Single or multiple blocks, depending on switch type, that rigidly fix the switch rail to the adjacent rail in the correct geometric configuration. The adjacent rail is the stockrail and can include a closure rail for some switch types.
Flexible Switch	A switch machined from longer rails and fixed towards the end of this rail with blocks or other device to the adjacent stockrail. The switch movement is provided by the flexibility of the longer switch rail and a section machined from the rail foot (foot relief) towards the fixed end.
Tangential Switch	A switch with a continuous curve through the full length of the switch. The curved gauge line of the switch is tangent to the gauge line of the attached stockrail at a distance in front of the switch tip.
Conventional Switch	Conventional switches are machined from rails and tapered down from a full rail at the heel, to a thin point that fits closely against the stock rail. They are only in use with 53kg and lighter rail and are not used when turnouts are renewed.
Undercut Switch	Switches for use with 50kg and 60kg rail have the stockrail undercut by machining to allow the switch to move partially under the head of the stockrail.
Asymmetric Switch	Switches used with tangential turnouts. They are not machined from rail. They have a thick web and are shallower than conventional and undercut switches.
Housed Switch	A heavy duty switch and joggled stockrail equipped with a “Housing”. 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.
In - Bearer	A bearer fabricated into a hollow channel shape that is used at a set of points to house the switch operating rodding. This eliminates the rodding being located in a bay between bearers.
Interlocking	Interaction of equipment controlling switches and/or signals to prevent conflicting movements, and to make sure that routes are set correctly.

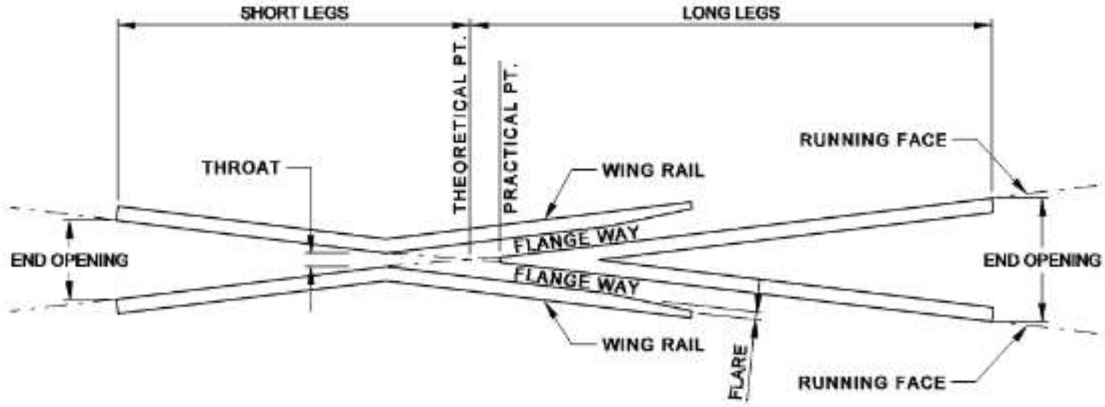
Term	Description
Chair Plates	A chair is a flat plate with a pressed up section that is attached with a bolt through the web of either stockrail, in the case of a switch assembly, or the checkrail carrier, in the case of a checkrail assembly.
Rail Brace	Component used in points assemblies to fasten the stockrail in position where fastenings on the gauge side of the rail cannot be used. The Rail Brace is bolted through the web of the stockrail.
Rail Brace Plates	Attach the Rail Brace to the bearer.
Switch Rollers	Rollers that support the switch during the opening and closing operation. Theycan be located in the bay between bearers, usually bolted to the stockrail, or be fabricated as a part of the plate assembly under the switch. They eliminate the need to lubricate the switch plate/switch interface.
Switch Stops	Switch Stops are bolted to the web of the stockrail and make contact with the web of the switch when the switch is in the closed position, providing lateral support. They can be manufactured from castings, rolled angle section or extended bolts.
Manual Point Lever	An apparatus consisting of a manually actuated lever and connecting rodding to operate points in turnouts and catchpoints or to operate a derail device. Manual point levers do not include ground frame or signal box levers that are generally connected to an interlocked signalling system.
Trailable Point Lever	A manual point lever that is designed to allow for vehicle wheels trailing through points set the wrong way to re-set the points for the trailing movement without the need to operate the lever.
Crossings	
Crossing Assembly	The component of a track system where lines branch out or intersect. Crossings assist in the passage of track wheels where two track rails intersect. Crossings may be fixed or switchable. In diamond crossings there are K and V crossings and in turnouts V crossings.
V crossing	A unit that allows a train travelling on the turnout direction rail to cross the mainline rail. The crossing rate is a measure of the angle made by the main line and turnout rail gauge faces that intersect at the theoretical point. The crossing rate is the cotangent of the angle made. All crossings are identified by markings on the wing rail which are provided during manufacture. See Appendix 2 Crossing Identification The catalogue number allows the geometry of the particular crossing to be identified. Each catalogue number defines a crossing with a unique geometry. See Appendix 2 for diagrams of standard crossing types
K Crossing	The principal special component of a diamond crossing. It is the intersecting component between two rails. The intersection creates an unchecked area in the centre of the K, thus limiting the angles that can be designed for K crossings
Fabricated Crossing	Comprises a V and two (2) wing rails fabricated from sections of rail, set, machined and fitted together with chocks. The hand of the crossing is determined by the location of the point rail and may be right or left. The point rail is always the rail carrying the maximum tonnages, or higher speed. A right hand crossing has the point rail in the rail that connects to the right hand switch.
Compound Crossing	Comprises a crossing V point that is manufactured from a single cast nose which is welded to head hardened rails to complete the V which replaces the point/housed rails in a fabricated crossing. They may be manufactured from manganese steel, chrome vanadium alloys or other materials.
Compound Manganese Crossing	A Compound crossing V point that is manufactured from a cast manganese nose which is explosively hardened and flashbutt welded to head hardened rails to complete the V. It replaces the point/housed rails in a fabricated crossing.
Fully cast crossing	A one piece solid cast steel crossing with the four legs joined to standard rail sections through a welding process or by bolts and plates.

Term	Description
Fixed crossings.	These crossings have a wheel flange gap in both rails. Wheel transfer at fixed crossings depends on matching wheel and rail profiles. Fixed crossings are used in conjunction with checkrails to provide lateral guidance in the crossing area.
Switchable crossings.	These crossings close the gap in one track that is being made active for traffic allowing a continuous surface for the wheel to run through the crossing. Wheel transfer in switchable crossings is without any impact for any wheel profile. Switchable crossings have no flange gap in the active track and thus do not require checkrails. They can have either Swing Nose or Spring Wing
Swing Nose Crossing	A switchable V crossing with a nose assembly that moves from the main line rail to the turnout rail, depending on the train movement, allowing a continuous surface for the wheel to run through the crossing. They are provided with straight crossings only. No checkrails are required with this crossing type.
Spring Wing crossing	A switchable 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 road.
Wing Rail	The rails of a crossing (on the end closest to the switch in a turnout) that are flared to allow the passage of the wheel to transfer to or from the crossing nose. Named for their resemblance to a wing in shape.
Flangeway	The space adjacent to the gauge face of a running rail to allow for the passage of wheel flanges.
Flangeway Clearance	The distance between the gauge side of a running rail and the guard face of a checkrail or the guard face of a wing rail.
Flangeway depth	Flange way depth is the height of the running surface of the rail above the top of the blocks at checkrails and in ‘V’ and ‘K’ crossings.
Theoretical Point	Located on the crossing nose at the intersection of the gauge lines of the two running rails forming the crossing.
Checkrail unit	
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 a flangeway clearance. The centre of the checkrail is usually opposite the theoretical point of the crossing.
Checkrail	A rail placed inside the running rail which comes into contact with the back of the wheel flange and is used in points and crossing work to provide steering of the wheelset such that the crossing nose is not contacted by the opposite wheel.
Chocks	An iron casting used mainly with checkrails and crossings to support rail components at a fixed distance apart. Raised lettering and numbers on the chock identify its application.
Flare	The tapered widening at the ends of flangeways to gradually engage wheel flanges and position them to pass through flangeways.

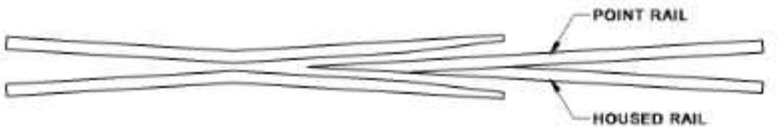
Appendix 2 General turnout data



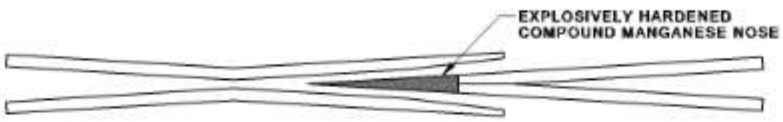
STANDARD TURNOUT CONFIGURATION
(DRAWN FOR L.H. TURNOUT)



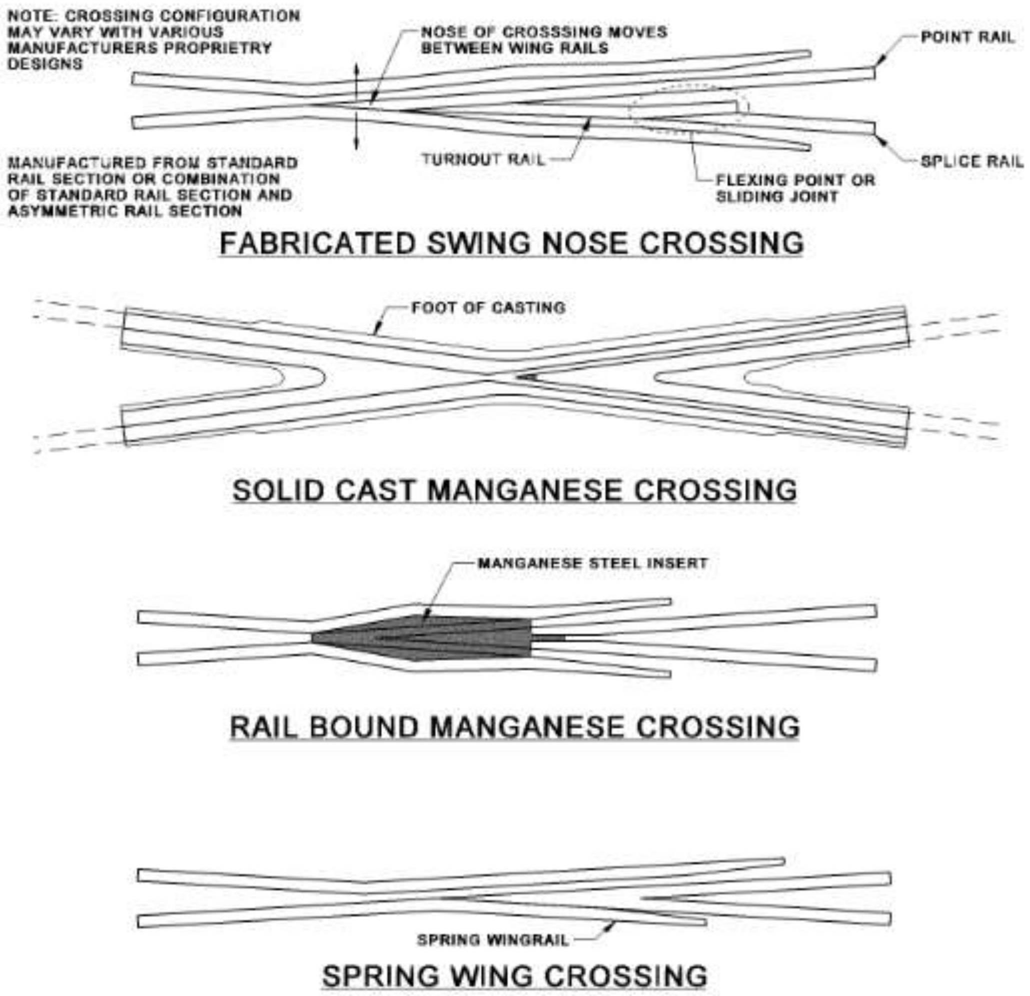
'V' CROSSING



FABRICATED CROSSING
DRAWN FOR R.H. POINT RAIL

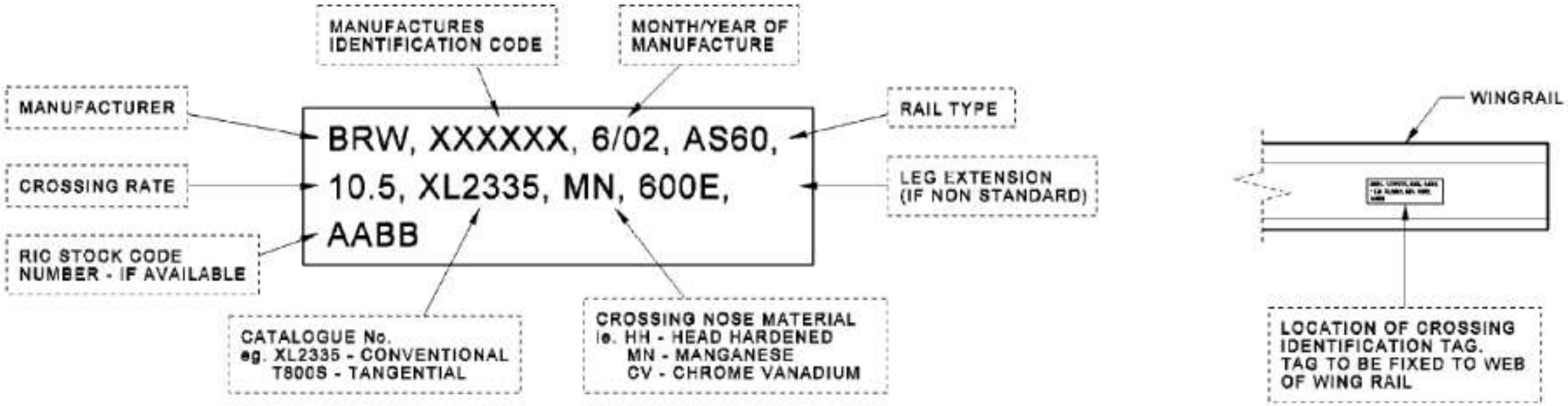


COMPOUND MANGANESE NOSE CROSSING



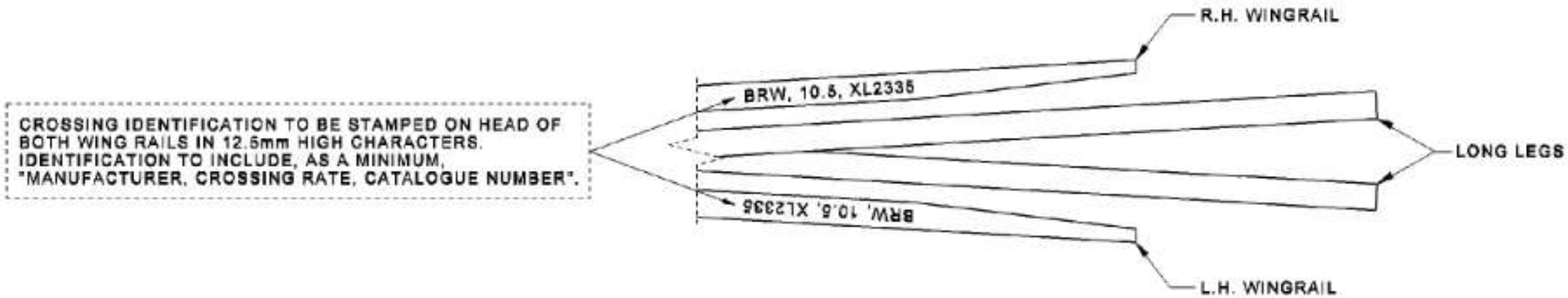
'V' CROSSING TYPES

NOTE:
ONLY RAIL HEAD SHOWN IN DIAGRAMS (UNLESS NOTED OTHERWISE)



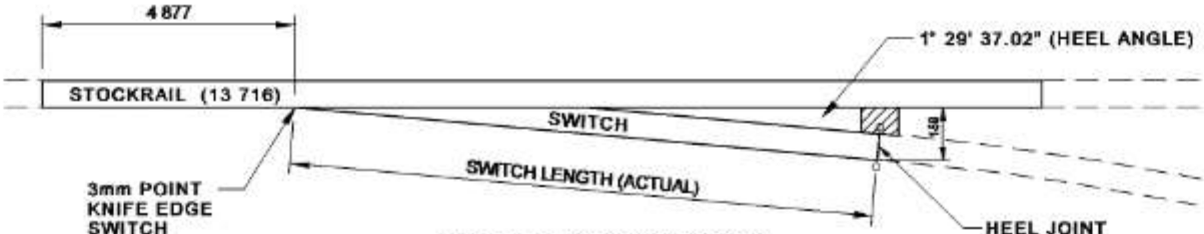
IDENTIFICATION TAG

(CONTAINS A MINIMUM OF " MANUFACTURER, DATE OF MANUFACTURE, RAIL TYPE, CROSSING RATE, CATALOGUE NUMBER")

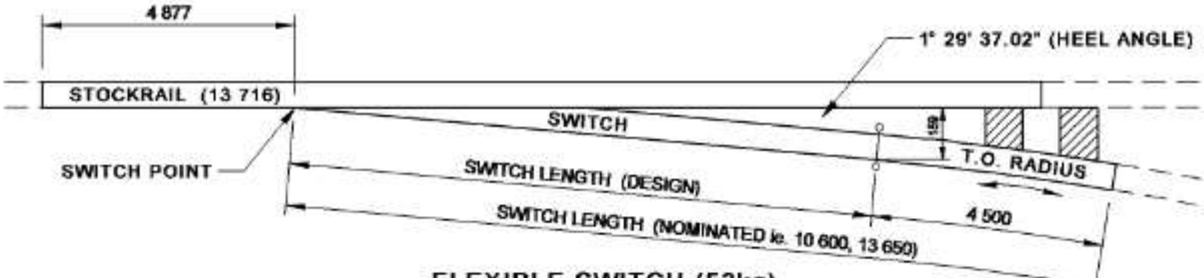


CURRENT REQUIREMENT

(TO BE RETAINED)



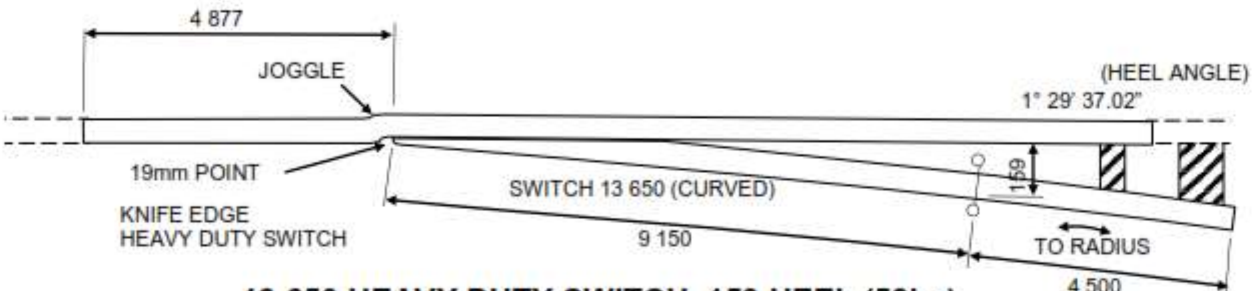
HEELED SWITCH (53kg)



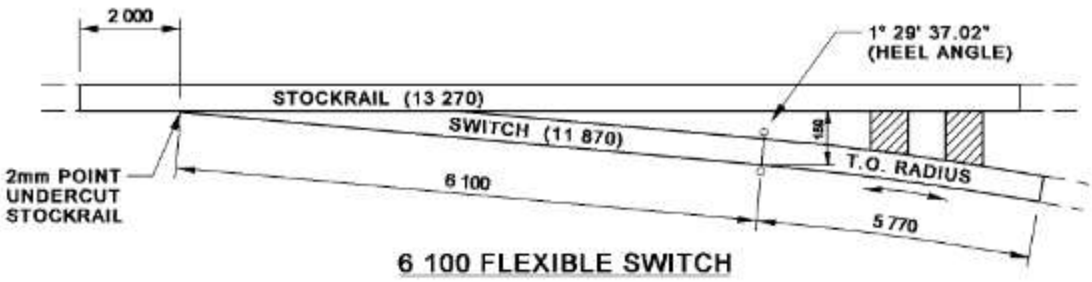
FLEXIBLE SWITCH (53kg)

SECTION AT SWITCH TIP

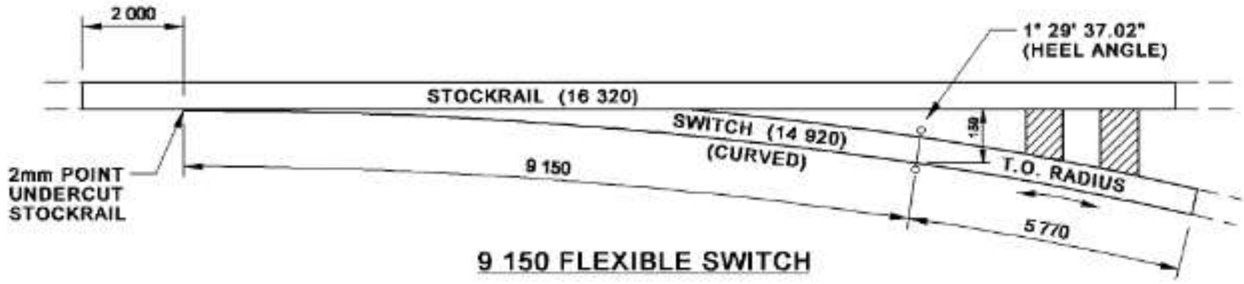
53kg HEELED & FLEXIBLE SWITCHES



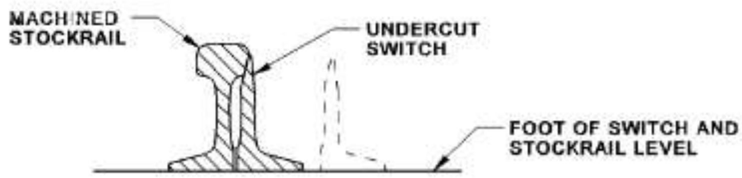
13 650 HEAVY DUTY SWITCH, 159 HEEL (53kg)



6 100 FLEXIBLE SWITCH



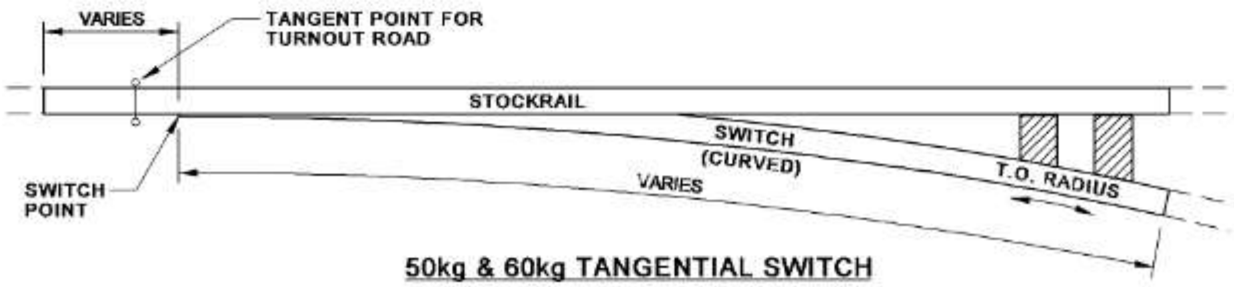
9 150 FLEXIBLE SWITCH



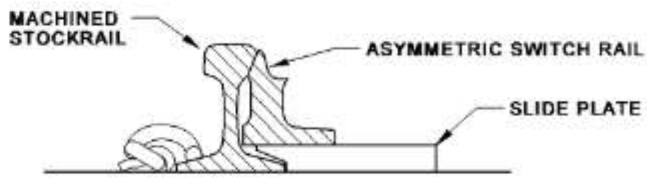
SECTION AT SWITCH TIP

50kg & 60kg FLEXIBLE SWITCHES

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



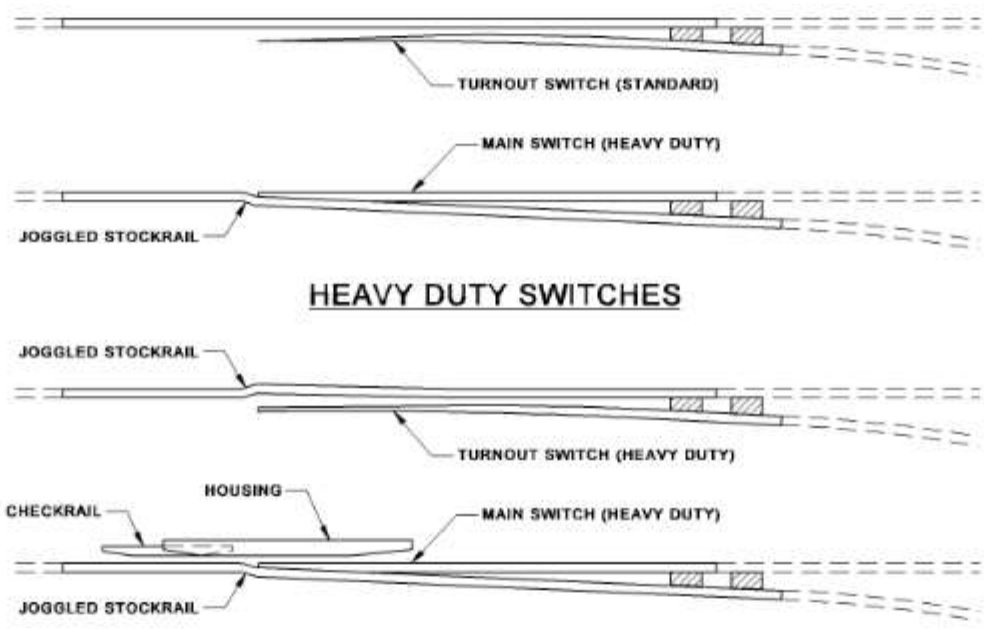
50kg & 60kg TANGENTIAL SWITCH



SECTION AT SWITCH TIP

TANGENTIAL SWITCHES

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



HOUSED SWITCHES

Appendix 3 Other Special Trackwork

Not Applicable

Appendix 4 Standard designs for conventional turnouts

Standard Conventional Turnouts							
Rail (kg)	Crossing		Switch Description	General Arrangement			
	Rate	Type		Length	Bearers	Plating	Design Reference
50	8.25	Curved	5030 x 159 H	21.770	Timber	Resilient	720-420
			6100 x 159 F	23.470	Timber	Standard	320-1197
	9	Straight	6100 x 159 F	23.510	Timber	Standard	320-1305
		Curved	6100 x 159 H	24.740	Timber	Standard	320-1520
	10.5	Straight	6100 x 159 F	25.730	Timber	Standard	320-1309
		Curved	6100 x 159 F	27.170	Timber	Standard	320-1310
53	8.25	Curved	5030 x 159 H	21.770	Timber	Resilient	246-466
			10600 F	23.470	Timber	Resilient	246-403
	9	Straight	10600 F	23.510	Timber	Resilient	246-920
	10.5	Straight	10600 F	25.730	Timber	Resilient	720-497
	15	Straight	10600F / 13650F	32.270/35.320	Timber	Resilient	248-1180
60	8.25	Curved	6100 x 159 H	23.470	Timber	Resilient	320-1215
			6100 x 159 F	23.470	Concrete	Resilient	690-418(RH) 690-419(LH)
					Timber	Resilient	425-462
	9	Straight	6100 x 159 F	23.510	Timber	Resilient	250-1258
			9150 x 159 F	26.560	Timber	Resilient	250-1258
	10.5	Straight	6100 x 159 F	25.730	Timber	Resilient	720-615
					Concrete	Resilient	320-1282(RH), 720-436(LH)
			9150 x 159 F	28.780	Timber	Resilient	720-615
	15	Straight	6100 x 159 F	32.270	Timber	Resilient	425-725, 320-1219
			9150 x 159 F	35.320	Timber	Resilient	425-725, 320-1219*
			9150 x 159 F	35.320	Concrete	Resilient	720-538(RH), 720-539(LH)

Table 15 - Standard Conventional Turnouts

1. H - Heeled Switches.
2. F - Flexible switches
3. For 53kg rail the flexible switch is defined as the total length of switch rail from which the switch is made. For 50kg and 60kg 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. (ie 53kg 10600 and 13650 switches have the same design geometry as the 6100x159 and 9150x159 (respectively) indicated for 50 and 60kg rail.
4. Standard Plating is a non-resilient type i.e. dogspikes, lockspikes, and/or screwspikes.
5. Resilient plating refers to an elastic type of fastener securing the rail foot to the baseplate

6. The layout for turnout bearers or ties forms part of the configuration. References to drawings detailing interface requirements for fixing components on standard turnouts, that is, crossings, checkrails, switch/stockrails and closure rails are indicated under design references.

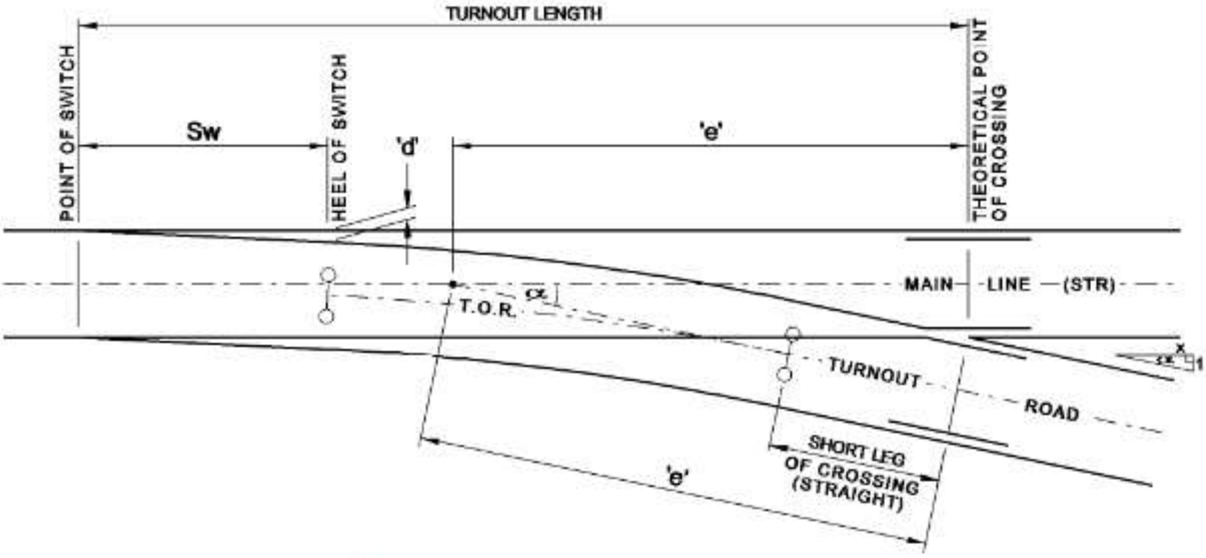


Figure 8 - Straight Crossing Conventional Turnout (drawn for RH turnout)

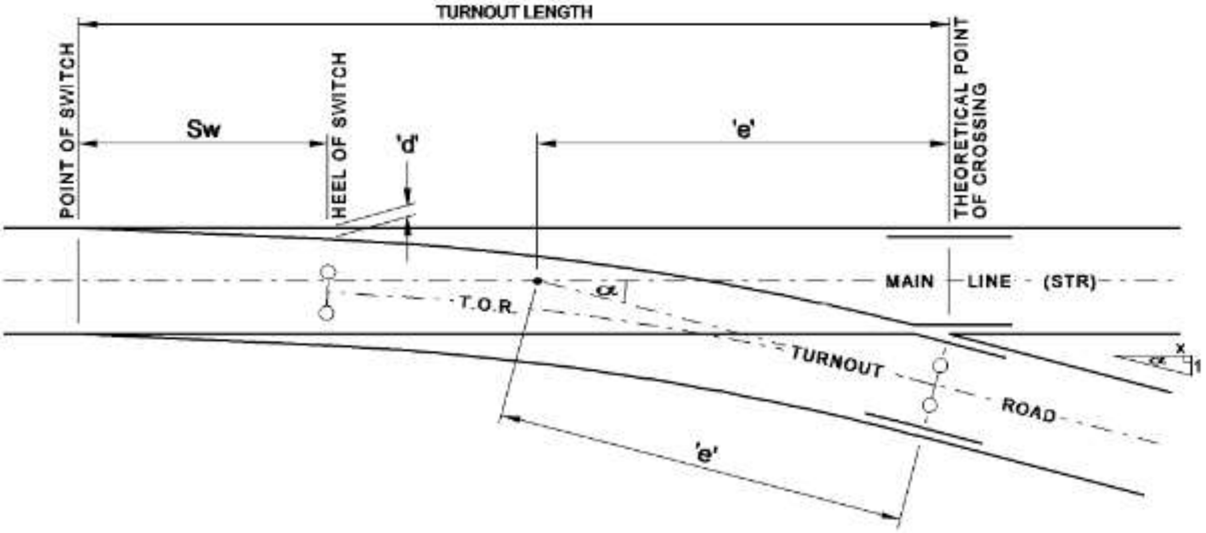


Figure 9 - Curved Crossing Conventional Turnout – short leg curved (drawn for RH turnout)

Crossing Rate	'e'
8.25	11.882
9	12.955
10.5	15.102
15	21.549

Sw	=	Switch length	Switch length and heel centres are measured at heel joint for heeled switches and for flexible switches they are adopted for design purposes
d	=	Heel Centres (159mm)	
g	=	Gauge (1435mm)	
α	=	Crossing angle	
x	=	Crossing rate	

Appendix 5 Standard designs for tangential turnouts

Tangential Turnouts – Design Parameters							
Type	Crossing	Turnout Angle (^{0})	Length (T) (m)	Turnout Length (Pts to Theo Pt) (m)	Total Length (TOTP to TOEP) (m)	Distance (Pts to TP) (m)	General Layout Design Drawing Ref No.
160:6.6	Curved	8.615648	12.052	20.939	24.105	0.490	CV0479038
160:8.25	Straight	6.911227	9.622	21.058	24.644	0.490	CV0479039
190:7	Curved	8.130102	13.503	22.862	27.006	0.490	775-802
190:9	Straight	6.340192	10.523	22.988	26.298	0.490	775-801
250:8.25	Curved	6.911227	15.096	26.296	30.193	0.490	775-133
250:10.5	Straight	5.440332	11.878	26.489	30.309	0.490	775-134
300:9	Curved	6.340192	16.616	28.853	33.231	0.490	775-135
300:12	Straight	4.763642	12.478	29.238	33.630	0.490	775-136
500:12	Curved	4.763642	20/797	37.391	41.595	0.490	775-137
500:15	Straight	3.814075	16.648	37.707	43.532	0.490	775-003
800:15	Curved	3.814075	26.637	46.827	53.274	1.090	775-138
800:18.5	Straight	3.094058	21.606	47.083	54.660	1.090	775-139
1200:18.5	Curved	3.094058	32.409	56.996	64.818	1.690	775-140
1200:24	Straight	2.385944	24.989	57.754	67.026	1.690	775-141

Table 16 - Standard Tangential Turnouts

Tangential Turnouts – In-bearer design		
Type	Comment	General Layout Design Drawing Ref No.
190	no back-drive required	CV0278550
250	with backdrive	CV0278551
300	with backdrive	CV0278552

Table 17 –Standard In bearer layouts for tangential turnouts

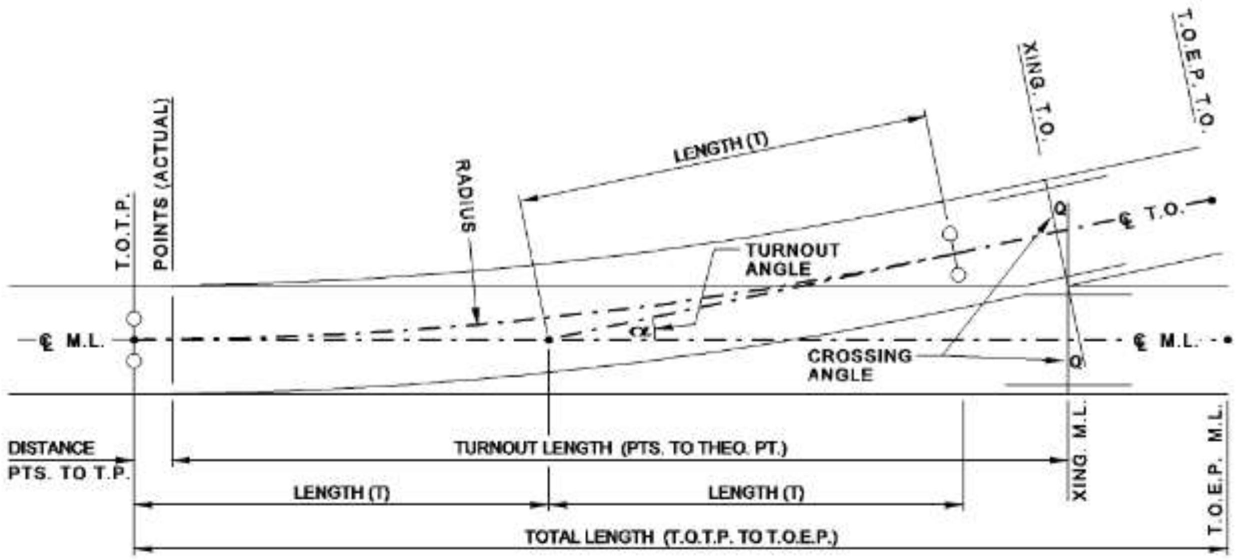


Figure 10 - Straight Crossing Turnout (drawn for LH turnout)

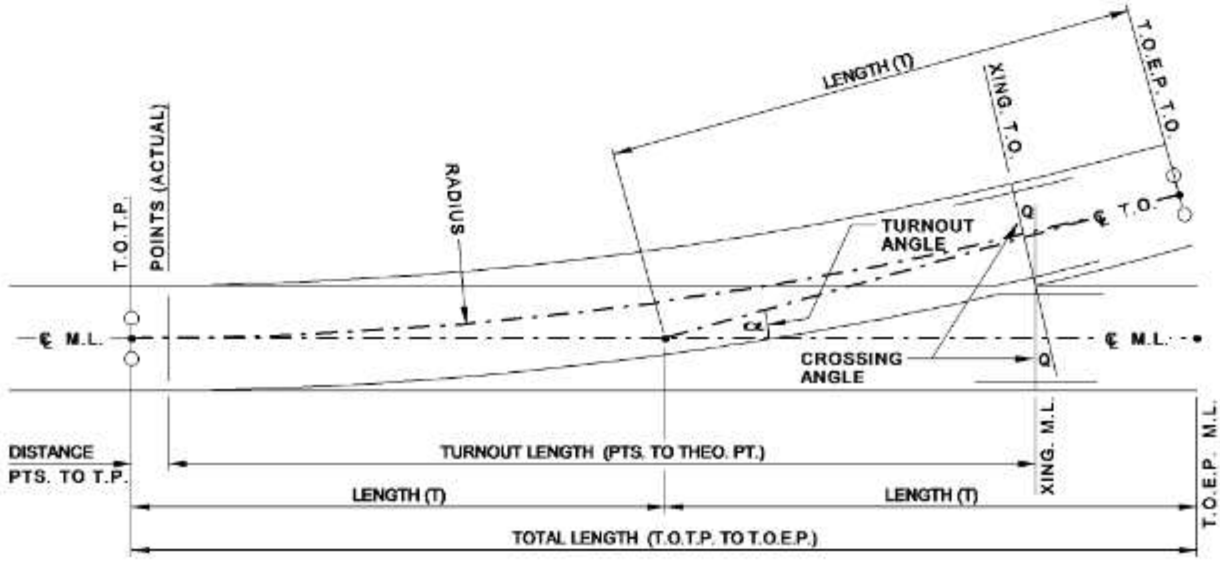


Figure 11 - Curved Crossing Turnout (drawn for LH turnout)

Appendix 6 Approved products

The approved product list for turnouts and special trackwork contains only those products that may be used independently of any manufacturer's proprietary designs.

Common Item Name	Description	Standard/ Drawing	Manufacturer/ Supplier
Manual levers			
Thornley levers	Type 45		VCAU
Switch equipment			
Switch roller plates			
Switch pad protectors	Mack Reversible Switch Protector		VCAU
Chair Bolt Cat. No 3	M24 x 75 Square Head Chair Bolt Cat. No3	Dwg. No 91-187C	Greg Sewell Forgings
Crossings			
Compound manganese	Fully cast manganese crossings (Monobloc)	CRN CS 250	VAE
Rail Bound Manganese			VCAU